



Rixa Quarries Pty Ltd
Proposed Sand Quarry Expansion at Lot 2 DP 1040274,
Doonbah
Environmental Impact Statement

November 2014

Submission of an Environmental Impact Statement (EIS)

Prepared under the Environmental Planning and Assessment Act 1979 Section 78A(8)

EIS Prepared by

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In Respect of GHD Pty Ltd

Development Application

Applicant Name: Rixa Quarries Pty Ltd
Applicant address: PO Box 381
Corindi Beach NSW 2456
Lot No. DP Lot 2 DP 1040274
No. and Address of Land to be Developed: 405 Woodburn Evans Head Road, Doonbah

Environmental Impact Statement

Section 5 of the Environmental Impacts Statement (EIS) assesses the potential environmental impact of the proposed development.

Certificate

I certify that I have prepared the contents of this Statement and to the best of my knowledge:

- It has been prepared in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*;
- It contains all available information that is relevant to the environmental assessment of the development to which the statement relates; and
- The information contained in this Statement is neither false nor misleading.

Signature:

Name Ben Luffman

Date:

Glossary of terms	
Acoustic	Relating to hearing, noise and sound.
Ambient	Surrounding, background or existing.
dB(A)	A unit of sound measurement which has its frequency modified by an A-weighted filter so that results are more like the frequency response of the human ear.
Emission	The release of material into the environment (eg dust).
Flora and Fauna	Plants and animals
Hydrology	The science dealing with water on the land or under the surface and its properties, distribution and other characteristics
LA10 (Time)	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
LAeq (Time)	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
LA90 (Time)	The A-weighted sound pressure level that is exceeded for 90 per cent of the time over which a given sound is measured. This is considered to represent the background noise e.g. LA90 (15 min).
Particulate	Small particles, usually occurring in suspension.
Putrescible	Capable of biological decomposition.
State Environmental Planning Policy	A planning instrument made by the Minister for Urban Affairs and Planning that deals with matters of significance for environmental planning in NSW.
Threatened species	Species of flora and fauna that are listed as endangered species or vulnerable species under the Threatened Species Conservation Act 1995.

List of Abbreviations	
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
CKPoM	Comprehensive Koala Plan of Management
DA	Development Application
DCP	Development Control Plan
DGB	Densely Graded Base
DGS	Densely Graded Sub-base
DoPI	Department of Planning and Infrastructure
ECRTN	Environmental Criteria for Road Traffic Noise
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
ENCM	Environment Noise Control Manual
EP&A Act	Environmental Planning and Assessment Act 1979
EP&A Regulation	Environmental Planning and Assessment Regulation 2000
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPL	Environment Protection Licence
ESD	Ecologically Sustainable Development
FFMP	Flora and Fauna Management Plan
GDE	Groundwater dependant ecosystems
INP	Industrial Noise Policy
KTP	Key threatening process
KSC	Kempsey Shire Council
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LOS	Level of service
mgbs	Meters below ground surface
MHRDC	Maximum Harvestable Rights Dam Capacity
MNES	Matters of National Environmental Significance
NPI	National Pollution Inventory
PEA	Preliminary Environmental Assessment
PKFT	Preferred Koala feed trees
POEO Act	Protection of the Environment Operations Act 1997
RMS	Roads and Maritime Service
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
SISD	Safe Intersection Sight Distance
TEC	Threatened Ecological Community
tpa	Tonnes per annum
TSC Act	Threatened Species Conservation Act 1995
Vtpd	Vehicle trips per day
WIRES	Wildlife Information Rescue and Education Service
WMP	Waste Management Plan

Executive summary

Rixa Quarries Pty Ltd (Rixa) proposes to expand an existing sand quarry at Lot 2 DP 1040274, 405 Woodburn Evans Head Road, Doonbah, known as Doonbah Quarry (the site). Quarry operations at the site date back to 1961. In 1997, the quarry was granted approval to extract up to 35,715 m³ (approximately 57,000 tonnes) per annum (DA 128/95). The quarry has now exhausted the resources available under this approval.

The proposal is to expand the existing quarry to an extraction rate of up to 490,000 tonnes per annum. To provide the required material, the area of the quarry would need to be extended to approximately 21.4 hectares, the extraction area would increase from its current 6.28 hectares to 18.3 hectares and to a depth of 15 metres below ground level or -12 metres Australian Height Datum (AHD). It is estimated that the quarry would have an available resource of 4,000,000 tonnes which would allow extraction for a period of between 20 and 30 years, depending on demand.

Statutory position

The provisions of *SEPP Mining, Petroleum Production and Extractive Industries 2007* and *Richmond Valley Local Environmental Plan 2012* allow the proposed development to be permissible with consent.

The proposal constitutes a 'Designated Development' in accordance with Schedule 3, Clause 19 of *EP&A Regulation*.

As the proposal is considered a designated development involving an extractive industry, it is also defined as regional development under Clause 8 of Schedule 4A of the *EP&A Act*. The development would therefore be notified and assessed by Richmond Valley Council but may be determined under the Joint Regional Planning Panel.

The proposal would require additional licences and approvals under a range of applicable NSW legislation and is therefore also considered to be integrated development. Permits and approvals required as part of the proposal include:

- an Environmental Protection Licence to undertake a scheduled activity under the *Protection of the Environment Operation Act, 1997*
- a groundwater licence under Part 5 of the *Water Act, 1912*

Community consultation

A consultation strategy was formulated as a part of the EIS process to assist in the identification of key stakeholders and issues for consideration. Consultation with a range of government agencies and community stakeholders was incorporated into the strategy to both inform the stakeholders of the project and to allow any issues of concern to be raised at an early stage of the planning process and facilitate incorporation into the EIS.

Land and water resources

The landform of the site is relatively flat with an approximate elevation of 5 metres AHD and is dominated by the presence of two adjacent 'lakes' that represents the current extent of the quarry.

The geology of the site consists of a layer of Pleistocene tidal-delta flat which consists of marine sand, silt, minor clay, indurated sand and shell. This was confirmed by seven boreholes which encountered a number of sandy layers extending to over 15m bgl.

The site has been mapped as Class 3 acid sulfate soils (ASS) and an assessment confirms the soils are ASS.

Surface water runoff generally collects within the extraction areas, dams, ponds and drainage lines. Once offsite, the stormwater is reported to discharge to a dish drain and flow west through the adjacent wetland, ultimately draining to the Richmond River.

The site is subject to backwater flooding from the Richmond River, with flood events discharging from north-west to south-east across the site.

Water quality of the lake appears relatively clear with results indicating the water is moderately acidic, is sodium chloride/sulfate dominant and has elevated aluminium, copper and zinc concentrations compared to the ANZECC (2000) guidelines.

The existing and proposed excavation intercepts the groundwater.

The proposal would increase the area of the current excavation by approximately 12 hectares and increase the depth of the excavation by approximately 11 metres. Due to the current number of dams or lakes existing in the area, the modification to topography is not deemed to create a significantly negative impact.

Localised, short-term impact on soils are likely, however provided stabilisation strategies are effectively implemented, medium to long-term impacts would be low.

Exposure of potential acid sulfate soils to the atmosphere is likely to create acidic conditions that may have a detrimental impact on the local environment.

The main surface water related risks associated with the operation of the proposed expansion would be

- increased risk of erosion and sedimentation
- Contamination via chemicals, hydrocarbons or other contaminants from accidental spillage

Impacts to local and regional flood regimes is considered to be negligible, however flooding of the site may result in flood risk to staff, result in off-site flood impacts, erode stockpiles and entrain sediment and damage equipment.

The predicted drawdown at the pit is less than 2 metres. However, it is likely that the proposed sand extraction will result in a lowering of groundwater pH in the vicinity of the pit lakes due to exposure of the PASS to the atmosphere.

Sufficient runoff would be generated from the operational area to meet operational water requirements. Surplus water captured in the new excavation on site would discharge via the existing flow paths to the south-west corner of the site.

Detailed mitigation measures have been provided to minimise these potential impacts through:

- Erosion and sedimentation control
- Material storage and management
- Monitoring

Biodiversity

The field survey recorded a total of 135 species of flora were recorded within the study area, comprising 103 native and 32 exotic species. No threatened plant species were recorded. No weed species that are declared noxious in the Richmond Valley LGA were recorded within the subject site.

Five vegetation types were recorded within the study area, of which three are native and two are exotic. These were:

- Coastal heath on sands of the North Coast
- Modified Pink Bloodwood – Red Mahogany Open Forest
- Paperbark Swamp Forest on coastal lowlands
- Exotic grassland
- Disturbed land / Existing quarry

A total of 34 bird species, three frog species (including one introduced) and eight mammal species (including three introduced species) were recorded.

Evidence of the presence of Koala in the form of tree trunk scratches and a scat were observed in open forest in the southern part of the subject site but outside the area of the quarry.

An assessment of bat species present at the time of the survey indicated the probable presence of the Little Bent-wing bat, (*Miniopterus australis*), Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*) and Hoary wattled bat (*Chalinolobus nigrogriseus*) which are all listed as vulnerable under the TSC Act.

There was evidence of *Bufo marinus* (Cane Toad) inhabitation across the study area

The vegetation communities at the subject site can be defined as partially dependant, facultative groundwater dependent ecosystems and classified as terrestrial ecosystems partially dependant on groundwater.

One threatened vegetation community was recorded during field surveys within the study area; the EEC Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.

Based on known habitat associations and the nature and condition of habitat available, there is suitable habitat within the study area for one threatened flora species, *Rutidosia heterogama* (Heath Wrinklewort).

Of the fauna species predicted to occur on site, two species (*Phascolarctos cinereus* (Koala), and *Phascogale tapoatafa* (Brush-tailed Phascogale)), are known to occur within the proposed development area. A further six species have a high likelihood of occurrence while a further 22 species are moderately likely to occur on site.

No endangered populations or migratory fauna species were recorded or are considered likely to occur within the study area.

The primary new impact associated with the proposed expansion is the clearing of 1.3 ha of native vegetation. This would reduce the area of the modified Pink Bloodwood - Red Mahogany Open Forest and Paperbark Swamp Forest vegetation types on the site, considered to be the EEC Swamp Sclerophyll forest

Assessments of significance were undertaken for species recorded or that were considered highly likely to occur within the subject site against State and Commonwealth guidelines. The outcome of these assessments was that the proposed expansion would be unlikely to have a significant impact upon species, populations or endangered ecological communities or their habitats.

It is expected that with implementation of the management measures proposed a 'maintain or improve' outcome for the biodiversity values of the site could be achieved in the medium to long term.

A suite of mitigation measures have been provided to minimise the impacts of the proposal on the flora and fauna including potentially establishing an offset area and preparing detailed flora and fauna management plan.

Noise and vibration

Thirteen noise sensitive receivers are within the vicinity of the site. Background noise monitoring was undertaken at two identified noise sensitive receivers between 9 and 21 October 2013.

Site observations at the monitoring locations indicated that the primary noise sources in the area were as follows:

- Intermittent road traffic on Woodburn – Evans Head Road
- Natural noise sources such as insect and bird noise and wind noise in foliage

As a conservative measure, the lowest project specific noise criterion of 41 dB(A) $L_{eq(15\text{ min})}$ has been adopted at all identified noise receivers.

Noise model results indicate the operation is predicted to comply with the INP daytime noise criterion at most receivers, except for exceedances at receivers R1, R2, R3, R4, R5, R6, and R8 during some stages of operations. It is also noted that several receivers are very close, or equal to the adopted noise criterion.

An analysis of the model results leads to the following observations:

- Noise associated with the operation of haul trucks, the loader and the screening plant are the dominant noise source at most receivers.
- Noise from the movement of haul trucks is particularly dominant at receivers close to the haul road (R1, R2 and R3).
- Operation of the dredge impacts receivers during stages 1 and 4 of operations but has a lesser degree of impact in stages 2 and 3.

In order to mitigate the noise impacts associated with the quarry, it is recommended that staged acoustic barriers (fencing) be erected, thereby providing shielding effects at these receivers.

The predicted noise levels would be verified through compliance noise monitoring. If an exceedance is measured, noise control measures should be negotiated and agreed to by Rixa and the affected land owners.

Air quality and greenhouse gas emissions

The primary sources of particulate (dust) emissions for the area around Evans Head are likely to be general agricultural activities, dust and vehicle emissions from traffic along unsealed roadways and the Pacific Highway as well as smoke from domestic wood heaters or vegetation burn-offs or wild fires.

Prevailing winds are shown to be from the north and south, with the strongest winds most often from the south and southeast.

An ambient PM₁₀ concentration of 15 µg/m³ was adopted as the background level.

Predicted results indicate there is potential for the 24-hour average PM₁₀ criterion to be exceeded at a number of sensitive receptors without dust control measures at both average and peak production rates.

Analysis of predicted results for peak production with control measures revealed that the frequency at which the adopted criterion was predicted to be exceeded is approximately five days per year at the most exposed receptors, based on the site-representative meteorology used.

The proposal would operate at peak production (205 tph) only on occasion, and when it does, it is unlikely that this event would be coupled with the adverse (5 out of 365 days) meteorological conditions required to cause maximum off-site dust impact. Therefore, assuming dust control measures are implemented, short-term PM₁₀ impacts off-site can be managed to the requirements of the Approved Methods. PM₁₀ concentration levels over an annual average are also predicted to be well below the adopted criterion.

Modelling indicated that even without dust control measures, the predicted incremental impact at the most exposed sensitive receptor is well below the TSP criterion of 90 µg/m³.

The incremental dust deposition criterion of 2 g/m²/month is expected to be readily met at all identified receptors.

The greenhouse gas emissions are estimated to be approximately 44,500 t CO₂-e over a 20 year life (approximately 2,225 t CO₂-e per annum on average). Emissions associated with the transportation of material from the facility were estimated to be about 66% of emissions for the proposal. The next greatest source of emissions at 32% was fuel consumption during operations. The emissions from the proposal per annum would be approximately 0.001% of New South Wales' total greenhouse gas emissions and 0.0004% of Australia's total GHG emissions in 2010/11.

General measures to control dust are:

- Revegetated as early as possible after completion.
- Water and revegetate stripped topsoil stockpiles with a grass cover or similar.
- Water haul truck routes as required, particularly during peak periods of vehicle movements and extended dry spells.

Mitigation measures to reduce greenhouse gas emissions are:

- Opportunities for the use of biodiesel should be further investigated and used where possible.
- Efficient plant and vehicles would be used where reasonable and feasible to do so.

Traffic

Key roads in the surrounding area include the Woodburn Evans Head Road, and Alfred Street.

At its peak, the quarry would be expected to generate 140 truck movements per day, and 10 staff movements. Current levels of activity are around 20 truck movements per day.

As a result of the proposal, daily traffic volumes on Woodburn Evans Head Road would be expected to increase from the existing average of 2691 vehicles per day to some 2821 vehicles per day. This level of activity would represent an increase of some 5% on the current traffic volumes on Woodburn Evans Head Road. The proportion of heavy vehicles on Woodburn Evans Head Road would increase from 7% currently to approximately 11%.

To minimise potential impacts to traffic and access due to the proposal, a range of mitigation measures are recommended in relation to the quarry access, haulage route and truck numbers.

Heritage

A Due Diligence Assessment was carried out in accordance with the relevant administrative and legislative standards for NSW.

As a result of the desktop study and field inspection of the proposed expansion to the quarry and consultation with Bogal LALC Sites Officer Daryl Knight and Bundjalang Traditional Owner representatives Doug Wilson and Lewis Williams, the following were agreed to:

- No Indigenous cultural heritage sites or relics were identified within the proposed expansion to the Doonbah Quarry extraction areas.
- No areas have been identified that are considered to potentially contain subsurface deposits of significant Aboriginal heritage.
- All of the Project Area has been disturbed in a manner which constitute 'disturbance' within the meaning of the Due Diligence Code and is consistent with the Due Diligence Code.
- The Bundjalang Traditional Owners and Bogal LALC representative agreed in discussion that no further Aboriginal cultural heritage investigation was required.

A historic heritage assessment indicated there are no places of historic heritage listed in heritage lists or have been found within the Project Area.

Visual

The site is relatively flat and is visually dominated by current quarrying machinery and stockpiles.

Visual receptors in the form of residential properties are located along the Woodburn-Evans Head Road to the south of the site

Potentially negative visual impacts may result from the following:

- A larger number of stockpiles
- Larger sized stockpiles
- Larger numbers of machinery
- More truck movements
- Dust

In general, the assessment has found that the potential visual impacts are not deemed significant based on limited view points, the majority of the quarry being below ground level (as

opposed to a large cut face), existing visual impact of the quarry operations and presence of vegetation. The most significant visual impact would be on residence R1, located to the east of the access road.

However, the following mitigation measures are proposed to minimise future visual impacts:

- Maintain and enhance the existing vegetation between the project site and property boundary to provide ongoing screening to the quarry
- Maintain the site in a clean and tidy condition at all times

Progressively revegetate disturbed areas where quarrying is complete.

Waste

The type of waste generated from the proposed quarry would include construction and excavation waste, vegetation waste, packaging materials and liquid wastes. The volumes of solid wastes would be relatively small as most waste would be reused or recycled on site e.g. excavation waste and vegetation waste.

All waste would continue to be managed in accordance with the requirements of the *Waste Avoidance and Resource Recovery Act 2001*, the *Protection of the Environment Operations Act 1997*, the *OEH Waste Classification Guidelines 2009* (DECCW, 2009) and the principles of the waste management hierarchy.

Risk and hazards

The existing and proposed quarry site is subject to various risks and hazards, including:

- Contamination and dangerous goods
- Bushfire
- Safety

The risk assessment has found that all risks for the selected factors can be mitigated to achieve a residual ranking of “Low” or “Medium” provided the identified mitigation measures are implemented.

Agricultural impact

Historically, agriculture is a significant industry in the region and plays an important role in both the social and economic wellbeing of constituents.

It can be concluded that the proposed expansion of Doonbah Quarry would not significantly reduce the agricultural potential of adjoining lands or agricultural land within the broader Richmond Valley LGA.

Socio-economic

The socio-economic impacts of the proposed expansion are mainly considered to be positive. The proposal would provide a valuable resource to the upgrade of the Pacific Highway which is shown to significantly reduce travel times, crashes and fatalities.

The proposal would also have economic benefits via the provision of direct and indirect employment and contributions to RVC for the improvement of the local road infrastructure.

However, there would be some negative amenity impacts, mainly associated with noise, as discussed above.

Environmental management

A summary of the mitigation measures are provided as a basis for an Environmental Management Plan (EMP), which would be prepared to provide an overall framework for the management of environmental impacts that could potentially arise from the proposed quarry.

Project justification

Alternatives were considered as part of the EIS. The reasons for justifying the final proposal are presented having regard to biophysical, economic and social considerations and the principles of ecologically sustainable development (ESD).

Conclusion

The EIS has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity. The proposal, as described in the EIS, best meets the project objectives but would still result in some impacts on biodiversity via vegetation clearing, soil and water via erosion, noise, dust and traffic via the increased vehicle movements. Mitigation measures as detailed in this EIS would ameliorate or minimise these expected impacts. The proposal would also provide sustained employment and provide a local source of suitable material for the Pacific Highway upgrade with few impacts. On balance the proposal is considered justified.

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Appendix B – Director Generals Requirements
Appendix C – Stakeholder consultation
Appendix D – Soil and Water Management Plan
Appendix E – Noise Impact Assessment
Appendix F – Air Impact Assessment
Appendix G – Ecology Assessment
Appendix H – Traffic Impact Assessment
Appendix I – Heritage Assessment

1. Introduction

1.1 Project overview

Rixa Quarries Pty Ltd (Rixa) proposes to expand an existing sand quarry at Lot 2 DP 1040274, 405 Woodburn Evans Head Road, Doonbah, known as Doonbah Quarry (the site). The location of the quarry is shown in Figure 1-1 and is within the Richmond Valley Council (RVC) Local Government Area (LGA). The quarry would be operated under a 'profit a prendre' (royalty) arrangement with Rixa (the current quarry operators) and the owner of the property (Cameron and Jenny Uebergang - Evans Head Sand Pty Ltd).

Quarry operations at the site date back to 1961. In 1997, the quarry was granted approval to extract up to 35,715 m³ (approximately 57,000 tonnes) per annum (DA 128/95). The quarry has now exhausted the resources available under this approval.

The proposal is to expand the existing quarry to an extraction rate of up to 490,000 tonnes per annum. The primary purpose of the quarry would be to supply sand and topsoil to the current and proposed Pacific Highway upgrade works, and for supply to local Councils and contractors. The quarry is well located to service the upgrade works between Woolgoolga and Ballina which is to take place over a timeframe of approximately 5 years.

To provide the required material, the area of the quarry would need to be extended to cover an area of approximately 21.4 hectares, the extraction area would increase from its current 6.28 hectares to 18.3 hectares and to a depth of 15 metres below ground level or -12 metres Australian Height Datum (AHD). It is estimated that the quarry would have an available resource of 4,000,000 tonnes which would allow extraction for a period of between 20 and 30 years, depending on demand.

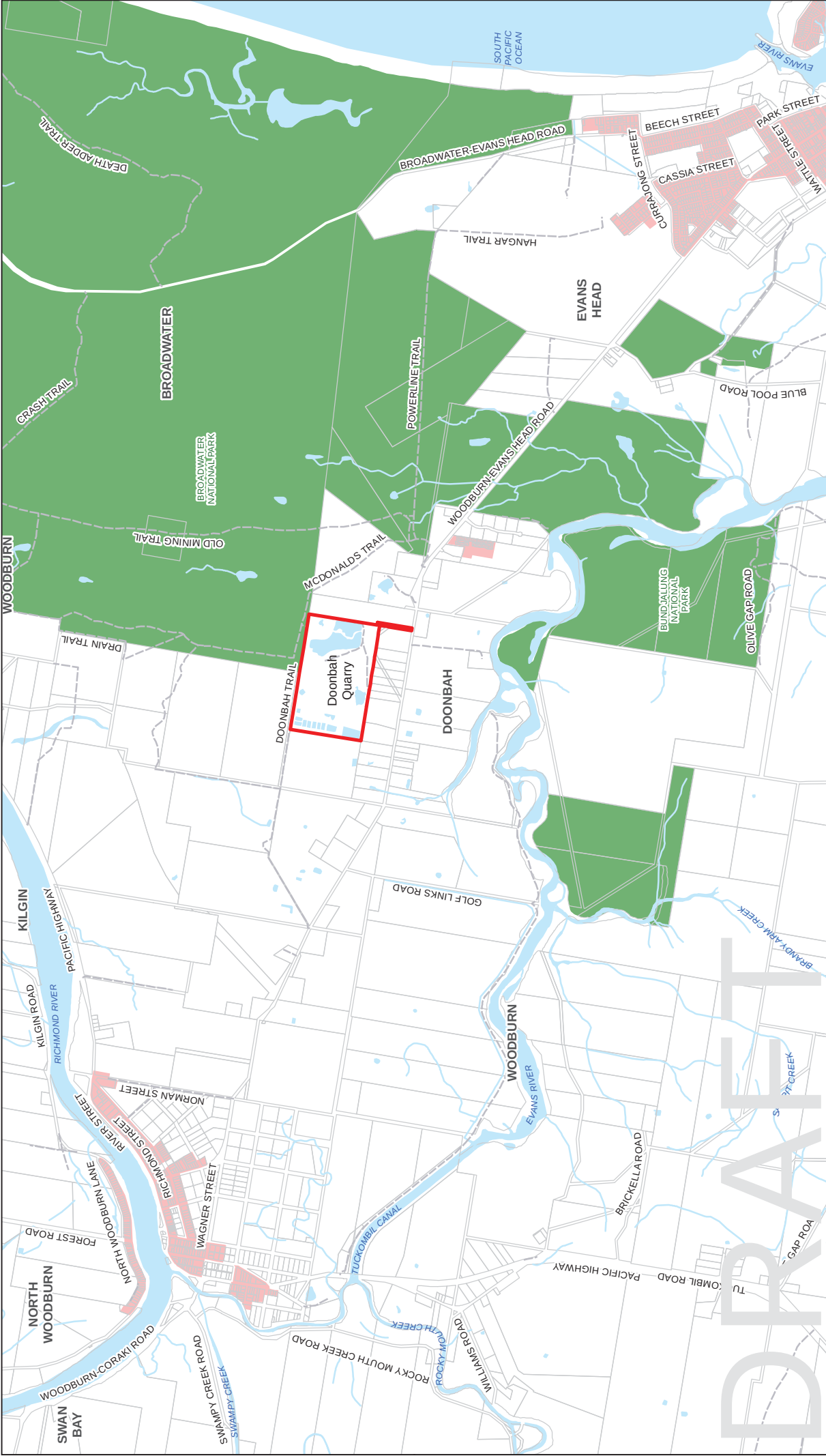
More details on the proposal are provided in Section 2.

1.2 EIS scope

This Environmental Impact Statement (EIS) has been undertaken to assess the significance of the potential environmental impacts associated with the expansion of Doonbah Quarry. The EIS has been prepared in accordance with the *Environmental Planning and Assessment Act, 1979* (EP&A Act), the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) and other relevant legislation.

Schedule 3 of the *EP&A Regulation* sets out categories of development that are "designated" and which require the preparation of an EIS. The proposed development has been identified as an 'extractive industry' and constitutes 'Designated Development' in accordance with Schedule 3, Clause 19 of the *EP&A Regulation*. Accordingly, this EIS has been prepared pursuant to Part 4 of the *EP&A Act* and will accompany a development application (DA) to be lodged with the relevant consent authority. In this instance, the development would be notified and assessed by RVC and determined by the Northern Joint Regional Planning Panel.

The EIS has been prepared to accord with the Director-General's requirements (DGRs) developed by the NSW Department of Planning and Environment (DP&E) in conjunction with a range of other government agencies. The EIS has been prepared using conservative scenarios for assessments to develop a range of acceptable environmental and social parameters within which the quarry can operate.



Paper Size A4

0 250 500 750 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

LEGEND

- Doonbah Quarry
- Track
- Watercourse
- Waterbody
- Cadastre
- Built Up Area
- National Park

Rixa Quarries Pty Ltd
Doonbah Quarry

GHD

Job Number 22-17200
Revision A
Date 07 Apr 2014

Study Area

Figure 1-1

2. Proposal

2.1 General

Rixa proposes to expand the existing Doonbah Sand Quarry. The quarry would be operated under a 'profit a prendre' (royalty) arrangement with the owner of the property (Cameron and Jenny Uebergang - Evans Head Sand Pty Ltd).

Quarry operations at the site date back to 1961. In 1997, the quarry was granted approval to extract up to 35,715 m³ (approximately 57,000 tonnes) per annum (DA 128/95). The quarry has now exhausted the resources available under this approval.

The excavation currently occupies an area of approximately 6.28 hectares and it is proposed to expand the excavation to approximately 18.3 hectares as shown in the plans in Appendix A. The average depth of extraction would increase from approximately 4 metres (-1 metre AHD) to 15 metres (-12 metres AHD).

The proposal is to expand the existing quarry to an extraction rate of up to 490,000 tonnes per annum. The primary purpose of the quarry would be to supply sand and topsoil to the current and proposed Pacific Highway upgrade works, and for supply to local Councils and contractors.

The Pacific Highway between Ballina and Woolgoolga is to be upgraded in the near future. The alignment of the upgrade is approximately 5km west of the quarry.

The upgrade will require significant volumes of imported quarry materials. Depending on a range of factors, including funding, these works could extend over a period of approximately five years. After completion of the highway works, the quarry would continue to supply local councils and private contractors.

2.2 Objectives of the proposal

The objectives of the proposal are to:

- Establish a quarry operation to extract sand for delivery to highway works projects, local councils and local industry.
- Operate the quarry so as to minimise any potential environmental impacts and comply with all relevant legislation and guidelines.
- Rehabilitate the extraction area upon exhaustion of the resource to minimise any long term impacts.

2.3 Resource characteristics

Three soil samples were taken to NATA accredited laboratory for testing. The range of tests undertaken comprised:

- Sieve Analysis (AS1141.11.1);
- Bulk Density and Water Absorption of Fine Aggregate (AS 1141.5)
- Organic Matter Content (AS1289.4.1.1)
- Chloride (AS1012.20 – 1992)
- Sulfate (AS1012.20 – 1992).

The results are summarised in Table 2-1.

Table 2-1 Summary of laboratory test results

Borehole	Depth (m)	Sieve Analysis (% passing by mass)		USC	Particle Density Dry (t/m3)	Water Absorption (%)	Organic Matter Content (%)	Chloride (kg/m3)	Sulfate (as %SO3)
		Clay / Silt	Sand						
BH5	1.0 – 1.45	2.1	97.9	SP	2.61	0.1	0.1	0.05	0.01
BH5	5.5 – 5.95	1.2	98.8	SP	2.19	0.2	0.1	0.01	0.05
BH61	13.0 – 13.45	2.0	98	SP	-	-	0.1	0.01	0.15

1. Boral Test Report references BH5 at this depth.

Sieve analyses were completed on three samples from the borehole investigations. Figure 2-1 shows the particle size distribution for each of the tested samples.

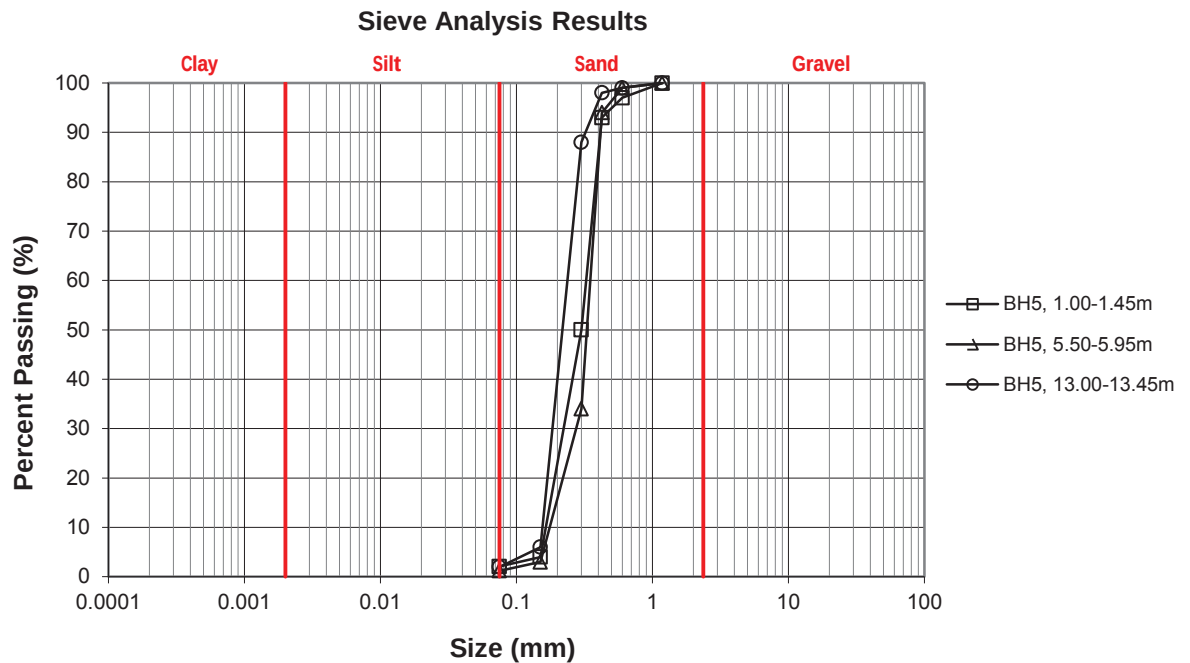


Figure 2-1 Results of sieve analysis

The tested samples can be classified as poorly graded (SP), fine to medium grained sand, with trace fines (clay and silt sized particles).

2.4 Proposed method of extraction

The quarry operation would be carried out in response to demand. It is therefore difficult to predict exactly how the extraction would progress. In general, the extraction is proposed to move to the west of the existing extraction area and then south in four stages. Topsoil would be removed initially and the sand extracted using an excavator. Once the excavation fills with water, a dredge will be introduced to extract the sand to a depth of 15 metres (-12 metres AHD).

In order to meet client requirements, select material may be sourced from different locations within each of the identified stages at any time. However, a maximum of two stages would be operating at any one time.

The proposed quarry operation would increase the extraction area to about 18.3 hectares which would be an increase of 10.1 hectares on the current extraction area. The depth of the excavation would increase by approximately 11 metres.

Following extraction, the material would be screened, washed and where necessary blended with other materials from the quarry, or material imported to the quarry. The materials would be stockpiled within the confines of the quarry and numbered. Samples from each stockpile would be analysed for compliance with client specifications before being transported off site. This process takes approximately 20 days.

The proposed extraction plans are provided in Appendix A, including extraction areas, cross sections, long sections, site layout and final levels.

The proposed sequence of operations would generally be:

- Establish sediment and erosion control measures and other environmental safeguards.
- Clearing vegetation, if necessary. The bulk of cleared vegetative wastes would be stockpiled in a suitable location, clear of adjacent vegetated areas and mulched for future revegetation works.
- Topsoil would be stripped and stockpiled.
- The top 4 metres of each extraction area would be extracted using an excavator. A dredge would then be introduced to extract the sand to a maximum depth of 15 metres (-12 metres AHD).
- Once excavated, the material would be passed through a screening plant to separate the sand into different sized fractions.
- Where necessary, in order to comply with client specifications, the material would be blended with other materials won from the quarry, or with imported materials, prior to being loaded onto trucks for removal from site.

A detailed list of equipment to be used in the operation is provided in Section 2.7.

2.4.1 Imported materials

As outlined above, following the extraction of the raw material from the quarry and screening, additional material may be required for blending to satisfy client specifications. This material may need to be imported to the quarry and could include rock, topsoil or landscaping products. The quantity of this material would be dependent upon the material's end use and is difficult to predict. It is likely that some of the blending materials would be stockpiled on site.

This material would be brought to site via trucks returning from their delivery of quarried materials.

2.5 Proposed extraction rate and project life

2.5.1 Extraction rate

It is estimated that the area to be extracted would yield approximately four million tonnes of material, however it is difficult to accurately estimate the annual extraction rate of materials from the quarry in order to service the demand from the Pacific Highway upgrade works. It may be necessary to extract and process up to 490,000 tonnes per annum, although this rate of extraction is expected to be uncommon. It is more likely that the annual extraction rate during the upgrade of the Pacific Highway would be around 300,000 to 350,000 tonnes per annum. After the highway upgrade is complete, the annual extraction rate is anticipated to reduce to about 100,000 tonnes per annum.

Based on the assessment of the underpinning demand, and after allowing for downtime from wet weather and breakdowns, it is realistic to expect the quarry to operate for 40 weeks a year. The maximum daily extraction and haul rate would be about 2,250 tonnes with an average daily win and haul of about 1,600 tonnes. The average daily win and haul rate would reduce significantly following the completion of the Highway upgrade.

2.5.2 Project life

Estimated quarry reserves are in the order of four million tonnes. If extraction was carried out at the maximum rate of 490,000 tonnes per annum the site would have an extractive life of approximately ten years, however this extraction rate is deemed unlikely. As mentioned above, it is likely that demand would be high during the highway upgrade works (approximately five years) and then reduce, resulting in a life of the extraction operation in the order of 20 to 30 years.

The life of the quarry and the annual extraction rate are dependent upon:

- The timing of Government funding for the Woolgoolga to Ballina Pacific Highway Upgrade project.
- The quantity of materials needed to satisfy the upgrade, and the timeframe within which those materials are required.
- The impact of the required quantity as it relates to the total quantity of materials available from the quarry.

2.6 Hours of operation

As mentioned above, allowing for breakdowns and wet weather, the quarry is expected to operate for approximately 40 weeks per year.

The hours of operation would depend on demand with some periods of high activity and other times when activity is limited to the occasional loading of haulage trucks. The proposed hours of operation are:

- Weekdays - 7.00am - 6.00pm
- Saturdays - 8.00am - 1.00pm
- Public holidays - No work

Some minor work (eg maintenance) may occur outside these hours but these are considered to be inaudible.

2.7 Type of machinery

The following items of plant and equipment are necessary for the operation of the quarry:

Table 2-2 Proposed machinery requirements

Type	Number	Frequency of use	Description
Excavator (35 tonne)	2	20-90%	Excavating material and stockpiling. Used constantly during initial excavation and then less frequently, once the dredge is operating.
Dredge	1	20-90%	Main form of extraction
Screen	1	90%	Consists of screen and 42 inch cyclone
Front-end Loader	1	80%	Loading material onto the haul trucks
Haul Trucks	Up to 70 per day	20-90%	Delivery of materials to customers
Water Cart (15,000L)	1	60%	To water haul roads and excavation
Light vehicles	5	90%	Employee vehicles
Water Pump	1	50%	To supply water cart
Generator	1	90%	Supply power to the screen
Hand tools	Numerous	10%	General activities

It is anticipated that not all of the equipment listed above would be operational on-site at all times.

2.8 Employment

To operate the quarry, it is anticipated that five full time employees would be required during periods of maximum extraction. Haulage of the material would also provide employment for truck drivers. The haulage trucks would be engaged or operated by clients external to the quarry operations.

Additional off site employment would also be generated, in the maintenance and support services for equipment and machinery.

2.9 Access and traffic volumes

Access to the site is from Woodburn Evans Head Road via an existing access road that runs to the quarry pit.

Delivery of quarry materials to highway projects would be via Woodburn Evans Head Road directly to the Pacific Highway at Woodburn.

In respect of materials to be delivered for non-highway works, it is not possible to predict the delivery routes for such materials. The volume of materials supplied to non-highway works would be limited during the timeframe of the highway upgrade works but of greater volume following completion of the upgrade.

2.9.1 Traffic generation

Workforce traffic

During operation, it is likely that there would be a maximum of five employees or plant operators on the site at any one time. This would yield a daily workforce traffic generation in the order of 10 vehicle trips per day (vtpd). It is assumed the majority of the workforce would arrive between 6:30 am and 7:30 am and depart generally between 4:00 pm and 6:30 pm.

Heavy vehicle traffic

Truck and dog trailer combinations have a capacity of approximately 32 tonnes. At an average daily production, which would generate a win and haul rate of approximately 1,600 tonnes, the quarry is expected to generate about 50 truck and dog loads or 100 truck movements per day. At its peak, the quarry is expected to win and haul about 2,250 tonnes per day which would involve about 70 truck and dog loads or 140 truck movements per day.

Once the Woolgoolga to Ballina Pacific Highway Upgrade is complete, the demand is expected to decrease, as would the number of truck movements. It is anticipated that no more than 100,000 tonnes annually would be won and hauled from the quarry, which would generate, on average, about 450 tonnes per day. This would result in about 14 truck and dog loads or 28 truck movements per day.

As is typical with quarries, demand for materials would fluctuate, resulting in truck numbers potentially exceeding these numbers for short periods and having no trucks operating at other times.

2.10 Site facilities

It is proposed to have a small site office and amenities established on the site. This facility would be equipped with a portable toilet that is pumped out on an as-needs basis. Water for the site office and amenities would be supplied via water tanks and electricity via a generator or solar power.

All plant and equipment proposed for use at the site would either be diesel or petrol driven. Fuel would be stored on the site in a 10,000L above-ground storage tank, in accordance with AS 1940-2004 *The Storage and Handling of Flammable and Combustible Liquids*.

During periods of wet weather, the excavation would potentially overflow. The excess water would be captured in a settling pond and treated, as required, prior to discharge.

A weighbridge is located along the access road in order to accurately monitor the volume of material exiting the site.

Prior to the commencement of excavation, the site manager shall confirm on site, the location and dimensions of all existing service structures. The site manager shall protect service authority assets in accordance with the authority's requirements. Should relocation of services be required, the site manager shall determine a recommended option for relocation in consultation with the authority concerned.

2.11 Rehabilitation

The aim of the rehabilitation is to return the area of the quarry, excluding the excavation and hard stand areas, to its pre-quarrying condition after quarrying activities have ceased. The proposed approach to the rehabilitation of the area includes:

- Spreading and shaping the topsoil stripped from the site prior to the quarry operations commencing to form a minimum 100mm deep layer on those areas available for rehabilitation.
- Hydromulching or hand seeding and mulching with a mix of pasture grasses and sterile cover crop.
- Maintaining sediment and erosion controls until the site is stable.

To ensure the rehabilitation is completed, the proponent contains a detailed arrangement by which the quarry operator is required to deposit a contribution per tonne of material won and hauled into an account which is to be used for the costs relevant to rehabilitation.

2.12 Future Use

The owner of the property has some preliminary ideas for the use of the excavation at the cessation of the quarrying activities, including:

- Eco Friendly Tourism
- Aquaponics
- Aquaculture
- Organic farming
- Intensive agriculture

The ultimate use will depend on the characteristics of the site at the cessation of the quarrying activities, legislation and the economic conditions at the time.

The future use of the land is not the subject of this proposal or EIS.

3. Statutory legislation

3.1 Commonwealth legislation

3.1.1 Environmental Protection and Biodiversity Conservation Act 1999

Under the environmental assessment provisions of the *Environment Protection and Biodiversity Conservation Act 1999*, the following matters of national environmental significance (MNES) and impacts on Commonwealth land are required to be considered to assist in determining whether the proposal should be referred to the Department of the Environment.

Table 3-1 Consideration of potential impact on MNES and Commonwealth land

Factor	Impact
a. <i>Any impact on a World Heritage property?</i> The site is not located near any World Heritage areas.	Nil
b. <i>Any impact on a National Heritage place?</i> The Proposal would not have any impact on a National Heritage place.	Nil
c. <i>Any impact on a wetland of international importance?</i> The Proposal would not have any impact on a wetland of international importance.	Nil
d. <i>Any impact on a listed threatened species or communities?</i> An ecological assessment was completed as discussed in section 5.2. One endangered ecological community, Swamp Sclerophyll Forest on Coastal Floodplain, and one threatened fauna species, the Koala, were recorded during the field surveys at the subject site. In addition, potential habitat was available for at least seven other threatened fauna species that were assessed as being highly likely to occur, but were not detected during surveys. Assessments of significance were undertaken for species recorded or that were considered highly likely to occur within the subject site against State and Commonwealth guidelines. The outcome of these assessments was that the proposed expansion would be unlikely to have a significant impact upon species, populations or endangered ecological communities or their habitats.	Nil
e. <i>Any impacts on listed migratory species?</i> The Proposal would not impact on any Commonwealth listed migratory species. Refer Section 5.2.	Nil
f. <i>Any impact on a Commonwealth marine area?</i> The Proposal would not impact on a Commonwealth marine area	Nil
g. <i>Does the Proposal involve a nuclear action (including uranium mining)?</i> The Proposal does not involve a nuclear action.	Nil
h. <i>Additionally, any impact (direct or indirect) on Commonwealth land?</i> No Commonwealth land would be impacted by the Proposal.	Nil

3.2 State legislation and policies

3.2.1 Environmental Planning and Assessment Act

All development in NSW is assessed in accordance with the provisions of the EP&A Act and the EP&A Regulation. The EP&A Act institutes a system for environmental planning and assessment, including approvals and environmental impact assessment requirements for proposed developments. Implementation of the EP&A Act is the responsibility of the Minister for Planning, statutory authorities and local councils.

The EP&A Act contains three parts that impose requirements for planning approval. These are generally as follows:

- Part 4 provides for control of “development” that requires development consent from the local councils, a regional planning panel or the state government.
- Part 5 provides for control of ‘activities’ that do not require approval or development consent under Part 4.
- Part 5.1 provides for control of State Significant Infrastructure.

As outlined in the following subsections, the proposal would require additional licences and approvals under a range of applicable NSW legislation and is therefore also considered to be ‘integrated development’ under section 91 of the EP&A Act.

The need or otherwise for development consent is set out in environmental planning instruments including State Environmental Planning Policies (SEPPs) and Local Environmental Plans (LEPs) which are discussed below.

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

The aim of the *State Environmental Planning Policy (State and Regional Development) 2011* (State and Regional Development SEPP) is to identify development that is ‘State Significant Development’ or ‘State Significant Infrastructure’ and to confer functions on joint regional planning panels to determine development applications.

The proposed development is deemed to be a ‘Regional Development’ as it falls under the definition of extractive industries under Schedule 4A of the EP&A Act. Under Section 21 of the State and Regional Development SEPP, a regional panel may exercise consent authority functions for determination of development applications under Part 4 of the EP&A Act. The development would therefore be notified and assessed by RVC but may be determined by the Joint Regional Planning Panel.

The proposal does not constitute a ‘State Significant Development’ under Schedule 1 of the State and Regional Development SEPP.

3.2.3 State Environmental Planning Policy (Mining Petroleum and Extractive Industries) 2007

The aims of the *State Environmental Planning Policy Mining Petroleum and Extractive Industries 2007* (Mining Petroleum and Extractive Industries SEPP), in recognition of the importance to New South Wales of mining, petroleum production and extractive industries, are:

- (a) 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,*
- (b) to facilitate the orderly and economic use and development of land containing mineral, petroleum and extractive material resources, and*
- (c) 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.*

Under the Mining Petroleum and Extractive Industries SEPP, extractive industries may be carried out with consent on any land for which agriculture or industry is permitted with or without consent. The proposed site is currently zoned, under *Richmond Valley LEP 2012*, RU1 Primary Production and extensive agriculture is permitted without consent.

Development applications are required to take into consideration a number of factors including:

- Compatibility with other surrounding land-uses (including other extractive industries)
- Natural resource and environmental management
- Resource recovery
- Transport
- Rehabilitation

This EIS has been prepared to support a DA and includes an assessment of all matters of consideration prescribed within Mining Petroleum and Extractive Industries SEPP.

3.2.4 State Environment Planning Policy (Infrastructure) 2007

Clause 104 of the SEPP for Infrastructure requires that, amongst other things, the consent authority (in this case, Richmond Valley Council) advise the Road and Maritime Services of the application, and take into account any response received from Road and Maritime Services on the proposal when determining the application. The consent authority is also required to take into consideration:

- The efficiency of movement of people and freight to and from the site and the extent of multi-purpose trips.
- The potential to minimise the need for travel by car and to maximise movement of freight in containers or bulk freight by rail.
- Any potential traffic safety, road congestion or parking implications of the development.

3.2.5 State Environmental Planning Policy (Rural Lands) 2008

The aims of the *State Environmental Planning Policy (Rural Lands) 2008* (Rural Lands SEPP) are as follows:

- (a) to facilitate the orderly and economic use and development of rural lands for rural and related purposes
- (b) to identify the Rural Planning Principles and the Rural Subdivision Principles so as to assist in the proper management, development and protection of rural lands for the purpose of promoting the social, economic and environmental welfare of the State
- (c) to implement measures designed to reduce land use conflicts
- (d) to identify State significant agricultural land for the purpose of ensuring the ongoing viability of agriculture on that land, having regard to social, economic and environmental considerations
- (e) to amend provisions of other environmental planning instruments relating to concessional lots in rural subdivisions

The proposal forms the expansion of a quarry operation that has been operating at the site since the 1960's. The proposed extension area is currently used to graze cattle but has limited other agricultural value (as discussed in Section 5.10).

3.2.6 State Environmental Planning Policy 33 – Hazardous and Offensive Development

Clause 3 of the *State Environmental Planning Policy 33 – Hazardous and Offensive Development* (Hazardous and Offensive Development SEPP) defines a 'Potentially Hazardous Industry' as:

"a development for the purposes of 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 in relation to the locality:

- (a) *to human health, life or property, or*
- (b) *to the biophysical environment, and includes a hazardous industry and a hazardous storage establishment.*

Clause 3 of the SEPP defines a Potentially Offensive Industry as:

potentially offensive industry means a development for the purposes of an 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 emit a polluting discharge (including for example, noise) in a manner which would have a significant adverse impact in the locality or on the existing or likely future development on other land, and includes an offensive industry and an offensive storage establishment.

The very nature of extractive industries suggests the potential for such uses to be hazardous or offensive to the local environment exists, if not appropriately managed.

However, all appropriate site management controls and environmental impact mitigation measures would be implemented and monitored during the operation of the quarry which would reduce the potential of a hazardous or offensive impact occurring.

A preliminary hazard analysis is provided in Section 5.9. In summary, if all mitigation measures provided in this EIS are implemented:

- There would be limited potential for polluting discharge from the site which would pose a significant risk to human health, life or property.
- There would be limited potential for polluting discharge from the site which would pose a significant risk to the biophysical environment.

3.2.7 State Environmental Planning Policy 44 – Koala Habitat Protection

State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas. SEPP 44 also aims to ensure a permanent free-living population of Koalas over their present range, and reverse the current trend of Koala population decline by:

- Requiring the preparation of plans of management before development consent can be granted in relation to areas of core Koala habitat.
- Encouraging the identification of areas of core Koala habitat.
- Encouraging the inclusion of areas of core Koala habitat in environment protection zones.

RVC is listed on Schedule 1 (potential koala habitat) of the SEPP 44. The potential for Koalas to occur in the subject site was assessed during field surveys and potential impacts on the Koala have been considered in this report. Evidence of koalas was observed within the property and potential koala habitat trees listed under Schedule 2 are present within the subject site as discussed in Section 5.2 and Appendix G.

Based upon the SEPP 44 definition, the site therefore contains 'potential koala habitat', however there was no evidence that the study area supports a local population of the Koala, including breeding females. Therefore, based upon the SEPP 44 definition, the site does not constitute 'core Koala habitat'.

Regardless, the subject site is considered highly likely to provide suitable habitat for the Koala and so potential impacts on the species with respect to the requirements of the EP&A Act have been assessed in this report.

3.2.8 State Environmental Planning Policy 71 – Coastal Protection

Pursuant to Clause 7 of the *State Environmental Planning Policy 71 – Coastal Protection* (Coastal Protection SEPP), the matters for consideration set out in Clause 8 are to be taken into account by a consent authority when it determines a development application to carry out development on land to which this Policy applies.

Table 3-2 Matters for consideration

Consideration	Response
(a) the aims of this Policy set out in clause 2	
(b) existing public access to and along the coastal foreshore for pedestrians or persons with a disability should be retained and, where possible, public access to and along the coastal foreshore for pedestrians or persons with a disability should be improved	The site is not located on the coastal foreshore
(c) opportunities to provide new public access to and along the coastal foreshore for pedestrians or persons with a disability	The site is not located on the coastal foreshore

Consideration	Response
(d) the suitability of development given its type, location and design and its relationship with the surrounding area	The site is currently used as a quarry. The extension would increase the area and volume removed but the relationship with the surrounding area would not change significantly. Section 5 provides more details.
(e) any detrimental impact that development may have on the amenity of the coastal foreshore, including any significant overshadowing of the coastal foreshore and any significant loss of views from a public place to the coastal foreshore	The site is not located on the coastal foreshore
(f) the scenic qualities of the New South Wales coast, and means to protect and improve these qualities	The site is not located on the coastal foreshore and would only be visible to the immediate neighbours
(g) measures to conserve animals (within the meaning of the Threatened Species Conservation Act 1995) and plants (within the meaning of that Act), and their habitats	The measures to conserve the animals, plants and their habitats are contained in Section 5.2
(h) measures to conserve fish (within the meaning of Part 7A of the Fisheries Management Act 1994) and marine vegetation (within the meaning of that Part), and their habitats	The measures to conserve the animals, plants and their habitats are contained in Section 5.2.
(i) existing wildlife corridors and the impact of development on these corridors	The site does not contain a wildlife corridor
(j) the likely impact of coastal processes and coastal hazards on development and any likely impacts of development on coastal processes and coastal hazards	The site is not impacted by coastal processes or hazards and the proposal is not expected to impact the coastal processes or hazards
(k) measures to reduce the potential for conflict between land-based and water-based coastal activities	The proposal would not create any conflict between land-based and water-based coastal activities
(l) measures to protect the cultural places, values, customs, beliefs and traditional knowledge of Aboriginals	Measures to protect the cultural places, values, customs, beliefs and traditional knowledge of Aboriginals are provided in Section 5.6
(m) likely impacts of development on the water quality of coastal waterbodies	The proposal has the potential to impact the water quality of the local groundwater but as explained in Section 5.1 this impact is not considered to be significant
(n) the conservation and preservation of items of heritage, archaeological or historic significance	The measures to preserve items of heritage, archaeological or historic significance are provided in Section 5.6
(o) only in cases in which a council prepares a draft local environmental plan that applies to land to which this Policy applies, the means to encourage compact towns and cities	Not applicable
(p) only in cases in which a development application in relation to proposed development is determined: (i) the cumulative impacts of the proposed development on the environment (ii) measures to ensure that water and energy usage by the proposed development is efficient	The cumulative impact of the development is considered negligible because there is no similar development in the area. The development would be self-sufficient in energy and water, so it would be expected to be efficient

3.2.9 Protection of the Environment and Operations Act 1997

The objectives of the *Protection of the Environment and Operations Act 1997* (PoEO Act) are to protect, restore and enhance the quality of the environment, in recognition of the need to maintain ecological sustainable development.

The PoEO Act provides for an integrated system of licensing and contains a core list of activities requiring Environmental Protection Licenses (EPL) from the Environment Protection Authority (EPA). These activities are called 'scheduled activities' and are listed in Schedule 1 of the Act.

Extractive industries including crushing, grinding and separating is defined as an activity that requires an EPL when the operations exceed 30,000 tonnes per year. As the proposal involves the extraction of up to 490,000 tonnes per year, an EPL would be required for the operation of the quarry.

The PoEO Act also includes requirements for the protection against water, air and noise pollution, waste disposal and incident reporting requirements for actual or potential pollution incidents.

3.2.10 Water Act 1912

The *Water Act 1912* governs access, trading and allocation of licences associated with both surface and underground water for water sources where a Water Sharing Plan (WSP) has not been put in place. The elements to which the Water Act 1912 applies include extraction of water from a river, extraction of water from underground sources, aquifer interference and capture of surface runoff in dams.

At this point in time, the *Water Act 1912* applies to groundwater interference, bore installation and extraction of groundwater within the Project Application Area. Currently the site does not have a licence to extract groundwater under the *Water Act 1912*. Any interference and/or removal of groundwater as a result of the Project will need to be licenced under the *Water Act 1912*.

3.2.11 Water Management Act, 2000

The objectives of this Act are to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations and, in particular:

- a. to apply the principles of ecologically sustainable development
- b. to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality
- c. to recognise and foster the significant social and economic benefits to the State that result from the sustainable and efficient use of water, including:
 - (i) benefits to the environment
 - (ii) benefits to urban communities, agriculture, fisheries, industry and recreation
 - (iii) benefits to culture and heritage
 - (iv) benefits to the Aboriginal people in relation to their spiritual, social, customary and economic use of land and water
- d. to recognise the role of the community, as a partner with government, in resolving issues relating to the management of water sources
- e. to provide for the orderly, efficient and equitable sharing of water from water sources

- f. to integrate the management of water sources with the management of other aspects of the environment, including the land, its soil, its native vegetation and its native fauna
- g. to encourage the sharing of responsibility for the sustainable and efficient use of water between the Government and water users
- h. to encourage best practice in the management and use of water

At this stage, it is envisaged that a Controlled Activity Approval under the Water Management Act 2010, will not be required. The reason being, that there do not appear to be any drainage lines that meet the definition of a “river” under this Act.

The Project Application Area is not currently covered by a WSP, although a draft WSP for the Northern Coastal Sands Groundwater Sources is currently being prepared by NSW Office of Water. This WSP will include the Project Application Area and is anticipated to commence in 2014. Therefore, at this point in time any interference and extraction of alluvial groundwater throughout the Project Application Area will not require a water access licence (WAL) under the WM Act. Groundwater licences granted under the Water Act 1912 will be converted to licences under the WM Act once the WSP commence.

3.2.12 Aquifer Interference Policy

The NSW Aquifer Interference Policy was finalised in September 2012 and clarifies the water licencing and approval requirements for aquifer interference activities in NSW, including the taking of water from an aquifer in the course of carrying out mining. Many aspects of this Policy will be given legal effect in the future through an Aquifer Interference Regulation. Stage 1 of the Aquifer Interference Regulation commenced on 30 June 2011.

This Policy outlines the water licensing requirements under the *Water Act 1912* and WM Act. A water licence is required whether water is taken for consumptive use or whether it is taken incidentally by the aquifer interference activity (such as groundwater filling a void) even where that water is not being used consumptively as part of the activity’s operation. Under the WM Act, a water licence gives its holder a share of the total entitlement available for extraction from the groundwater source. The water access licence must hold sufficient share component and water allocation to account for the take of water from the relevant water source at all times.

Sufficient access licences must be held to account for all water taken from a groundwater or surface water source as a result of an aquifer interference activity, both for the life of the activity and after the activity has ceased. Many mining operations continue to take water from groundwater sources after operations have ceased. This take of water continues until an aquifer system reaches equilibrium and must be licensed.

The NSW Aquifer Interference Policy requires that potential impacts on groundwater sources, including their users and GDEs, be assessed against minimal impact considerations, outlined in Table 1 of the Policy. If the predicted impacts are less than the Level 1 minimal impact considerations, then these impacts will be considered as acceptable. The minimal impact considerations relevant to the Project are outlined in Section 5.1.

3.2.13 State Groundwater Policy

The objective of the NSW State Groundwater Policy Framework Document (NSW Government 1997) is to manage the State’s groundwater resources so that they can sustain environmental, social and economic uses for the people of NSW. NSW groundwater policy has three component parts:

- NSW Groundwater Quantity Protection Policy.
- NSW Groundwater Quality Protection Policy.
- NSW Groundwater Dependent Ecosystems Policy.

Groundwater Quantity Protection Policy

The principles of this policy include:

- Maintain total groundwater use within the sustainable yield of the aquifer from which it is withdrawn.
- Groundwater extraction shall be managed to prevent unacceptable local impacts.

All groundwater extraction for water supply is to be licensed. Transfers of licensed entitlements may be allowed depending on the physical constraints of the groundwater system.

Groundwater Quality Protection Policy

The objective of this policy is the ecologically sustainable management of the State's groundwater resources so as to:

- Slow and halt, or reverse any degradation in groundwater resources.
- Direct potentially polluting activities to the most appropriate local geological setting so as to minimise the risk to groundwater.
- Establish a methodology for reviewing new developments with respect to their potential impact on water resources that will provide protection to the resource commensurate with both the threat that the development poses and the value of the resource.
- Establish triggers for the use of more advanced groundwater protection tools such as groundwater vulnerability maps or groundwater protection zones.

Groundwater Dependent Ecosystems Policy

This policy was designed to protect ecosystems which rely on groundwater for survival so that, wherever possible, the ecological processes and biodiversity of these dependent ecosystems are maintained or restored for the benefit of present and future generations.

3.2.14 Roads Act 1993

Section 138 of the *Roads Act, 1993* (Roads Act) sets out the requirement for approval to carry out certain works undertaken within the vicinity of a road. Under Section 138 of the Roads Act, a person must not, without consent of the appropriate roads authority:

- erect a structure or carry out a work in, on or over a public road.
- dig up or disturb the surface of a public road.
- remove or interfere with a structure, work or tree on a public road.
- pump water into a public road from any land adjoining the road.
- connect a road (whether public or private) to a classified road.

A traffic assessment is presented in Appendix H. The proposed works may entail an upgrade of the existing quarry access intersection to provide a BAL-type treatment for left turns into the site. This would require consent with RVC and Roads and Maritime Services.

3.2.15 Rural Fires Act 1997 No 65

The principle objectives of the *Rural Fires Act 1997 No 65* (Rural Fires Act) are to provide for the prevention, mitigation and suppression of bush and other fires, co-ordinate bush firefighting and bush fire prevention and provide for the protection of persons, infrastructure and environmental, economic, cultural, agricultural and community assets from damage arising from fires.

Division 8 of the Rural Fires Act addresses development of bush fire prone land. To demonstrate compliance with *Planning for Bush Fire Protection* (NSW RFS, 2006), as required by Section 79BA of the EP&A Act 1979, a bushfire risk is assessed in Section 3.3.3 and 5.9

3.2.16 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) provides for the protection of Aboriginal objects (sites, objects and cultural material) and Aboriginal places. Under the NPW Act, an Aboriginal object is defined as '*any deposit, object or material evidence (not being a handicraft for sale) relating to indigenous and non-European habitation of the area that comprises New South Wales, being habitation both prior to and concurrent with the occupation of that area by persons of European extraction, and includes Aboriginal remains*'.

An Aboriginal place is defined under the National Parks and Wildlife Act 1974 as an area which has been declared by the Minister administering the Act as a place of special significance for Aboriginal culture. It may or may not contain physical Aboriginal objects.

It is an offence under Section 86 of the NPW Act to 'harm or desecrate an object the person knows is an Aboriginal object'. It is also a strict liability offence to 'harm an Aboriginal object' or to 'harm or desecrate an Aboriginal place', whether knowingly or unknowingly. Section 87 of the NPW Act provides a series of defences against the offences listed in Section 86 which includes if the harm was authorised by and conducted in accordance with the requirements of an Aboriginal Heritage Impact Permit (AHIP) under Section 90 of the NPW Act.

As discussed in Section 5.6, it is considered highly unlikely that scientifically or culturally significant Aboriginal cultural deposits remain at the site.

3.2.17 NSW Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) lists a number of threatened species, populations or ecological communities to be considered in deciding whether there is likely to be a significant impact on threatened biota, or their habitats. If a species of flora or fauna listed in Schedule 1 or 2 of the TSC Act is identified, a review must be undertaken of the factors set out to establish if there is likely to be a significant effect on that species, population, ecological community or habitat. If any of these could be impacted by the proposal, an assessment of significance that addresses the requirements of Section 5A of the EP&A Act must be completed to determine the significance of the impact. If a significant impact on a threatened species, population or ecological community is likely, a Species Impact Statement (SIS) must be completed including consultation with the NSW Office of Environment and Heritage (OEH).

As discussed in Section 5.2, the proposal is not likely to have a significant effect on threatened species, populations or ecological communities listed under the TSC Act therefore a SIS is not required.

3.2.18 Native Vegetation Act 2003

The *Native Vegetation Act 2003* (NV Act) and *Native Vegetation Regulation 2005* guide the way native vegetation is managed in NSW by preventing broadscale clearing, unless it improves or maintains environmental outcomes.

Under Section 25(f) of the NV Act, clearing is permitted that is, or that is part of, designated development within the meaning of the EP&A Act and for which development consent has been granted under that Act.

3.2.19 The Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) is aimed at identifying and protecting significant items of historic (as opposed to Aboriginal) cultural heritage. The focus of the legislation is on identifying places of either local or state heritage significance, and protecting them by registration on heritage registers.

The *Heritage Act 1977* (NSW) also makes allowances for the protection of archaeological deposits and relics (Part 6). An archaeological "relic" means any deposit, object or material evidence which relates to the settlement of the area, not being Aboriginal settlement.

As discussed in section 5.6, it is highly unlikely that archaeological relics of significant historic sites are located within the Project Area.

3.3 Environmental Plan

3.3.1 North Coast Regional Environmental Plan

The following clauses of the *North Coast Regional Environmental Plan* is relevant to the proposal:

Clause 12

Clause 12 prevents RVC from approving an application unless it has considered its impact on adjoining or adjacent agricultural land and whether or not the development would cause a loss of prime crop or pasture land.

As discussed in Section 5.10, it can be concluded that Doonbah Quarry would not significantly reduce the agricultural potential of adjoining lands or agricultural land within the broader Richmond-Valley LGA. Given that this site has been used as a quarry for over 50 years, agricultural activities have been limited on this site with grazing primarily used to control vegetation for fire management purposes. Grazing has primarily occurred when quarrying activities on site have been minimal.

The proposed quarry is for a single definable development that is not likely to lead to an immediate or future decline in the area of prime agricultural land or to a decrease in the socio-economic outcomes for the residents of Richmond-Valley LGA.

Clause 18

Clause 18 prevents RVC from giving consent to a development application for an extractive industry unless it includes any necessary conditions of consent to require implementation, both during and after extractive operations, of an erosion and sediment control plan and rehabilitation plan.

As described in Section 5.1, the proposal includes rehabilitation and erosion and sediment controls.

3.3.2 Richmond Valley Local Environmental Plan 2012

Local Environmental Plans (LEPs) are prepared by councils to guide planning decisions in their LGAs and establish the requirements for the use and development of land. The LEP for RVC is referred to as *Richmond Valley Local Environmental Plan 2012* (RVLEP 2012)

The subject land is zoned RU1 Primary Production pursuant to RVLEP 2012. The objectives for the RU1 Primary Production zone are as follows:

- *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 unreasonably increase the demand for public services or public facilities.*

Extractive industries are permitted with consent in the RU1 Primary Production zone.

Other relevant clauses of the RVLEP 2012 include:

Clause 5.5 – Development within the coastal zone

Clause 5.5 has similar objectives to Coastal Protection SEPP, which are addressed in Section 3.2.8.

Clause 5.9 - Preservation of trees or vegetation

The objective of this clause is to preserve the amenity of the area, including biodiversity values, through the preservation of trees and other vegetation.

This clause applies to species or kinds of trees or other vegetation that are prescribed for the purposes of this clause by a development control plan made by the Council.

Vegetation clearing associated with the proposal has been assessed in Section 5.2 and Appendix G.

Clause 6.1 – Acid sulfate soils

According to the Acid Sulfate Soils Map, the site contains Class 3 Acid Sulfate Soils. Clause 6.1 prevents development on Class 3 land that involves works more than 1 metre below the natural ground surface unless an acid sulfate soil management plan has been prepared. The acid sulfate soils management plan must be prepared in accordance with the Acid Sulfate Soils Manual (ASSMAC, 1998).

A detailed assessment of the acid sulfate soils onsite is discussed in more detail in Section 5.1.

Clause 6.2 – Essential services

Clause 6.2 prevents development consent being granted unless any of the following services, that are essential for the proposed development, are available or that adequate arrangements have been made to make them available when required:

- (a) the supply of water*
- (b) the supply of electricity,*
- (c) the disposal and management of sewage,*
- (d) stormwater drainage or on-site conservation,*
- (e) suitable road access.*

As discussed in Section 5.11 the proposal has access to the above essential services or adequate arrangements will be made to make them available.

Clause 6.3 - Earthworks

The objective of this clause is to ensure that earthworks for which development consent is required would not have a detrimental impact on environmental functions and processes, neighbouring uses, cultural or heritage items or features of the surrounding land.

The impact of the excavation is assessed in detail in Section 5.1. This indicates that while the proposal would have impacts, with the implementation of the mitigation measures, these impacts would be minimal.

Clause 6.5 – Flood planning

The *Richmond River County Council: Richmond Valley Flood Mapping* indicates the site is subject to flooding during the 1 in 20 year average Recurrence Interval (ARI) flood event. Development must not be granted unless the development:

- (a) is compatible with the flood hazard of the land, and*
- (b) is not likely to significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and*
- (c) incorporates appropriate measures to manage risk to life from flood, and*
- (d) is not likely to significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses, and*
- (e) is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding.*

An assessment of potential impacts from flooding is presented in Section 5.1.2. Impacts to local and regional flood regimes is considered to be negligible. Since the operation would remove soil from the site, more flood storage may be available on the site which would reduce flood risk offsite. However this is likely to be marginal, since antecedent conditions before the flood arrival may well fill available flood storages on the site.

Clause 6.6 – Terrestrial biodiversity

The objective of this clause is to maintain terrestrial biodiversity. The impact of the proposal on the local ecology has been assessed in Section 5.2 and Appendix G. This assessment indicates the proposed expansion would be unlikely to have a significant impact upon species, populations or endangered ecological communities or their habitats.

It is expected that with implementation of the management measures proposed a 'maintain or improve' outcome for the biodiversity values of the site could be achieved in the medium to long term.

Clause 6.10 - Wetlands

The objective of this clause is to ensure that wetlands are preserved and protected from the impacts of development. The Wetlands Map provided in the RVLEP 2012 identifies some areas of the site as Wetland, therefore the consent authority must consider:

(a) whether or not the development is likely to have any significant adverse impact on the following:

(i) the condition and significance of the existing native fauna and flora on the land,

(ii) the provision and quality of habitats on the land for indigenous and migratory species,

(iii) the surface and groundwater characteristics of the land, including water quality, natural water flows and salinity, and

(b) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development

The impact of the proposal on the local hydrology is assessed in Section 5.1 and Appendix D and ecology has been assessed in Section 5.2 and Appendix G. The conclusion from both these assessment indicates the proposal would not have significant adverse impact on the wetlands. A range of mitigation measures are also provided to further minimise any identified impact.

3.3.3 Richmond Valley Development Control Plan 2012

Richmond Valley Development Control Plan 2012 (RVDCP 2012) complements RVLEP 2012 and provides information necessary for development planning. Relevant parts of the RVDCP 2012 are outlined in the following subsections.

Part H Natural Resources and Hazards

H1 Floodprone Land

The *Richmond River County Council: Richmond Valley Flood Mapping Map* indicates the site is subject to flooding during the 1 in 20 year ARI flood event.

Development Control Planning measures aim to ensure developments take into account the flood hazard in the area, thereby reducing the risk to life and lowering the health, social, and psychological trauma associated with flooding.

The Floodplain Risk Management Plan (FRMP) provides the definitive planning controls for all land within Richmond Valley LGA.

An assessment of potential impacts from flooding is presented in Section 5.1.2. Impacts to local and regional flood regimes is considered to be negligible. Since the operation would remove soil from the site, more flood storage may be available on the site reducing flood risk offsite. However this is likely to be marginal, since antecedent conditions before the flood arrival may well fill available flood storages on the site.

H2 Bushfire Prone Land

The site has been mapped by RVC as being bushfire prone, however the only buildings are a site office and shed.

To demonstrate compliance with *Planning for Bush Fire Protection* (NSW RFS, 2006), as required by Section 79BA of the EP&A Act 1979, a Bushfire Risk Assessment has been presented in Table 3-3.

Table 3-3 Bush Fire Risk Assessment

Performance Criteria	Response
Asset Protection Zones (APZ)	The site is level with very little vegetation surrounding the location of site office and shed. Assuming flat land, grassland vegetation and a Bushfire Attack Level (BAL) 29, AS3959-2009 indicates the site office and shed require an APZ of 8-<12m. The required APZ is achievable on the site.
Siting and design	The site office and shed are metal structures, as shown in Figure 3-1 and Figure 3-2. They are located and designed appropriately.
Construction standards	AS3959-2009 construction standards are not applicable to Class 10 buildings, however, it is considered the site office and shed comply with BAL 29.
Access	The access is greater than 200 m from a main road as required by NSW RFS (2006). However, the quarry access is relatively clear of vegetation and the quarry area itself is clear of vegetation and provides a refuge.
Services	Electricity would be provided via solar power or generator. Water would be provided by rainwater. The dedicated water supply for firefighting purposes would be the water in the excavation. This is supplied by groundwater and is considered a reliable water source.
Landscaping	The landscaping would be maintained, in accordance with Appendix 5 of NSW RFS (2006)



Figure 3-1 Existing site office



Figure 3-2 Existing shed

H3 Acid Sulfate Soils

As explained above, the site is mapped as Class 3 Acid Sulfate Soils and a detailed assessment of the acid sulfate soils onsite is discussed in more detail in Section 5.1.

H4 Natural Resources

The sections of this chapter that are relevant to the proposal are terrestrial biodiversity and wetlands. These issues have been addressed in Sections 5.1 and 5.2.

Part I other considerations

Other areas of the RVDCP 2012 requiring consideration are summarised in Table 3-4.

Table 3-4 Consideration of other RVDCP 2012 Factors

Consideration	Response
I1 Heritage	Refer to Section 5.6.
I2 Development In, On, Over or Under a Public Road	Refer to Section 5.5.
I3 Setbacks and Building Height	The only buildings would be the Site Office and Shed, as the site plans show, both comply with the required setbacks
I4 Car Parking Provisions	No specific car parking requirements for Extractive Industry are provided in the DCP. However, the site has sufficient room to accommodate car parking and manoeuvring for staff and the occasional visitor. Access arrangements also comply with the DCP. Refer to Section 5.5.
I7 Noise Impact Assessment	Refer to Section 5.2
I8 Social Impact Assessment	Refer to Section 5.11
I9 Water Sensitive Urban Design	Refer to Section 5.1.
I11 Land Use Conflict Risk Assessment	Refer to Section 5.10
I12 Context and Site Analysis	Refer to Appendix A
I16 Additional State Considerations	Refer to Section 3.2

3.4 Statutory position

The provisions of *SEPP Mining, Petroleum Production and Extractive Industries* 2007 and RVLEP 2012 allow the proposed development to be permissible with consent as discussed in Sections 3.2 and 3.3. A DA would therefore be submitted to RVC to be assessed under Part 4 of the *EP&A Act*.

The proposal seeks the extraction of up to 490,000 tonnes of material and therefore meets the definition of an 'extractive industry' and constitutes a 'Designated Development' in accordance with Schedule 3, Clause 19 of *EP&A Regulation*.

An EIS is therefore required to accompany the DA to RVC. This EIS has been prepared to meet the requirements of the Part 4 of the *EP&A Act*, the *EP&A Regulation* and the DGR's for the preparation of an EIS. The DA is required to be assessed against the matters for consideration set out in Section 79C of the *EP&A Act* and Part 6 of the *EP&A Regulation*.

As the proposal is considered a designated development involving an extractive industry, it is also defined as regional development under Clause 8 of Schedule 4A of the *EP&A Act*. The development would therefore be notified and assessed by RVC but may be determined under the Joint Regional Planning Panel.

The proposal would require additional licences and approvals under a range of applicable NSW legislation and is therefore also considered to be integrated development. Permits and approvals required as part of the proposal include:

- An Environmental Protection Licence to undertake a scheduled activity under the Protection of the *Environment Operation Act, 1997*.
- A groundwater licence under Part 5 of the *Water Act, 1912*.
- A section 138 approval under the *Roads Act, 1993*.

Prior to granting development consent for the proposal, the consent authority must obtain general terms of approval from each relevant approval body administering the relevant legislation.

4. Consultation

4.1 Introduction

A consultation strategy was formulated as a part of the EIS process to assist in the identification of key stakeholders and issues for consideration. Consultation with a range of government agencies and community stakeholders was incorporated into the strategy to both inform the stakeholders of the project and to allow any issues of concern to be raised at an early stage of the planning process and incorporated into the EIS.

This chapter provides a description of the government and community consultation activities undertaken and outlines the key issues identified and where they are addressed in this document.

4.2 Consultation with government agencies

During the preparation of the EIS, regular consultation has been maintained with State government agencies and RVC. Consultation has been both formal and informal and has been used to refine the proposal and develop the assessment methodology.

4.2.1 Director General's requirements

The DGRs for the preparation of this EIS were provided by the Department of Planning and Environment (DPE) following submission of the Preliminary Environmental Assessment (PEA) and subsequent agency consultation. A summary of key issues raised in the DGRs and the section of the EIS where they are addressed is provided in Table 4-1. An unabridged copy of the DGRs are provided in Appendix B.

Table 4-1 Director General's requirements

Issue category	Requirement	Section addressed in EIS
General requirements	The Environmental Impact Statement must include: An executive summary.	Beginning of report
	- A detailed description of the proposal including: - Resource identification. - Site description. - History of previous quarry operations of the site. - Proposed works and rehabilitation. - Duration and intensity of operations. - Interactions between the proposed operations and the existing approved development and land use in the area. - Detailed justification for the proposal.	2
	A conclusion justifying the development on economic, social and environmental grounds, taking into consideration whether the proposal is consistent with the objects of the EP&A Act.	7, 8
	Certification by the author of the EIS that the information contained in the document is neither false nor misleading.	Page i

Issue category	Requirement	Section addressed in EIS
Key issues	An assessment of the potential impacts during the establishment, operation and decommissioning of the proposal, and measures to avoid, minimise, mitigate, offset and/or monitor the potential impacts on the key issues listed below.	5
	Land resources including an assessment of potential impacts on:	
	• Soils and land capability, including activities that may result in erosion and sedimentation and proposed mitigation measures.	5.1
	• Landforms and topography.	5.1
	• Land use including agricultural, forestry and conservation lands.	5.2, 5.10, 5.11
	Water resources including:	
	• Identification of licensing requirements under the <i>Water Act 1912</i> and the <i>Water Management Act 2000</i>.	3.2.10, 3.2.11, 5.1
	• An assessment of potential impacts on the quality and quantity of existing surface and ground water, including impacts from the exposure of potential acid sulfate soils	5.1
	• The provision of measures to ensure operation is in accordance with the requirements of any relevant Water Sharing Plan.	NA
	• An annual water balance.	5.1, Appendix D
	• A description of proposed water and wastewater management systems and any monitoring programs.	5.1, Appendix D
	• A flood impact assessment	5.1, Appendix D
	Biodiversity	
	• Accurate predictions of any vegetation clearing on site or for road upgrades.	5.2.2
	• A detailed assessment of potential impacts of the development on: biodiversity, threatened species, populations or their habitat, endangered ecological communities and groundwater dependant ecosystems.	5.2.2
	• A detailed assessment of any indirect impacts on the biodiversity values of Broadwater and Bundjalung National Parks.	5.2.2
	• A detailed description of the proposed measures to maintain or improve biodiversity values within the development area in the medium to long-term.	5.2.3
	• Consideration of a Biodiversity Offset Strategy.	5.2.2, Appendix G

Issue category	Requirement	Section addressed in EIS
	Heritage	
	An Aboriginal cultural heritage assessment (including 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.	5.6
	A historic heritage assessment including a statement of heritage impact for any State significant or locally significant heritage items.	5.6
	Traffic and transport	
	An assessment of potential traffic impacts on the capacity, efficiency and safety of the road network including a Road Safety Audit on the proposed route.	5.5.2
	A description of proposed measures to maintain and/or improve the capacity, efficiency and safety of the road network in the surrounding area over the life of the project.	5.5.3
	Noise, vibration and blasting	
	An assessment of potential noise impacts on nearby private receptors due to construction, operation or road haulage.	5.3.3
	Air quality	
	An assessment of any potential dust impacts on nearby private receptors from construction, operation or road haulage.	5.4.2
	Rehabilitation	
	A detailed description of the proposed measures that would be undertaken progressively and during quarry closure.	5.1
	A detailed rehabilitation strategy, including justification for the proposed final land form and consideration of the objectives of any relevant strategic land use plans or policies.	5.1
	The measures that would be undertaken to ensure sufficient financial resources are available to implement the proposed rehabilitation strategy.	2.11
	Waste management – including importation of waste material to the site.	5.8
	Hazards and risks – including transport or storage of any dangerous goods.	5.8.1
	Visual amenity	5.7
	Agricultural impacts	5.10

Issue category	Requirement	Section addressed in EIS
	Utilities and services	2.10
	Social and economic impacts	5.11
Environmental planning instruments	The EIS must assess the proposal against the relevant environmental planning instruments and development control plans.	7
Guidelines	The EIS must consider relevant State government policies and guidelines.	3
Consultation	Consultation must be undertaken with relevant local, State and Commonwealth government agencies, service providers, community groups, surrounding landowners and occupiers that may be affected by the proposal and address any issues raised in the EIS.	4

4.3 Community consultation

Rixa Quarries have had informal discussions with most of the immediate neighbours to the quarry over the past couple of months. A community meeting was held at the quarry on 15 November 2014 which was attended by six local residents, a RVC representative and Rixa representatives. An attendance sheet is provided in Appendix C.

The main concern raised was in relation to the increase in truck numbers, the impact of the trucks on the condition of Evans Head Woodburn Road and noise. The impact on groundwater levels and start times, especially for trucks arriving at site, were also discussed.

The impacts have been assessed and appropriate mitigation measures proposed in Section 5.

4.4 Aboriginal consultation

As discussed in Section 5.6, a meeting was held on 5 May 2014 with the Bandjalang Native Title holders.

5. Environmental assessment

5.1 Land and water resources

To assess potential impacts on soil and water, a Soil and Water Management Plan (SWMP, GHD, 2014a) was prepared. The SWMP is provided in Appendix D and summarised in the following subsections. The SWMP consisted of:

Surface water

- An assessment, review and description of the existing hydrological conditions.
- An assessment of potential surface water quantity/quality impacts associated with the proposed works.
- Nomination of measures to mitigate any potential impacts associated with the proposed works.

Groundwater

- Review of the existing local and regional hydrogeological environment including the main aquifer units, groundwater levels and groundwater quality.
- Review of the relevant water management legislation for the site (Water Act 1912 and Water Management Act 2000).
- Identification of the sensitive groundwater receptors, including Groundwater Dependent Ecosystems (GDEs) and registered groundwater bore users.
- Installation and sampling of three groundwater wells.
- Prediction of drawdown in groundwater levels as a result of the proposed development.
- Assessment of potential water table and groundwater quality impacts against the relevant criteria in the NSW Aquifer Interference Policy (NoW, 2012).
- Identification of avoidance and mitigation measures that should be adopted to keep impacts below the Level 1 impact criteria under the NSW Aquifer Interference Policy.

5.1.1 Existing conditions

Plans of the existing quarry are presented in Appendix A.

Landform

A summary of the landform of the site is as follows:

- The area surrounding the quarry is relatively flat with an approximate elevation of 5 metres AHD.
- The site is dominated by the presence of two adjacent 'lakes' that represents the current extent of the quarry.
- A settling pond is located at the outflow of the lake.
- Several drainage channels are found onsite to help alleviate floodwater.
- The site contains several man-made dams for provision of water for livestock and from a former aquaculture venture.
- The site contains several stockpiles resulting from the construction of the dams and other earthworks.
- Several large stockpiles associated with the quarry operation are located along the western edge of the lakes.

Geology and soils

According to the Lismore 1:100,000 and 1:25,000 Coastal Quaternary Geology Map Series (Hashimoto and Troedson, 2008) the site is defined as being an Estuarine Plain System where the Quaternary layer of the site is a layer of Pleistocene tidal-delta flat which consists of marine sand, silt, minor clay, indurated sand and shell. The North East corner of the site is defined as being Coastal Barrier System with Pleistocene beach-ridge swale and dune-deflation hollow which consists of marine sand, indurated sand, organic mud and peat.

Between 24 February 2014 and 28 February 2014, a total of seven boreholes (BH1 – BH7) were drilled within or on the edge of the proposed area to be excavated. Boreholes were drilled to depths ranging from 15.95m to 16.45m below ground level (bgl). The boreholes encountered a number of sandy layers extending to over 15m bgl.

The site has been mapped as Class 3 acid sulfate soils (ASS) and an assessment confirms the soils are ASS.

Surface water

Surface water runoff generally collects within the extraction areas (which have become lakes), dams, ponds and drainage lines. Should the excavation lake overflow, this would discharge to an overflow channel along part of the northern boundary, which thereafter bisects the site in a north-south direction, bypassing the dam along the southern boundary and discharging to the dam in the south-western corner of the site. The excavation adjacent to the lakes currently acts as a sediment control structure for the quarry operation.

Once offsite, the stormwater is reported to discharge to a dish drain and flow west through the adjacent wetland, ultimately draining to the Richmond River. Water quality of the lake appears relatively clear. Limited water quality data exists, but results from a sample indicate the water is moderately acidic, is sodium chloride/sulfate dominant and has elevated aluminium, copper and zinc concentrations compared to the ANZECC (2000) guidelines.

Groundwater

The primary groundwater source in the vicinity of the Project Application Area is the coastal sand aquifer, which is considered to be a highly productive coastal sands water source due to its high yield and low salinity. A minor groundwater source would occur in the porous and fractured rock underlying the sand layers. The porous and fractured groundwater source will not be intercepted by the project and therefore is not discussed further.

Three standpipe piezometers were installed to depths of approximately 4m bgl to allow for ongoing groundwater monitoring. Groundwater levels measured in March 2014 ranged from 0.76 m AHD to 1.45 m AHD. These levels were used to plot local groundwater elevation contours shown in Figure 5-1. Based on the contours, the local groundwater flow direction at this time was westerly. A coastal unconfined sand aquifer is likely to have natural variation in groundwater levels in the order of 2m based on review of NSW Office of Water bores adjacent to the site.

Groundwater samples collected from the site in March 2014 indicated that the coastal sand groundwater source is fresh, slightly acidic to neutral, sodium chloride/sulfate dominant or sodium bicarbonate/sulfate dominant, influenced by rainfall and shows some acidification of ASS. Based on this monitoring data, it appears that the existing impact of ASS on groundwater quality due to sand mining extends less than 100m from the excavation area.

A search of the NSW Groundwater Bore Database identified 39 bores, with almost half the bores (18) registered as monitoring/test bores, four bores users were unknown, three bores were registered for town water supply and the remainder (14) being registered for domestic, recreational, irrigation and / or stock use. Of the four Town Water Supply bores identified, all are located to the far west of the site. The closest of these bores was approximately 1km from the site. Overall, the search of the NSW Groundwater Bore Database indicates that there is groundwater usage and reliance for domestic, irrigation, stock watering and town water supply purposes in the vicinity of the Project Application Area.

The potential for vegetation Groundwater Dependant Ecosystem (GDE)s within the vicinity of the Project Application Area was assessed. Given the relatively shallow groundwater levels recorded at the site, it is likely that all native vegetation communities occurring at the subject site would have some groundwater dependence during periods of low rainfall and associated low surface water.

Flooding

The site is subject to backwater flooding from the Richmond River, with flood events discharging from north-west to south-east across the site. A review of the flood data shows that:

- The site is mostly noted as being located within a High Depth Hazard flood zone, where floodwaters are deep but are not flowing with high velocity. The excavation lake areas on the site are designated Rare High Floodway Hazard areas and may carry significant volumes of floodwater during a 500-year ARI flood.
- In a 20-year event, flood levels are approximately 3.85m AHD across most of the site, with flood depths of approximately 0.8m. In a 100-year event, flood levels are approximately 5m AHD across most of the site, with flood depths of approximately 1.5m.
- Flood velocities are very slow moving at approximately 0.2 m/s.

5.1.2 Potential impacts

Soil and landform

The proposed quarry would alter the topography of the site and limit future land use options following closure.

The proposal would increase the area of the current excavation by approximately 12 hectares and increase the depth of the excavation by approximately 11 metres, effectively increasing the extent of the lake currently found onsite. Due to the current number of dams or lakes existing in the area, the modification to topography is not deemed to create a significantly negative impact.

Topsoil would be removed and stockpiled for use in the rehabilitation of the site and excavated material would be temporarily stockpiled onsite prior to treatment and removal from site. All stockpiles would be removed or landscaped as part of the rehabilitation program.

As part of the rehabilitation, vegetation would be re-established enabling the portion of the site adjacent to the excavation to be used for the proposed future land uses.

The potential impacts of the excavation and stockpiles on the visual amenity are addressed in Section 5.7.

Potential negative impacts on soil quality from the proposal include:

- Short term erosion of stockpiles and exposed soils relating to vehicle movements, stockpiled materials and vegetation removal.
- Compaction of the deeper soil structure from the movement of large machinery.
- Transportation of soil onto nearby sealed roads resulting from offsite vehicle movements.

- Dust generation from excavation works and vehicle movement over exposed soils (as addressed in Section 5.4).
- Contamination from oil or chemical spills.
- Exposure of potential acid sulfate soils to the atmosphere which is likely to create acidic conditions that may have a detrimental impact on the local environment.
- Collapse of wall of excavation.

Localised, short-term impact on soils are likely, however provided stabilisation strategies are effectively implemented, medium to long-term impacts would be low.

Surface water

The main surface water related risks associated with the operation of the expanded Doonbah Quarry are assessed to be:

- The proposed quarry would alter the local topography at the site, which would affect the drainage of surface water. This could lead to a concentration and discharge of flows leading to increased risk of erosion and sedimentation.
- Surface water discharging from the quarry area could entrain sediment from disturbed areas causing decreased water quality in waterways.
- Contamination via chemicals, hydrocarbons or other contaminants from accidental spillage.
- Flooding of the site which may result in flood risk to staff, result in off-site flood impacts, erode stockpiles and entrain sediment and damage equipment.

Groundwater

Impacts on groundwater of 10 potential situations were analysed. Modelling showed that varying the water level by 0.5 m had little impact on the level of drawdown in the pit. Increasing the recharge from rainfall slightly decreased the drawdown in the pit.

It is likely that the proposed sand extraction will result in a lowering of groundwater pH in the vicinity of the pit lakes due to exposure of the PASS to the atmosphere. Based on monitored impacts from the existing sand extraction, it is likely that the reduction in groundwater pH will be limited to a distance of approximately 100 m from the pit lakes.

Under the NSW Aquifer Interference Policy the Level 1 minimal impact considerations for Highly Productive Coastal Sands Water Sources specify that the allowable predicted impact must be less than a 2 m water table decline cumulatively at any water supply work. The predicted drawdown at the pit is less than 2 metres and therefore the predicted impacts of this work will fall within this criterion. It is predicted that under average evaporation conditions, the works are likely have no impact (in terms of level or quality) on existing private bores. The closest of the town water supply bores is over a kilometre from the Project Application Area which lies outside the predicted radius of influence under average evaporation conditions.

Under the NSW Aquifer Interference Policy the Level 1 minimal impact considerations for Highly Productive Coastal Sands Water Sources specify that the allowable predicted impact must be less than or equal to 10% cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, at a distance of 40 m from any high priority groundwater dependent ecosystem or high priority culturally significant site listed in the schedule of the relevant WSP.

The likely typical climatic variations for coastal sand aquifers are estimated to be in the order of 2 m based on review of NSW Office of Water bores adjacent to the site. Based on the results of the search of the Groundwater Dependant Ecosystem Atlas the closest identified potential GDE lies approximately 250 metres from the Project Application Area boundary. This is likely to be within the radius of influence. The profile of the drawdown is unknown but the maximum drawdown under average evaporation conditions will be 0.36 m. Therefore, it is likely that the drawdown 40 m from the closest GDE will be approximately equal to or less than 10% of cumulative variation in the water table.

In addition as no WSP exists the predicted drawdown could not exceed the Level 1 criterion from the NSW Aquifer Interference Policy. However if it was desired to determine the precise impact on any potential GDEs; the location of any GDEs should be accurately mapped. Monitoring of groundwater levels in the installed bores should be continued to ascertain the actual impact.

Flooding

In consideration of the above and the proposed operation, impacts to local and regional flood regimes is considered to be negligible. Since the operation would remove soil from the site, more flood storage may be available on the site, reducing flood risk offsite. However this is likely to be marginal, since antecedent conditions before the flood arrival may well fill available flood storages on the site.

Water balance

A site water balance has been undertaken, with estimates of site operational water requirements (amenities, road/site dust control) and a MUSIC model was developed to represent the existing and developed scenarios for the site.

The results of modelling show that sufficient runoff would be generated from the operational area to meet operational water requirements. Surplus water captured in the new excavation on site would discharge via the existing flow paths to the south-west corner of the site.

5.1.3 Mitigation measures

It is not possible or practical to avoid the impacts of a quarry on the landform, geology, soils or land use of the site. However, there are a number of measures that would be implemented to mitigate potential impacts. In summary these include:

- An environmental protection licence must be obtained for the quarry. All relevant conditions relating to soil and water management would be implemented as required by the licence.
- A groundwater licence will be obtained from NSW Office of Water. All relevant conditions relating to soil and water management will be implemented as required by the licence.
- An Environmental Management Plan would be compiled for the quarry which would contain a Soil and Erosion Management Plan. Training would be provided to all quarry staff including relevant sub-contractors on erosion and sediment control practices and the requirements of the Plans through inductions, toolboxes and targeted training.
- Implement erosion and sediment controls in accordance with *Managing Urban Stormwater Soils and Construction – Volume 2e Mines and quarries* (DECC, 2008).
- Develop an Acid Sulfate Management Plan (ASSMP) for the site in accordance with the *Acid Sulfate Soils Assessment Guidelines* (Ahern *et al* 1998).
- The installed groundwater bores should be monitored.

- Excavate the quarry with similar batter slopes as the existing quarry and maintain a 5-10 metre buffer within the proposed excavation extent until the full depth of the quarry is reached and stable.

Additional mitigation measures are provided in the SWMP in Appendix D.

5.2 Biodiversity

To assess potential impacts on biodiversity an Ecological Assessment (GHD, 2014b) was prepared. The ecological assessment is provided in Appendix G and summarised in the following subsections. The objectives of the ecological assessment were to:

- Survey, identify and describe flora species (including rare and threatened flora), and vegetation communities present within the subject site and assess their conservation significance with regard to relevant Federal, State and Local Government environmental legislation.
- Survey, identify and describe fauna species (including rare and threatened fauna), and their habitats which are present, or which may occur within the subject site and surrounds, and assess their conservation significance with regard to relevant Federal, State and Local Government environmental legislation.
- Address the Director General's Requirements (DGRs) for the EIS in relation to biodiversity.
- Assess and describe the conservation significance of the flora and fauna of the subject site including the presence of any biota listed under the Threatened Species Conservation Act 1995 (TSC Act) and/or Matters of National Environmental Significance (MNES) listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).
- Assess the significance of the impact of the proposed development on threatened biota in accordance with Section 5A of the EP&A Act (known as the 'Seven Part Test') and the EPBC Act Significant Impact Guidelines 1.1 (DotE 2013).
- Provide recommendations for mitigating the effects of the proposed development on native flora and fauna, particularly threatened species and their habitats, and the general wider environment.
- Describe potential offsetting actions based on the biodiversity values which cannot be maintained or improved, should these be required.

5.2.1 Existing conditions

Methodology

A desktop review was undertaken to identify threatened species, populations and ecological communities listed under the TSC Act and FM Act (i.e. threatened 'biota') and matters of national environmental significance listed under the EPBC Act that could potentially occur at the site.

In order to identify and assess the presence of Groundwater Dependent Ecosystems (GDE) within the subject site, a review was undertaken of the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems – The Conceptual Framework* (Serov et. al., 2012), which were developed by the NSW Office of Water (NoW) and the OEH to provide an approach to GDE identification, classification, ecological valuation, and ecological risk assessment for a given activity or potential impact on a groundwater source. The Bureau of Meteorology Groundwater Dependant Ecosystem Atlas of potential GDEs within the vicinity of the subject site was reviewed.

Field surveys were completed by two ecologists between 8 April and 10 April 2014. Two days and two nights of flora, fauna and habitat assessments were undertaken.

All details of survey conditions and species observations were recorded on proforma field datasheets. The locations of threatened species and important habitat resources (such as nest or roost trees) were captured and mapped. Previous records and habitat assessments have been used to compile a full list of species potentially impacted by the proposal.

Following collation of database records, species and community profiles, a 'likelihood of occurrence' assessment was undertaken with reference to the broad habitats contained within the study area. The likelihood of threatened and migratory biota occurring in the study area was assessed based on presence of records from the locality, species distribution and habitat preferences, and quality of potential habitat present in the study area.

Vegetation types within the study area were assessed against identification criteria for state and Commonwealth listed threatened ecological communities (critically endangered ecological communities, threatened ecological communities and endangered ecological communities). Vegetation and habitats were compared with descriptions provided in OEH (2014) and DoE (2014) profiles.

Desktop results

A search of the BioNet Atlas of NSW Wildlife database found 995 species of flora and fauna have been previously recorded within a 10 km radius of the centre of the quarry site. This list included 38 threatened fauna species and 10 threatened flora species that are listed under the NSW TSC Act.

Based on the results of the EPBC Protected Matters Search Tool (PMST), one community listed as threatened under the EPBC Act is predicted to occur within the locality: This community is known as Lowland Rainforest of Subtropical Australia and is listed as critically endangered under the EPBC Act (DoE 2014).

The PMST report indicated that 64 threatened species listed under the EPBC Act are known or are predicted to occur within the locality. This includes 17 flora species, one reptile, three frogs, one fish, five birds and six mammals as well as 15 listed migratory birds. The remaining 10 species were identified as marine species for which no suitable habitat is present within the site.

A search of the DPI records viewer for the Richmond Valley LGA returned one species (Oxleyan pygmy perch), which has been recorded within approximately 200 m of the site to the north, east and south. This species is listed as endangered under the *Fisheries Management Act 1994*. There are approximately 30 other records of this species within approximately 3 km of the subject site, mostly within National Park estate.

Field survey

A total of 135 species of flora were recorded within the study area, comprising 103 native and 32 exotic species. No threatened plant species were recorded.

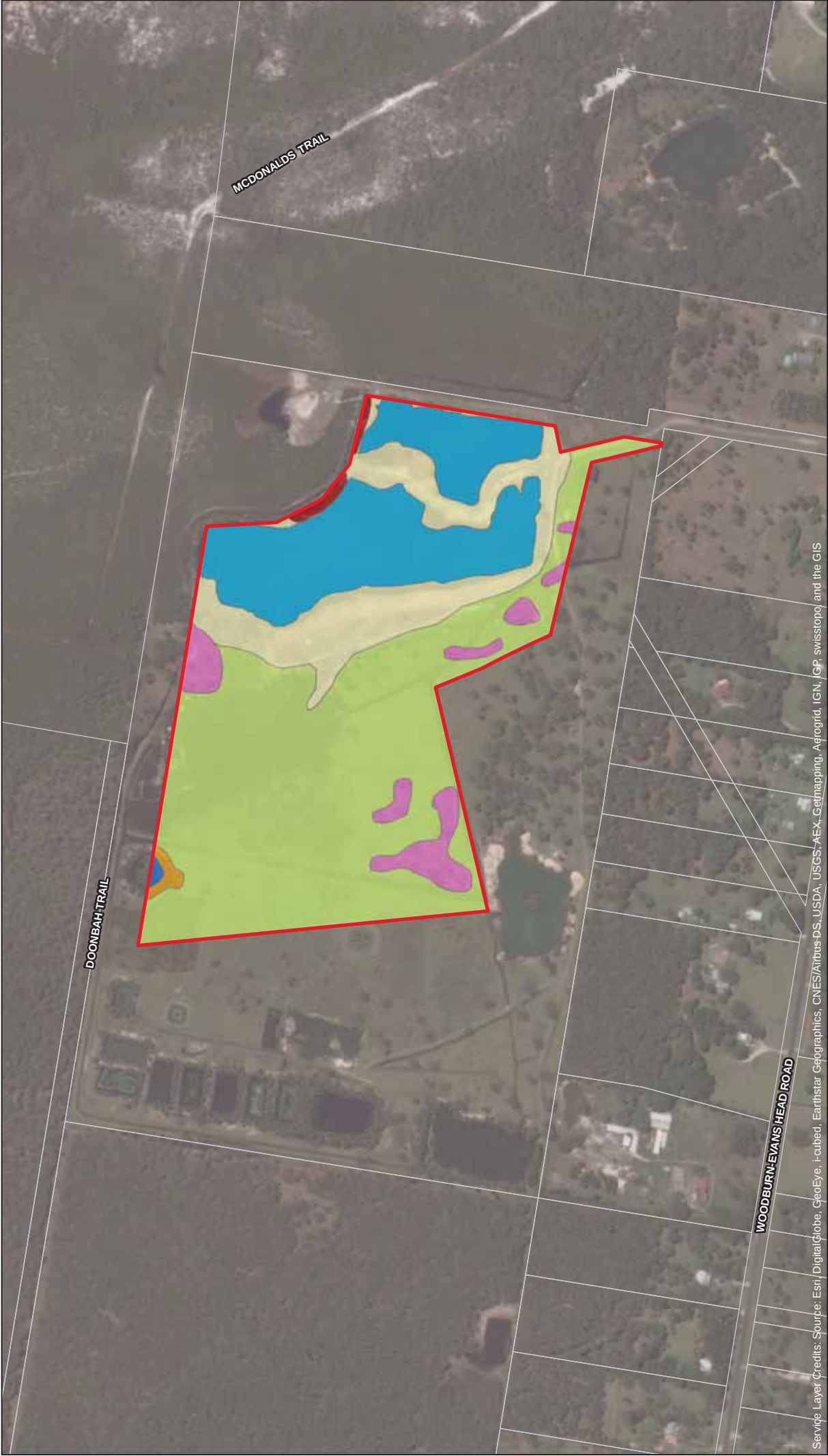
No weed species that are declared noxious in the Richmond Valley LGA were recorded within the subject site. Environmental weeds that occur within the site include *Cirsium vulgare* (Spear thistle), *Senecio madagascariensis* (Fireweed), *Verbena bonariensis* (Purpletop) and *Bidens pilosa* (Cobblers Pegs). These weeds are predominantly confined to areas within the site that have been disturbed as part of the existing quarry operations.

Based on the fine-scale vegetation mapping and flora sampling, five vegetation types were recorded within the study area, of which three are native and two are exotic. These were:

- Coastal heath on sands of the North Coast
- Modified Pink Bloodwood – Red Mahogany Open Forest

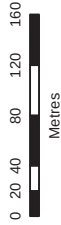
- Paperbark Swamp Forest on coastal lowlands
- Exotic grassland
- Disturbed land / Existing quarry

The vegetation communities are shown on Figure 5-2.



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS

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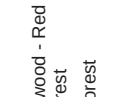
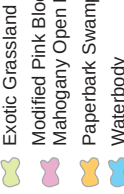
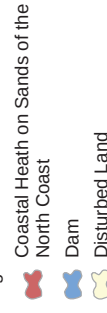


Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

LEGEND



Vegetation



Rixa Quarries Pty Ltd
Doonbah Quarry

Job Number 22-17200
Revision 0
Date 26 Nov 2014

Vegetation Communities

Figure 5-2

A total of 34 bird species, three frog species (including one introduced) and eight mammal species (including three introduced species) were recorded.

Evidence of the presence of Koala in the form of tree trunk scratches and a scat were observed in open forest in the southern part of the subject site.

An assessment of bat species present at the time of the survey indicated the probable presence of the Little Bent-wing bat, (*Miniopterus australis*) which is listed as vulnerable under the TSC Act and the Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*) and Hoary wattled bat (*Chalinolobus nigrogriseus*) which are listed as vulnerable under the TSC Act.

There was evidence of *Bufo marinus* (Cane Toad) inhabitation across the study area with carcasses observed around the lakes and large live Cane Toads were observed inhabiting burrows to the north west of the study area. Tracks of Dogs were noted and burrows were present that appeared to have been excavated by Rabbits. Cattle occurred across the study area as a herd managed by the property owner. Honey bees were also housed in hives at one location near the southern dam. A further bee hive was noted in a large tree hollow outside the proposed expansion area.

Four habitat types were recorded within the site during the field survey. These were:

- Low heath shrubland on sand
- Modified open forest with tall *Eucalypts* including hollow-bearing trees
- Waterbodies
- Disturbed land

Given the relatively shallow groundwater levels recorded at the site, it is likely that all native vegetation communities occurring at the subject site would have some groundwater dependence during periods of low rainfall and associated low surface water. Using the definitions in the NSW Groundwater Dependent Ecosystems Policy (Serov *et al.*, 2012), vegetation communities at the subject site can be defined as partially dependant, facultative GDEs and classified as terrestrial ecosystems partially dependant on groundwater.

Likelihood of occurrence of threatened biota

One threatened vegetation community was recorded during field surveys within the study area; the EEC Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.

The majority of the threatened flora species known or predicted to occur in the locality are considered unlikely to occur on the site as they have limited ranges and/or habitat requirements, which are not present at the site or surrounding proposal site. Based on known habitat associations and the nature and condition of habitat available, there is suitable habitat within the study area for one threatened flora species, *Rutidosis heterogama* (Heath Wrinklewort). This species is listed as vulnerable under the TSC and or EPBC Act.

Of the fauna species predicted to occur on site, two species (*Phascolarctos cinereus* (Koala), and *Phascogale tapoatafa* (Brush-tailed Phascogale)), listed as vulnerable under both State and Commonwealth legislation, are known to occur within the proposed development area. A further six species have a high likelihood of occurrence while a further 22 species are moderately likely to occur on site. The remaining 31 species are considered to have a low likelihood of occurrence on site because of the type and condition of the available habitat.

The 12 species known to occur and/or considered to have a high likelihood of occurrence or whose habitat is considered to be likely to occur on site, are listed in Table 5-1.

Table 5-1 Threatened species known to or likely to occur on site

Scientific Name	Common Name	TSC Act Status	EPBC Act Status
Amphibians			
<i>Crinia tinnula</i>	Wallum Froglet	Vu	
Birds			
<i>Erythrorhynchus radiatus</i>	Red Goshawk	CE	Vu
<i>Neophema pulchella</i>	Turquoise parrot	Vu	
Mammals			
<i>Miniopterus australis</i>	Little Bentwing-bat	Vu	
<i>Miniopterus schreibersii oceanensis (probable*)</i>	Eastern Bent-wing Bat	Vu	
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	Vu	
<i>Phascogale cinereus</i>	Koala (combined populations of Qld, NSW & the ACT)	Vu	Vu
<i>Petaurus poliocephalus</i>	Grey-headed Flying-fox	Vu	Vu
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	Vu	
<i>Chalinolobus nigrogriseus (probable)</i>	Hoary wattled bat	Vu	
<i>Syconycteris australis</i>	Common Blossom-bat	Vu	
Fish		FM Act Status	
<i>Nannoperca oxleyana</i>	Oxleyan Pygmy Perch	En	En

*Refer to section 5.2.5 of this report for definition

No endangered populations were recorded or are considered likely to occur within the study area.

No migratory fauna species were recorded or are considered likely to occur within the study area.

SEPP 44 Koala habitat assessment

The site contains one Koala feed tree species listed on Schedule 2 of SEPP 44, namely *Eucalyptus tereticornis* (Forest Red Gum). *E. tereticornis* comprises approximately 25% of the total number of trees in the upper or lower strata of the tree component within the open grassy woodland areas. Based upon the SEPP 44 definition, the site therefore contains 'potential koala habitat'.

Targeted surveys for Koalas and searches for signs of recent Koala activity were conducted, and evidence of the species was detected within the subject site, but outside of the study area. In addition, there is an OEH (2014) record of Koala within the immediate vicinity of the site (within 200 m to the south east of the property).

There is no evidence that the study area supports a local population of the Koala, including breeding females. Therefore, based upon the SEPP 44 definition, the site does not constitute 'core Koala habitat'.

The subject site is considered highly likely to provide suitable habitat for the Koala and so potential impacts on the species with respect to the requirements of the EP&A Act have been assessed.

5.2.2 Potential impacts

The subject site contains an existing operational sand quarry, and has been subject to a range of impacts for over 100 years. The expansion of the quarry is not likely to involve any activities that vary from those currently employed on site (although the intensity of the operation will increase). As such, many potential impacts that would typically be associated with a new sand quarry development would have previously been realised.

The primary new impact associated with the proposed expansion is the clearing of 1.3 ha of native vegetation. This would reduce the area of the modified Pink Bloodwood - Red Mahogany Open Forest and Paperbark Swamp Forest vegetation types on the site, considered to be the EEC Swamp Sclerophyll forest, by approximately 1.3 ha. This would also reduce the area of habitat available within the subject site for threatened species. As there is an unavoidable residual impact, offsetting is likely to require further consideration in consultation with RVC.

Potential indirect impacts, such as habitat degradation have previously occurred or degrading processes are presently in operation at the site. Potential environmental impacts associated with quarry operations are to be managed by implementation of controls detailed within an EMP for the operation of the quarry. The EMP would also include controls to manage any potential indirect impacts upon Broadwater and Bundjalung National Parks.

Assessments of significance were undertaken for species recorded or that were considered highly likely to occur within the subject site against State and Commonwealth guidelines. The outcome of these assessments was that the proposed expansion would be unlikely to have a significant impact upon species, populations or endangered ecological communities or their habitats.

It is expected that with implementation of the management measures proposed a 'maintain or improve' outcome for the biodiversity values of the site could be achieved in the medium to long term.

Direct impacts

The proposed expansion would result in the clearing of approximately 1.3 ha of native vegetation and 11.3 ha of exotic grassland as shown in Table 5-2. Vegetation clearing in these communities would involve removal of non-threatened native plants, including mature hollow bearing trees.

Table 5-2 Vegetation clearing

Vegetation Type	TSC Act Status	Area Impacted (ha)
Coastal Heath on Sands of the North Coast	-	0.16
Modified Pink Bloodwood - Red Mahogany Open Forest	Swamp Sclerophyll Forest EEC	1.16
Paperbark Swamp forest	Swamp Sclerophyll Forest EEC	0.12
Exotic Grassland	-I	11.32
Disturbed Land	-	3.62
Waterbodies	-	4.99
TOTAL		21.4

Fauna, including threatened species, could be directly impacted by collision with quarry operation vehicles, and could be killed or injured as a result. However, due to the noise associated with the vehicles, the limited operating hours, and the speed limit, the risk of interaction with vehicles and subsequent mortality or injury is considered to be low.

A total of 22 hollow-bearing trees would be cleared, although these are proposed for retention within the site as logs on the ground to provide habitat for ground-dwelling fauna. These trees could currently provide nesting, denning and breeding habitat for a range of hollow dependent fauna species including the Brush-tailed Phascogale (*Phascogale tapoatafa*). In addition, these trees would also provide foraging habitat for Koalas.

Fauna species that occupy or utilise the habitats within the proposed expansion area will be displaced to other areas of habitat, however based upon the condition of the habitats, species that utilise the subject site are unlikely to be solely dependent upon any of the resources within the proposed expansion area.

Habitat fragmentation

The proposed development is not likely to increase the level of disturbance to connectivity within the locality from the levels already occurring through the operation of the current quarry. It is expected there will be a decrease in the amount of open woodland however this habitat type will remain *in situ* to the south, west and north of the proposed development. The habitat is already somewhat disconnected and fragmented and it is considered unlikely that the proposed development will increase this to any significant extent.

Fauna is unlikely to be displaced by noise, construction and other human activity as the site is currently operated as a quarry. Displaced terrestrial fauna are likely to move into the surrounding vegetation of greater habitat value with the potential to increase pressures on populations through interspecific competition for resources.

The proposed expansion would not directly disturb natural water bodies, drainage lines or freshwater wetlands. The waterbodies within the study area are artificial and currently provide a series of settlement ponds connected by drains relating to the ongoing quarry operations.

Indirect impacts

Due to the historical clearing and condition of the existing vegetation, the proposed expansion is not likely to create new edges as the clearing is wholly within the subject site where only scattered trees occur.

Noise pollution as a result of an increase in the level of activity of vehicles, machinery and excavation may deter native fauna from utilising the study area and immediate surrounding areas as habitat. The Proposal could affect the migration and dispersal ability of native fauna particularly in relation to noise and vehicular movements. The Proposal may result in increased noise pollution which has the potential to disrupt the breeding cycle and the foraging and roosting behaviour of some native fauna species.

Potential indirect impacts on terrestrial flora and fauna from construction activities are not considered likely to be significantly different from the existing dust and vehicle exhaust emissions generated from operational vehicles and equipment.

Quarry operation may increase the degree of weed infestation through dispersal of weed propagules (seeds, stems and flowers) into nearby areas of native vegetation via erosion (wind and water) and through construction vehicles.

Construction activities within the subject site have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*) and Myrtle Rust (*Uredo rangelii*) throughout the site through vegetation disturbance.

There is also some potential that the water drawdown that would occur as a result of the proposal may have an impact on terrestrial ecosystem partially dependant on groundwater that may occur adjacent to the site. However given the expected maximum rate of drawdown it is not considered likely that these impacts would be significant.

Duration of impacts

The expansion of the quarry is expected to result in permanent removal of native vegetation and habitats within the proposed footprint for at least the duration of the quarry operations. There is however potential for future rehabilitation of the site should quarrying cease in the future.

Indirect impacts, such as noise, light, dust and traffic are existing impacts, and these are intermittent impacts associated with quarry operations, and would continue to operate while the quarry is in operation.

Key Threatening Processes

KTPs are listed under the TSC Act, the FM Act and also under the EPBC Act. A number of KTPs are listed under more than one Act. Those potentially relevant to the proposed expansion are discussed in Table 5-3.

Table 5-3 Key threatening processes relevant to the proposed expansion

KTP	Status	Comment
Clearing of native vegetation	TSC Act; EPBC Act	Clearing of native vegetation has occurred historically within and around the subject site. The proposal would result in the clearing of approximately 1.3 ha of native vegetation. The vegetation to be removed is in moderate condition due to past clearing and agricultural activities. The clearing of this vegetation is not likely to significantly affect any threatened biota. The implementation of a Vegetation Management Plan is recommended to minimise impacts on native vegetation. The proposal would result in a minor increase in the operation of this KTP.
Loss of hollow-bearing trees	TSC Act	Past clearing at the site is likely to have resulted in a loss of hollow-bearing trees. At present there is a mixture of mature and immature vegetation within the proposal site. This KTP would be exacerbated by the removal of 22 hollow-bearing trees within the subject site.
Removal of dead wood and dead trees	TSC Act	There are small quantities of dead wood in the subject site that would provide habitat resources for native fauna. The EMP would include measures for the salvage and reinstatement of woody debris which would partially mitigate against the operation of this KTP. The proposal would result in a minor increase in the operation of this KTP.
Infection of native plants by <i>Phytophthora cinnamomi</i>	TSC Act; EPBC Act	Construction activities have the potential to introduce the root-rot fungus <i>Phytophthora cinnamomi</i> into the site, which could lead to dieback of vegetation. The implementation of a Vegetation Management Plan is recommended to limit impacts on native vegetation. The proposal is unlikely to increase the operation of this KTP.
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	TSC Act	Construction activities have the potential to introduce Myrtle Rust to the site. The implementation of a Vegetation Management Plan is recommended to limit impacts on native vegetation. The proposal is unlikely to increase the operation of this KTP.
Invasion of native plant communities by exotic perennial grasses	TSC Act	Exotic perennial grasses are present in high abundance within the study area. Construction activities have the potential to spread exotic perennial grasses within and surrounding the site, which could lead to the further invasion of this species into native plant communities. Weed control measures including decontamination of personnel and plant equipment prior to entering construction areas and establishment of appropriate sedimentation controls would be developed as part of the EMP. Provided these mitigation measures are implemented. The proposal is unlikely to increase the operation of this KTP.

Assessment of impacts upon Broadwater and Bundjalung National Parks

In accordance with the Australian Government, Matters of National Environmental Significance, Significant impact guidelines 1.1 under the EPBC Act (DoE 2013), consideration of potential indirect and offsite impacts from the proposal on the adjacent National Parks was carried out.

Given that the excavated material is sand which is quite coarse and relatively heavy, when compared to clay particles, it is unlikely that this material would travel any great distance in the wind. Should finer materials become airborne, the prevailing winds would transport these particles away from Broadwater and Bundjalung National Parks.

It is not considered that upstream impacts are likely to result from an extension of the existing quarrying activities. It is expected that quarry pits will fill, as has occurred with the existing pits, to groundwater level and remain at a consistent level with the existing lakes which is not considered likely to impact on the National Park.

Assessment of significance

One EEC, seven fauna species and one flora species were considered likely to occur within the study area.

The likely significance of impacts of the proposal on these threatened species and communities were assessed in accordance with the State government's *Threatened species assessment* guidelines (DECC 2007). Impacts on MNES were assessed in accordance with the EPBC Act significant impact guidelines (DoE 2013). Species assessed are listed in Table 5-4.

Table 5-4 Species assessed

Species or EEC	State assessment	Commonwealth assessment
<i>Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.</i>	Yes	N/A
<i>Rutidosia heterogama</i> (Heath Wrinklewort)	Yes	Yes
<i>Crinia tinnula</i> (Wallum Froglet)	Yes	N/A
<i>Erythrotriorchis radiatus</i> (Red Goshawk)	Yes	Yes
<i>Miniopterus australis</i> (Little Bentwing-bat)	Yes	N/A
<i>Miniopterus schreibersii oceanensis</i> (Eastern Bent-wing Bat)	Yes	N/A
<i>Phascogale tapatoafa</i> (Brush-tailed Phascogale)	Yes	N/A
<i>Phascolarctos cinereus</i> (Koala)	Yes	Yes
<i>Petaurus poliocephalus</i> (Grey-headed Flying-fox)	Yes	Yes
<i>Chalinolobus nigrogriseus</i> (Hoary Wattled bat)		N/A
<i>Saccolaimus flaviventris</i> (Yellow-bellied Sheath-tail-bat)	Yes	N/A
<i>Syconycteris australis</i> (Common Blossom-bat)	Yes	N/A
<i>Nannoperca oxleyana</i> (Oxleyan Pygmy Perch)	Yes	Yes

The proposed expansion is unlikely to have a significant effect on Swamp Sclerophyll forest EEC, due to the relatively small amount of this community that would be removed as a result of the proposed expansion, and the relative large extent of similar vegetation types that occur within the study locality.

The proposed expansion is unlikely to have a significant effect on *Rutidosia heterogama* (Heath Wrinklewort) due to the relatively small amount of potential habitat that would be cleared as a result of the proposed expansion, and the relative large extent of similar vegetation types that occur within the study locality.

It is considered that the proposal is unlikely to have a significant impact on any threatened fauna species that may occur within the site due to:

- Clearing occurring in a disturbed vegetation community that is currently grazed with cattle. It is not likely that there will be additional negative effects on the quality of habitats in the broader locality through edge effects, fragmentation of habitat and the disruption of fauna movement corridors more than are already present at the site.
- The presence of hollows in the open woodland to the south of the study area.
- The lack of structures that would pose a significant obstruction or hazard to birds or bats in the context of existing land uses in the locality.
- The area of potential habitat to be removed represents only a small fraction of similar available habitat in the locality.

Assessment of significance summary

Based upon the assessments of significance, it is concluded that it is unlikely that the proposed expansion of Doonbah Quarry would have a significant impact upon any threatened species, populations or endangered ecological communities or their habitats

5.2.3 Mitigation measures

The mitigation measures in relation to flora and fauna, not covered in other sections of the EIS, include the potential establishment of an offset area and the preparation of a Flora and Fauna Management Plan (FFMP).

Proposed offset

OEH or RVC do not have an official offsetting policy, so it is suggested that a suitable offset proposal be negotiated with RVC and the applicant, if required.

Alternatively, the offsetting could be arranged under the NSW BioBanking Scheme whereby credits of an appropriate vegetation community could be purchased to offset the residual loss required as part of the development. As an alternative to purchasing credits, a biobanking site could be established on or nearby the property in order to compensate for the necessary loss required by the development. Further details regarding BioBanking can be provided if required.

Flora and Fauna Management Plan

The FFMP should include the following:

- Delineation and protection of exclusion zones around native vegetation to be retained.
- Communication with operational personnel regarding the conservation value of surrounding habitats and their responsibilities with regards to protecting these habitats during operations.
- Hygiene procedures to prevent the introduction and spread of pathogens such as Phytophthora and Myrtle Rust in areas of native vegetation. These would include exclusion zones around retained areas of native vegetation and/or provision of machine and footwear washdown stations for all equipment and personnel working in areas of native vegetation.
- Proposed weed control methods and targeted areas and weed disposal protocols.
- Identification and mapping of sensitive receivers (such as native vegetation and water bodies) adjacent to the subject site.
- Identification of mature and/or hollow-bearing trees to be retained.
- Measures to reduce impact on hollow-bearing trees from operational traffic and equipment such as exclusion zones.
- A tree felling protocol, including pre-clearing surveys for nests or sheltering terrestrial fauna and rescue and salvage of fauna where possible, and progressive clearing approaches.
- Re-use of fallen trees with hollows within adjacent vegetation areas that are to be retained.
- Installation of hollows of appropriate sizes to facilitate use by the identified species likely to occur within the area.
- Measures to avoid impacts of the expansion upon Broadwater National Park, including exclusion zones for stockpiling and limitations on vehicle movements.

5.3 Noise and vibration

5.3.1 Introduction

A *Noise Impact Assessment* (NIA) (GHD, 2014c) was prepared to address the overall noise and vibration impacts from the proposed quarry. The scope of work for the NIA involved:

- A review of the surrounding study area to gain an understanding of local site features and the location and nature of potential sensitive receivers.
- A review of existing environmental studies, as applicable.
- Establishing project specific noise goals for the project, based on previous long term noise monitoring data at the site, with consideration to the following guidelines and standards:
 - NSW Industrial Noise Policy (EPA, 2000) (INP).
 - NSW Road Noise Policy (DECCW, 2011)
- A review of site operations to identify principal noise sources during operation and their corresponding sound power levels.
- Undertaking one noise modelling scenario for the operation using Computer Aided Noise Abatement (CadnaA) software to predict sound pressure levels emanating from the site based on operations at the production rate of 490,000 tpa.
- Undertaking one noise modelling scenario with the inclusion of noise mitigation measures with the aim of demonstrating compliance at the nearest sensitive receivers.
- Undertaking a desktop assessment of road traffic noise impacts from heavy vehicles entering/exiting the site on public roads.
- Providing a summary of the predicted results and outlining recommendations for in-principle noise mitigation measures, where exceedances are predicted.

A summary of the NIA is provided below and a copy of the NIA report is provided in Appendix E.

5.3.2 Existing conditions

Noise sensitive receivers in the vicinity of the site are detailed in Table 5-5. Figure 5-3 shows a site aerial image and the location of identified noise sensitive receivers. These receivers have been identified to represent those with the greatest potential for adverse noise impact.

Table 5-5 Identified noise sensitive receivers

Receiver	Receiver type	Single or double storey dwelling	Nearest quarry noise source	Approximate distance to nearest quarry noise source (m)
R1	Residential	Single	Access road	85
R2	Residential	Double	Access road	100
R3	Residential	Double	Access road	240
R4	Residential	Double	Dredge/loader	310
R5	Residential	Single	Dredge/loader	400
R6	Residential	Double	Dredge/loader	430
R7	Residential	Single	Cyclone/screen	460
R8	Residential	Double	Cyclone/screen	410
R9	Residential	Double (elevated single)	Cyclone/screen	580
R10	Residential	Double	Cyclone/screen	680
R11	Residential	Single	Cyclone/screen	640
R12	Residential	Single	Access road	90
R13	Residential	Single	Access road	470



Figure 5-3 Site location and noise sensitive receivers

Background noise monitoring was undertaken at two identified noise sensitive receivers between 9 and 21 October 2013.

Unattended noise monitoring results

A summary of calculated background L_{A90} and ambient L_{Aeq} (day, evening and night) noise levels for the monitoring periods are provided in Table 5-6 and Table 5-7 for Logger 1 and Logger 2 respectively.

Site observations at the monitoring locations indicated that the primary noise sources in the area were as follows:

- Intermittent road traffic on Woodburn – Evans Head Road.
- Natural noise sources such as insect and bird noise and wind noise in foliage.

Some quarry operations were occurring during the noise monitoring period. These included dredge operations and excavator and loader movements. No haul truck movements occurred during the monitoring period. It was observed that quarry noise was faintly audible at the long term monitoring locations, however was not contributing to the measured ambient noise levels.

Table 5-6 Summary of noise monitoring results – Logger 1, dB(A)

Date	Background L_{A90} dB(A)			Ambient L_{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Wed-9-Oct-13	39	30	25	49	47	44
Thu-10-Oct-13	38	36	24	48	52	41
Fri-11-Oct-13	40	34	21	50	50	42
Sat-12-Oct-13	35	34	27	49	52	41
Sun-13-Oct-13	37	34	27	49	54	43
Mon-14-Oct-13	40	26	28	50	47	45
Tue-15-Oct-13	38	29	26	49	47	43
Wed-16-Oct-13	36	32	24	48	52	46
Thu-17-Oct-13	37	33	28	47	50	44
Fri-18-Oct-13	39	35	27	49	45	41
Sat-19-Oct-13	35	38	33	49	51	45
Sun-20-Oct-13	35	37	27	48	51	43
RBL and Leq Overall	37	34	27	49	51	43

Table 5-7 Summary of noise monitoring results – Logger 2 dB(A)

Date	Background L _{A90} dB(A)			Ambient L _{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Wed-9-Oct-13	38	32	25	46	46	43
Thu-10-Oct-13	38	34	26	49	48	40
Fri-11-Oct-13	39	30	21	48	50	42
Sat-12-Oct-13	35	33	25	46	45	43
Sun-13-Oct-13	34	35	26	46	46	44
Mon-14-Oct-13	38	28	28	48	44	42
Tue-15-Oct-13	37	29	26	46	46	43
Wed-16-Oct-13	35	35	25	45	46	43
Thu-17-Oct-13	35	34	27	46	47	42
Fri-18-Oct-13	38	31	28	46	45	43
Sat-19-Oct-13	34	33	27	46	48	44
Sun-20-Oct-13	32	36	25	45	48	44
RBL and Leq Overall	36	33	26	47	47	43

Attended noise monitoring results

A summary of the attended noise monitoring results are provided in Table 5-8.

Table 5-8 Summary of attended noise monitoring results dB(A)

Monitoring location	Date	Measurement time		Measured noise levels dB(A)				Observations (instantaneous dB(A))
		Start	Stop	L _{Aeq}	L _{A90}	L _{Amax}	L _{Amin}	
Logger 1	9/10/2013	11:31	11:46	47	38	69	34	- Intermittent traffic noise on Evans Head road (38 – 51) - Doonbah quarry faintly audible (estimated <30) - Wind in foliage (34 – 42) - Birds (34 – 46)
Logger 2	9/10/2013	15:18	15:33	54	39	72	35	- Doonbah quarry faintly audible (estimated <35) - Wind in foliage (39 – 43) - Intermittent traffic noise on Evans Head Road (36 – 49) - Insects (34 – 35)

Noise criteria

Operational industrial noise criteria are derived from the *NSW Industrial Noise Policy* (INP) (EPA, 2000) INP. The intrusive, amenity and project specific levels are shown Table 5-9. The rural residential category was used to determine the amenity criteria for each sensitive receiver.

Table 5-9 Project specific operational noise criteria – daytime dB(A)

Criterion	Logger 1	Logger 2
Rating background level, LA90(Period)	37	36
Intrusiveness criteria, LAeq(15min)	42	41
Amenity criteria (rural), LAeq(period)	50	50
Estimated site contribution when operating, LAeq(period)	<35	<30
INP Table 2.2 modification 1	N/A	N/A
Project specific criterion, LAeq (15min)	42	41

1. Modification is based on existing industrial noise relative to the acceptable amenity noise level. Existing quarry noise (when operating) is less than acceptable noise level minus 6. Therefore no modification is made with consideration to Table 2.2 of the INP.

The *NSW Industrial Noise Policy* (EPA, 2000) INP requires that the noise level at residences be assessed at the most affected point on or within the residential boundary or, if this is more than 30 m from the residence, at the most-affected point within 30 m of the residence.

As a conservative measure, the lowest project specific noise criterion of 41 dB(A) $L_{eq(15\ min)}$ has been adopted at all identified noise receivers.

The *NSW Road Noise Policy* (EPA, 2011) (RNP) provides non-mandatory road traffic noise target levels for land use developments with potential to create additional traffic on public roads.

The road traffic noise target levels are presented in Table 5-10.

Table 5-10 RNP traffic noise target levels at residential receivers – dB(A)

Type of Development	Day (7 am – 10 pm)	Night (10 pm – 7 am)
Existing residences affected by additional traffic on existing sub-arterial roads generated by land use developments.	LAeq(15 hour) 60 (external)	LAeq(9 hour) 55 (external)

5.3.3 Potential impacts

Noise generation

Sand is primarily extracted through the use of a suction dredge positioned on one of the lakes within the site. Sand is then pumped onshore and stockpiled. As required, sand is screened and stockpiled or loaded by front end loader to haul trucks for removal from site.

Table 5-11 displays a list of identified noise generating equipment expected to operate on site and their corresponding sound power levels.

For the purposes of noise level predictions, it has been assumed that all equipment listed in Table 5-11 will be operating simultaneously at maximum levels over the modelled duration, however during any given period, the machinery items to be used at the site will most likely operate at maximum sound power levels for only brief stages. At other times, the machinery may produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all equipment would be operating at maximum sound power levels at any one time. Therefore predictions are considered to be conservative estimates.

Table 5-11 Noise sources and sound power levels

Noise source	Octave centre frequency (Hz) dB(A)								Lw dB(A)	Source of data
	63	125	250	500	1k	2k	4k	8k		
Excavator (35 T)	58	60	58	61	62	60	54	42	96	A
Dredge (Generator)	85	92	95	93	91	90	83	69	100	B
Screening plant	75	85	87	96	100	99	94	90	104	B
Front-end loader	63	64	74	70	70	70	65	56	106	B/C
Haul truck/Water cart (at 20 km/hr)	85	94	96	98	100	97	91	83	105	D
Water pump	63	75	73	81	83	84	84	78	89	B
Light Vehicles (at 20 km/hr)	73	67	70	68	73	78	78	77	84	C
Cyclone – Generator (100 kW)	60	71	79	84	86	85	82	75	91	D
Cyclone – pump (75 kW)	59	71	80	85	92	90	86	78	95	D
Water pump	63	75	73	81	83	84	84	78	89	B

A. Previous noise measurement data undertaken by GHD of similar plant.

B. On site noise measurement.

C. BS 5228.1 – 2009.

D. Engineering Noise Control, Third Edition, A. Bies and H. Hanson, 1998.

Operational noise model results

Noise model results indicate the operation is predicted to comply with the INP daytime noise criterion at most receivers, except for exceedances at receivers R1, R2, R3, R4, R5, R6, and R8 during some stages of operations. It is also noted that several receivers are very close, or equal to the adopted noise criterion.

An analysis of the model results leads to the following observations:

- Noise associated with the operation of haul trucks, the loader and the screening plant are the dominant noise source at most receivers.
- Noise from the movement of haul trucks is particularly dominant at receivers close to the haul road (R1, R2 and R3).
- Operation of the dredge impacts receivers during stages 1 and 4 of operations but has a lesser degree of impact in stages 2 and 3.

Figure 5-4 shows the predicted operational noise contour plots during Stage 1 when 70 vehicles per day are used.

Table 5-12 Predicted operational noise levels

Receiver	Criterion	Predicted noise levels L_{Aeq} dB(A)									
		Stage 1		Stage 2		Stage 3		Stage 4			
		Peak daily production	Average daily production	Peak daily production	Average daily production	Peak daily production	Average daily production	Peak daily production	Average daily production	Peak daily production	Average daily production
R1	41	45	44	45	44	45	44	45	44	45	44
R2	41	45	44	45	44	44	44	44	44	45	44
R3	41	43	43	43	42	43	42	43	42	43	43
R4	41	46	46	45	45	45	45	45	45	45	45
R5	41	42	42	41	41	41	41	41	41	42	41
R6	41	42	42	42	41	42	41	42	41	42	42
R7	41	40	40	40	40	40	40	40	40	41	41
R8	41	42	42	42	42	42	42	42	42	44	43
R9	41	39	39	39	39	39	39	39	39	40	40
R10	41	38	37	37	37	37	37	37	37	38	38
R11	41	37	37	36	36	37	36	37	36	37	37
R12	41	41	40	41	40	41	40	41	40	41	40
R13	41	36	35	35	35	35	35	35	35	35	35

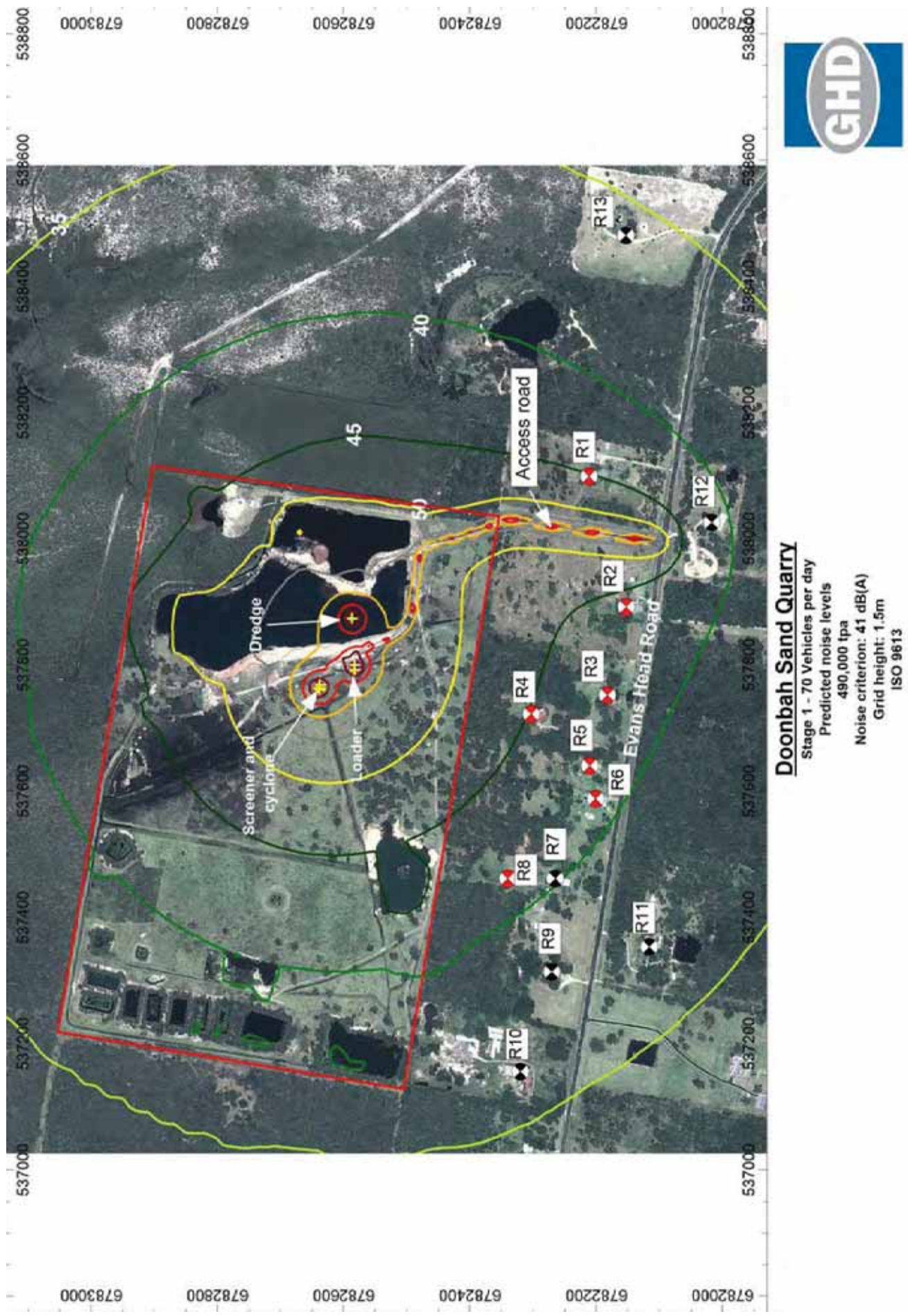


Figure 5-4 Predicted noise levels during Stage 1 at 70 vehicles per day

Road traffic noise

During operation, it is likely that there would be a maximum of five employees or plant operators on the site at any one time. This would yield a daily workforce traffic generation in the order of 10 vehicle trips per day (vtpd). It is assumed the majority of the workforce would arrive between 6:30 am and 7:30 am and depart generally between 4:00 pm and 6:30 pm.

Truck and dog trailer combinations have a capacity of about 32 tonnes. At an average daily production, which would generate a win and haul rate of approximately 1,600 tonnes, the quarry is expected to generate about 50 truck and dog loads or 100 truck movements per day. At its peak, the quarry is expected to win and haul about 2,250 tonnes per day which would involve about 70 truck and dog loads or 140 truck movements per day.

An assessment was made of the existing and future levels of road traffic noise from Woodburn – Evans Head Road. The predicted existing $L_{Aeq(15\text{ hour})}$ noise levels and the predicted future $L_{Aeq(15\text{ hour})}$ noise levels (due to the increase in traffic volumes associated with the operation of the quarry) are summarised in Table 5-13. The current predicted noise levels in Table 5-13 indicate that the daytime $L_{Aeq(15\text{ hour})}$ assessment criterion is currently exceeded at three receivers which are located in close proximity to the roadway (R2, R3 and R6). In these situations the RNP recommends that the proposed development does not increase road traffic noise levels by more than 2 dB.

Table 5-13 Predicted existing and future road traffic noise levels, dB(A)

Receiver	Traffic noise criterion $L_{eq(15\text{ hour})}$	Current Predicted noise level $L_{eq(15\text{ hour})}$	Future Predicted noise level $L_{eq(15\text{ hour})}$	Complies (yes/no)
R1	60	51	52	Yes
R2	60	63	64	Yes
R3	60	61	62	Yes
R4	60	47	48	Yes
R5	60	57	58	Yes
R6	60	62	63	Yes
R7	60	55	56	Yes
R8	60	49	50	Yes
R9	60	56	57	Yes
R10	60	54	55	Yes
R11	60	52	53	Yes
R12	60	53	54	Yes
R13	60	48	49	Yes

The predicted growth in traffic due to quarry operations would increase the existing traffic noise by approximately 1 dB(A) at all receivers. The RNP states that an increase of 2 dB(A) represents a level which is considered barely perceptible to the average person.

Despite road traffic noise predictions indicating compliance with the RNP criterion, heavy vehicle movements along the quarry access road and parts of Woodburn – Evans Head Road adjacent to sensitive receivers have the potential to generate annoyance. In particular bumps, pot holes or other irregularities in the roadway can cause short-term increased noise during vehicle pass-bys.

Vibration

Mobile machinery and haul trucks will generate vibration during their operations. Typically, vibration levels from these items are negligible at distances of 30 – 50 metres. Given there are no sensitive receivers within this distance, and the majority of operations are on a soft surface (sand) or water, vibration generated from quarry operations are expected to be negligible. No further assessment of vibration has been made.

5.3.4 Mitigation measures

Noise walls

In order to mitigate the noise impacts associated with the movement of vehicles to and from the quarry along the access road at receivers located close to the access road it is recommended that staged acoustic barriers (fencing) be erected, thereby providing shielding effects at these receivers. These barriers should be located as close as practicable to the haul road and positioned to intersect the line-of-sight between the noise source and receivers. The predicted model results indicate that:

- During peak daily production noise walls provide effective shielding at a height of 2.8 m.
- During average daily production noise walls provide effective shielding at a height of 2.0m.

The noise walls have been designed to achieve compliance with the adopted noise criterion at the most affected receivers under the modelled operating scenarios, as shown in Table 5-14.

Earth mounds

During peak daily production (140 truck movements per day) the following measures are recommended, in addition to the access road noise walls discussed above:

- A mound is erected in front of the screening plant. The mound would need to be approximately 3.5 m high and approximately 20 m long.
- A mound is erected in front of the loader. The mound would need to be approximately 4.5 m high and approximately 20 m long.
- A mound is erected adjacent to the haul route, within the access road gates. The mound would need to be approximately 2.5 m high and 150 m long.

During average daily production (100 truck movements per day) the following measures are recommended:

- A mound is erected in front of the screening plant. The mound would need to be approximately 3.5 m high and approximately 20 m long.
- A mound is erected in front of the loader. The mound would need to be approximately 4.5 m high and approximately 20 m long.
- A mound is erected along the western and southern banks of the lake during stage 1 operations. The mound would need to be approximately 1.0 m high and 150 m long. The mound would provide shielding from the noise associated with the dredge. The mound would only be necessary during stage 1 of operations, however, as the dredge moves further away from receivers as operations progress through stages 2, 3 and 4.

Figure 5-5 , Figure 5-6 and Figure 5-7 show the locations of the three noise mounds and Table 5-14 shows the mitigated noise levels. Where mounds are already partially constructed on site, these should be developed further in order to meet the height and length requirements detailed.



Figure 5-5 Noise mitigation scenario- peak daily production



Figure 5-6 Noise mitigation – average daily production – stage 1



Figure 5-7 Noise mitigation – average daily production – stages 2, 3 and 4

Table 5-14 Predicted operational noise levels - Mitigated

Receiver	Criterion	Predicted noise levels L _{Aeq} dB(A)							
		Stage 1		Stage 2		Stage 3		Stage 4	
		Peak daily production	Average daily production	Peak daily production	Average daily production	Peak daily production	Average daily production	Peak daily production	Average daily production
R1	41	41	40	41	40	41	40	41	40
R2	41	41	41	41	40	41	40	41	40
R3	41	39	39	39	39	39	39	39	39
R4	41	41	41	41	41	41	41	41	41
R5	41	38	38	37	37	37	37	38	38
R6	41	38	38	38	37	38	37	38	39
R7	41	37	37	37	37	37	37	38	39
R8	41	40	40	39	39	39	39	41	41
R9	41	37	37	36	36	36	36	37	38
R10	41	37	37	37	37	37	37	37	37
R11	41	34	34	33	33	33	33	34	35
R12	41	39	38	39	38	39	38	39	38
R13	41	35	34	35	35	35	34	35	34

Additional measures

The following measures are also recommended to assist in reducing potential impacts:

- Ensure operations do not begin before 7 am or continue after 6 pm, including vehicles arriving on site and leaving the site.
- As far as possible, materials dropping heights into or out of trucks should be minimised.
- All equipment would be selected to minimise noise emissions. Equipment would be fitted with appropriate silencers and be in good working order. Machines found to produce excessive noise compared to normal industry expectations would be removed from the site or stood down until repairs or modifications can be made.
- Machines found to produce excessive noise compared to industry best practice should be removed from the site or stood down until repairs or modifications can be made.
- To reduce the annoyance associated with reversing alarms, broadband reversing alarms (audible movement alarms) should be considered for all site equipment. Satisfactory compliance with occupational health and safety requirements would need to be achieved and a safety risk assessment may need to be undertaken to determine that safety is not compromised. Refer to Appendix C of the NSW Interim Construction Noise Guideline (OEH, 2009) for more information.
- Surfacing the haul road from the weighbridge to Woodburn – Evans Head Road would assist in reducing noise during haul truck movements. Although it is out of the control of Rixa Quarries, it would also be recommended to resurface or smooth Woodburn – Evans Head Road in areas adjacent to noise receivers. This would assist in minimising banging/bumping noise from haul trucks as they travel to and from the quarry, particularly when they are unloaded.

Work ethics

All site workers would be sensitised to the potential for noise impacts on local residents and encouraged to take practical and reasonable measures to minimise the impact during the course of their activities. This would include:

- Avoid the use of loud radios.
- Avoid shouting and slamming doors.
- Where practical, machines would be operated at low speed or power and switched off when not being used rather than left idling for prolonged periods.
- Keep truck drivers informed of designated vehicle routes, parking locations and delivery hours.
- Avoid dropping materials from height and avoid metal to metal contact on material.
- All engine covers would be kept closed while equipment is operating.

Community relations

Consultation and cooperation with the neighbours to the site will assist in minimising uncertainty, misconceptions and adverse reactions to noise. It is recommended the following community relation measures be implemented:

- The quarry manager would provide a community liaison phone number and permanent site contact so that noise complaints can be received and addressed in a timely manner.

- Upon receipt of a noise complaint, noise monitoring would be undertaken and reported as soon as possible. If exceedances are detected, the situation would be reviewed in order to identify means to attempt to reduce the impact to acceptable levels.

5.3.5 Compliance noise monitoring

Due to the marginal level of compliance at many receivers, it is recommended that compliance noise monitoring be undertaken during initial quarry operations to verify noise model predictions and confirm compliance with the adopted noise criterion.

5.4 Air quality and greenhouse gas emissions

To assess this impact an *Air Quality Impact Assessment* (AQIA) (GHD, 2014d) was prepared with a focus on dust and in accordance with the following scope:

- Desktop review of site plans, aerial photographs, and topographic maps to gain an understanding of the existing environment in terms of local terrain, existing/proposed operations and sensitive receptors within the study area.
- A review of available ambient air quality monitoring data to gain an understanding of existing air quality in the vicinity of the proposal.
- Determine applicable dust impact criteria with consideration to the NSW Approved Methods.
- Synthesis of a site-representative meteorological data file with which to gain an understanding of the local wind climate and use as model input for conducting atmospheric dispersion modelling.
- Derive a dust emission inventory for the proposed operations with which to identify significant sources of air pollution, in particular dust emissions, and estimate the emission rates for each item of equipment used on the proposal site. Then use this to undertake dust dispersion modelling using the regulatory atmospheric dispersion model Ausplume to predict the incremental dust impact from proposal operations at surrounding residences.
- Recommend targeted mitigation and management measures as required to reduce dust impacts from proposal operations and, if warranted, recommend dust monitoring programmes.

A summary of the AQIA is provided below and the full report is provided in Appendix F. An estimate of greenhouse gas emissions and mitigation measures have also been provided.

5.4.1 Existing conditions

Figure 5-8 shows a site aerial image and the location of identified sensitive receptors. These receptors have been identified to represent those sensitive receptors with the greatest potential for adverse dust impact.



Figure 5-8 Site location and identified sensitive receptors

The primary sources of particulate (dust) emissions for the area around Evans Head are likely to be general agricultural activities, dust and vehicle emissions from traffic along unsealed roadways and the Pacific Highway as well as smoke from domestic wood heaters or vegetation burn-offs or wild fires.

GHD expect that a reasonable representation of the ambient PM₁₀ 24-hour concentration levels would be in the order of 10 - 20 µg/m³ – the upper bound being what is typically encountered in much larger urbanised environments. An ambient PM₁₀ concentration of 15 µg/m³ has been adopted as the background level.

The transport and dispersion of the air emissions from the site will be influenced by prevailing synoptic wind flows and vertical temperature profiles that will alter both diurnally and with wind direction.

Long term weather data was sourced from the Bureau of Meteorology's (BoM) Evans Head RAAF Bombing Range Automatic Weather Station (AWS). This AWS is located approximately 10 km south of the site. Given the relatively flat land features in the area, weather data collected at this location is considered to be representative of weather conditions at the site and has been utilised in preparing this report. Cloud data from Ballina Airport was used for the stability classification (using the Turner Workbook approach allowed for in the *Approved Methods*) – this being the nearest site with ceilometer data and the same climatic zone.

Figure 5-9 and Figure 5-10 show the annual (all hours) and daytime (7 am to 6 pm) wind climate in the area. Prevailing winds are shown to be from the north and south, with the strongest winds most often from the south and southeast. Due to the nature of operations, the majority of dust generated at the site is during (daylight) operational hours when material handling and vehicle movements are occurring.

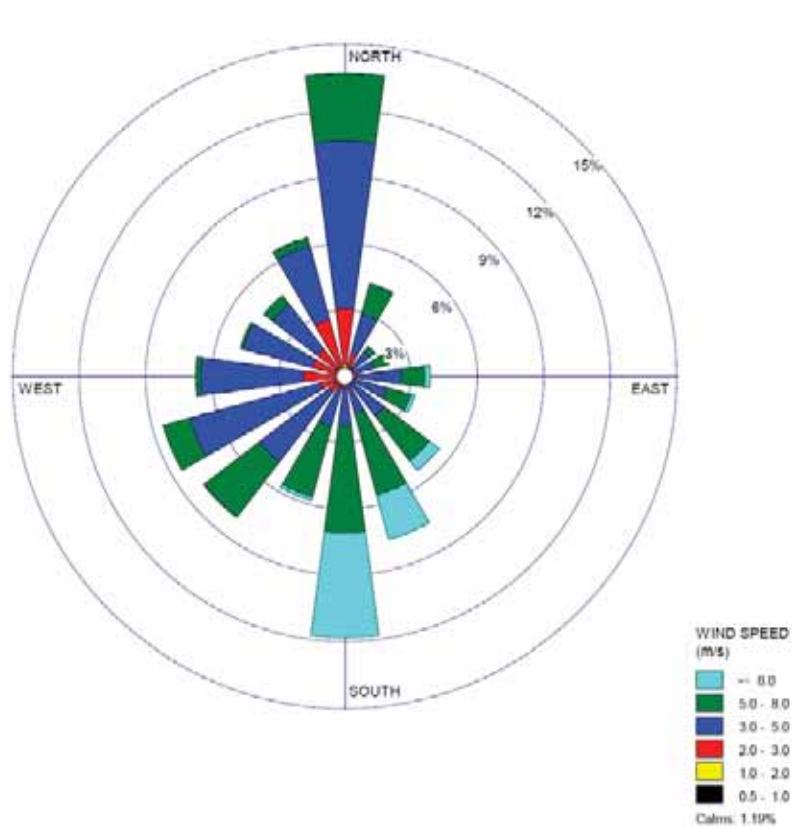


Figure 5-9 Evans Head annual (all hours) wind rose – 2011

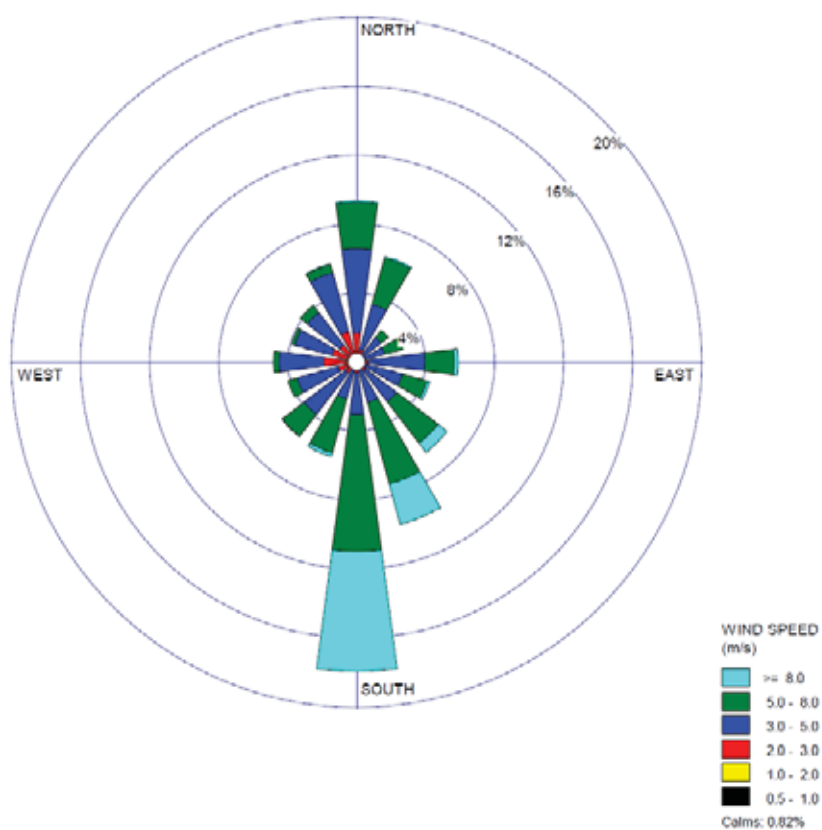


Figure 5-10 Evans Head daytime (7 am – 6 pm) wind rose – 2011

5.4.2 Potential impacts

The proposed quarry operation would be carried out in response to demand. It is therefore difficult to predict exactly how the extraction profile and footprint would progress.

Assessment criteria

Air quality impact assessment criteria are prescribed within the NSW OEH *Approved Methods*.

To ensure the environmental outcomes are achieved, dust emissions from premises must be assessed against the assessment criteria given in Table 5-15.

Table 5-15 Dust assessment criteria

Pollutant	Averaging period	Criterion
PM ₁₀	24 hours	50 µg/m ³
	Annual	30 µg/m ³
TSP	Annual	90 µg/m ³
Dust deposition (insoluble fraction)	Annual	2 g/m ² /month*

* *Maximum Increment. Maximum allowable cumulative impact of 4 g/m²/month.*

The above concentration criteria are provided as cumulative (incremental plus background) levels.

Proposed site operations

The individual processes that generate significant amounts of particulate matter (dust) were identified to be:

- Sand quarrying e.g. excavation.
- Material processing and handling e.g. screening and loading.
- Vehicle induced dust emissions on haul road.
- Wind erosion of exposed unstable soil surfaces and localised stockpiles.

The resource material is mostly near or below the water table. So much of the product handling will occur as a 'wet process' (dredging for example) although the initial excavation and materials handling after stockpiling will be at lower moisture levels.

The following assumptions were made in calculating the dust emission rates for proposal activities:

- The access road to enter and leave the site is unsealed.
- Truck and dog trailer combinations have a capacity of 32 tonnes. At the peak production rate of 2,250 tonnes per day, this equates to approximately 70 truckloads per day. As each haul truck would enter and exit the site, this equates to a maximum of 140 haul truck movements per day. At the average production rate of 1,600 tonnes per day, 50 truckloads would be required per day. Each haul truck was assumed to travel 640 m each way to enter and leave the quarry from Evans Head Road.
- The use of a water truck has been assumed not to generate dust emissions, as its use would act to suppress emissions. Therefore, the water truck has not been included in the emissions inventory.
- It was assumed that all the sand extracted, processed and stockpiled from the quarry is high in moisture content.

- It was assumed that 100% of the sand was processed (i.e. 205 tph at peak production input into the screener). GHD has conservatively assumed that the entire stockpile and processing area consists of unconsolidated areas. Therefore, wind erosion was modelled as acting over the entire pit area of 24,500 m² – even if a large part of the pit operations is by dredge in a fully submersed pit.

Table 5-16 and Table 5-17 summarise the emission factors adopted and calculated emission rates for each item of equipment and activity within the proposal area. Emission calculations have been supplied for:

- Peak production rate of 205 tph.
- Average production rate of 145 tph.

Table 5-16 Dust emission inventory – peak production 205 tph

Equipment	TSP Emission Factor	PM ₁₀ Emission Factor	Unit	Application / assumptions	Estimate of TSP Emission Rate (kg/hr)		Estimate of PM ₁₀ Emission Rate (kg/hr)	
					No controls	With controls	No controls	With controls
Excavator	0.025	0.012	kg/t	1 excavator, handling 205 tph. Extracting material. No control.	2.56	2.56	1.23	1.23
Screening plant	0.080	0.060	kg/t	205 tph of material processed. No control. Dry (but high moisture content) material.	8.18	8.18	6.14	6.14
Excavator	0.004	0.0017	kg/t	Stockpiling of processed material. Handling 205 tph. No controls.	0.41	0.41	0.17	0.17
Loader ⁽¹⁾	0.030	0.013	kg/t	1 loader, handling 205 tph. Loading material into haul trucks. 50% control applied when water sprays are used on screening plant and stockpiles are watered ⁽²⁾ .	6.14	3.07	2.66	1.33
Haul trucks (unsealed road)	3.880	0.960	kg/VKT ⁽³⁾	Maximum 140 truck movements per day. Haul route 640 metres. Equals 89.6 km per day total travel. (Only applicable to unsealed section.) • 75% controls for Level 2 watering (>2 L/m ² /hr)	34.8	8.69	8.60	2.15
Wind erosion								
Total hourly emission rate					52.1	22.9	18.8	11.0

(1) Loader processes include wheel generated dust emissions and fugitive emissions from loading of material into trucks.

(2) A 50% control factor applied when wet suppression used on screening plant. Moisture carry over would mean that processed material in stockpiles would also have higher moisture content. Stockpiles may also be watered.

(3) VKT: Vehicle Kilometres Travelled.

Table 5-17 Dust emission inventory – average production 145 tph

Equipment	TSP Emission Factor	PM ₁₀ Emission Factor	Unit	Application / assumptions	Estimate of TSP Emission Rate (kg/hr)		Estimate of PM ₁₀ Emission Rate (kg/hr)	
					No controls	With controls	No controls	With controls
Excavator	0.025	0.012	kg/t	1 excavator, handling 145 tph. Extracting material. No control.	1.82	1.82	0.87	0.87
Screening plant	0.080	0.060	kg/t	145 tph of material processed. No control. Dry (but high moisture content) material.	5.82	5.82	4.36	4.36
Excavator	0.004	0.0017	kg/t	Stockpiling of processed material. Handling 145 tph. No controls.	0.29	0.29	0.12	0.12
Loader ⁽¹⁾	0.030	0.013	kg/t	1 loader, handling 145 tph. Loading material into haul trucks. 50% control applied when water sprays are used on screening plant and stockpiles are watered ⁽²⁾ .	4.36	2.18	1.89	0.95
Haul trucks (unsealed road)	3.880	0.960	kg/VKT ⁽³⁾	Maximum 100 truck movements per day. Haul route 640 metres. Equals 64.0 km per day total travel. (Only applicable to unsealed section) • 75% controls for Level 2 watering (>2 L/m ² /hr)	24.83	6.21	3.14	1.54
Wind erosion								
Total hourly emission rate					10.4	6.30		

(1) Loader processes include wheel generated dust emissions and fugitive emissions from loading of material into trucks.

(2) A 50% control factor applied when wet suppression used on screening plant. Moisture carry over would mean that processed material in stockpiles would also have higher moisture content. Stockpiles may also be watered.

(3) VKT: Vehicle Kilometres Travelled.

Figure 5-11 and Figure 5-12 show the breakdown of emission sources from the proposed activities with and without controls such as water sprays. Emissions are based on an average production rate of 145 tph and assume an unsealed access road.

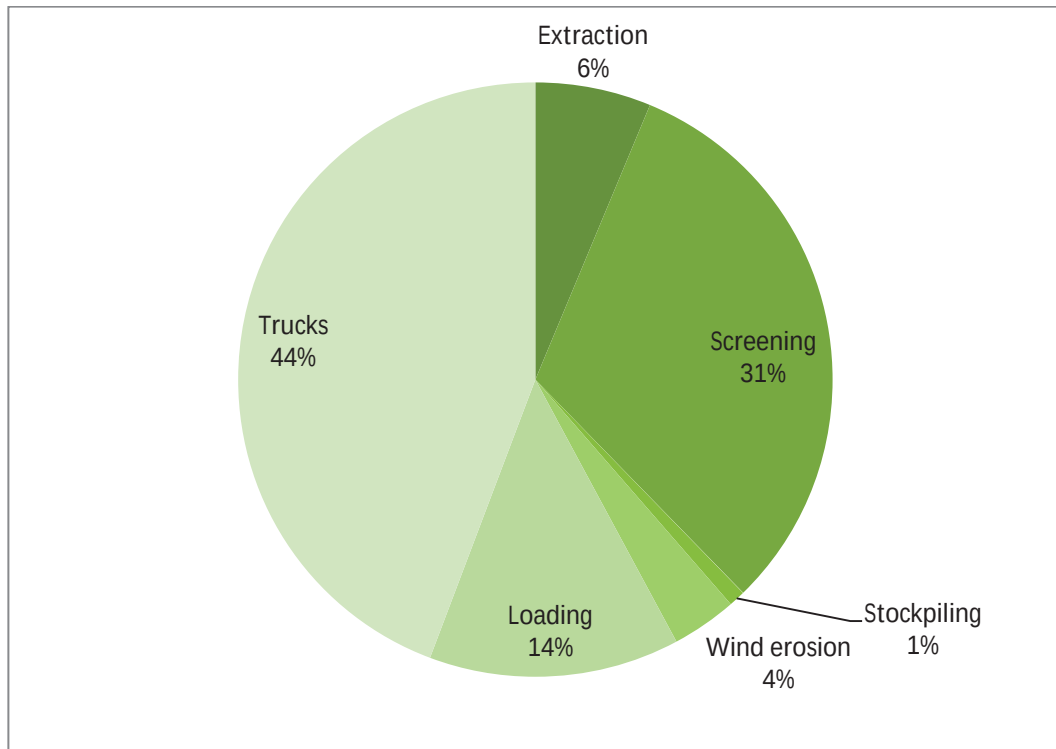


Figure 5-11 Breakdown of PM₁₀ emissions – no controls

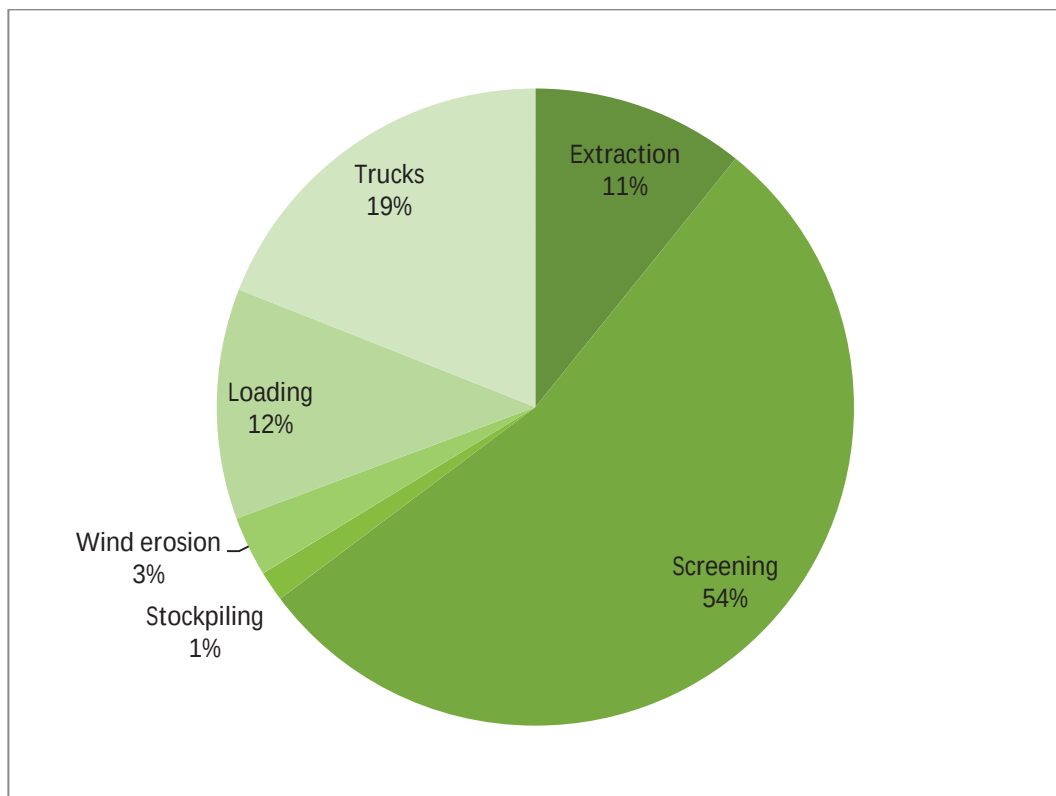


Figure 5-12 Breakdown of PM₁₀ emissions – with controls

Wind erosion is expected to contribute less than 4% of total site PM₁₀ emissions. Therefore, in general, over a 24-hour period, wind erosion is not considered to be a problem. However, the sudden onset of weather systems that involve sharp increases in wind speed can have the effect of quickly stripping the fine surface silt content from exposed non-vegetated or non-rehabilitated soil, particularly if the silt content on that soil is high through recent mechanical activity. If not dealt with pro-actively, this can cause short-term (in the order of minutes) peaks in inhalable dust concentrations. It is therefore recommended that the quarry manager be provided with daily weather updates (e.g. the Bureau of Meteorology have a standard daily service) that will contain warnings of the sudden onset of strong winds. In the event of such warning, the manager could then take steps to ensure that exposed areas that could reasonably be subjected to wind erosion are consolidated by the timely application of water sprays.

Other air emissions such as combustion products (e.g. vehicle exhaust) would also be present within the proposal site. However, due to the small number of vehicles and their limited time on-site, the potential for impact from these emissions is negligible. Therefore, vehicle exhaust emissions have not been considered further in this assessment.

Modelling

Atmospheric dispersion modelling was conducted to predict the maximum ground level concentrations (GLC) of dust (TSP and PM₁₀) resulting from emissions to air from the proposal. Dust deposition rates were also predicted. The predicted GLC's and dust deposition rates were then assessed against the relevant criteria.

Results included:

- Predicted results indicate there is potential for the 24-hour average PM10 criterion to be exceeded at a number of sensitive receptors without dust control measures at both average and peak production rates. Based on peak production rate of 2,250 tonnes per day, there is potential for the 24-hour criterion to be exceeded at two residences (R2 and R4), even with the implementation of dust control measures.
- Based on the average production rate of 1,600 tonnes per day, the 24-hour average criterion is predicted to be met at all but one receptor (R2) with the inclusion of dust control measures.
- Analysis of predicted results for peak production with control measures revealed that the frequency at which the adopted criterion was predicted to be exceeded is approximately five days per year at the most exposed receptors, based on the site-representative meteorology used.
- The proposal would operate at peak production (205 tph) only on occasion, and when it does, it is unlikely that this event would be coupled with the adverse (5 out of 365 days) meteorological conditions required to cause maximum off-site dust impact. Therefore, assuming dust control measures are implemented, short-term PM10 impacts off-site can be managed to the requirements of the Approved Methods.
- PM10 concentration levels over an annual average are predicted to be well below the adopted criterion.

Figure 5-13 to Figure 5-14 shows the maximum predicted ground level concentration contours for proposal operations at average production of 145 tph with and without dust control measures.

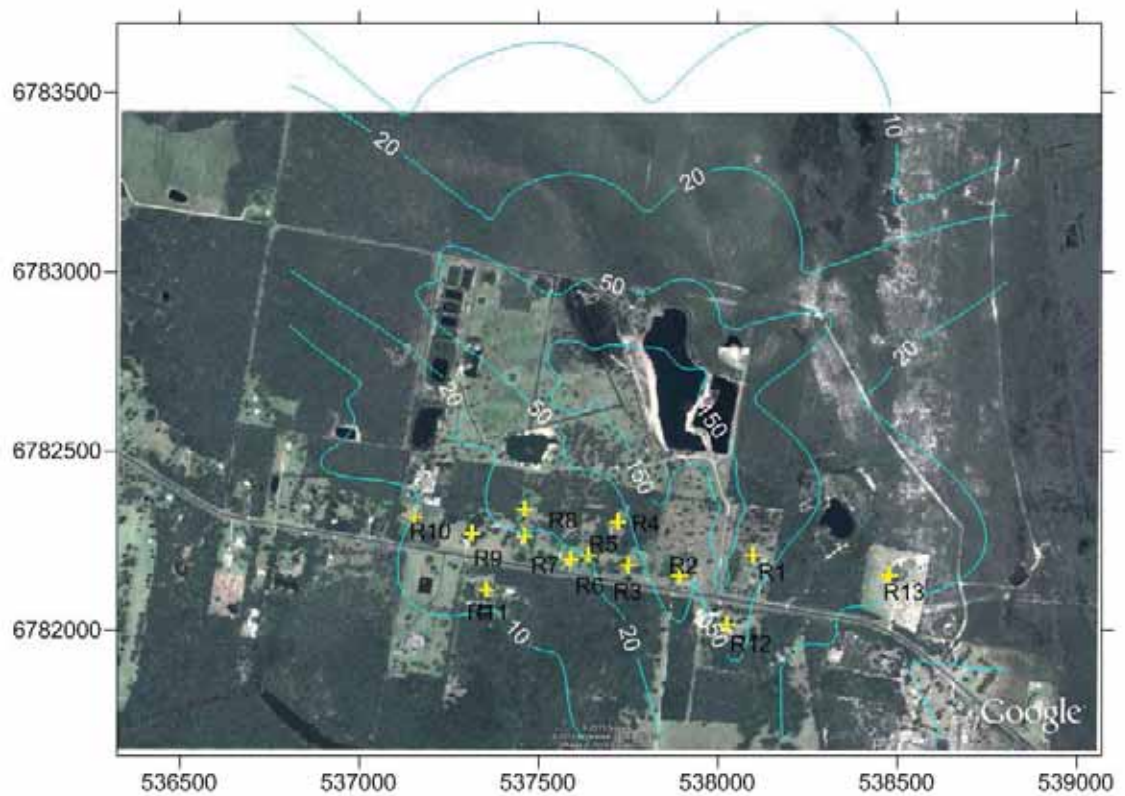


Figure 5-13 PM₁₀ 24-hour average highest concentrations, no controls (µg/m³)

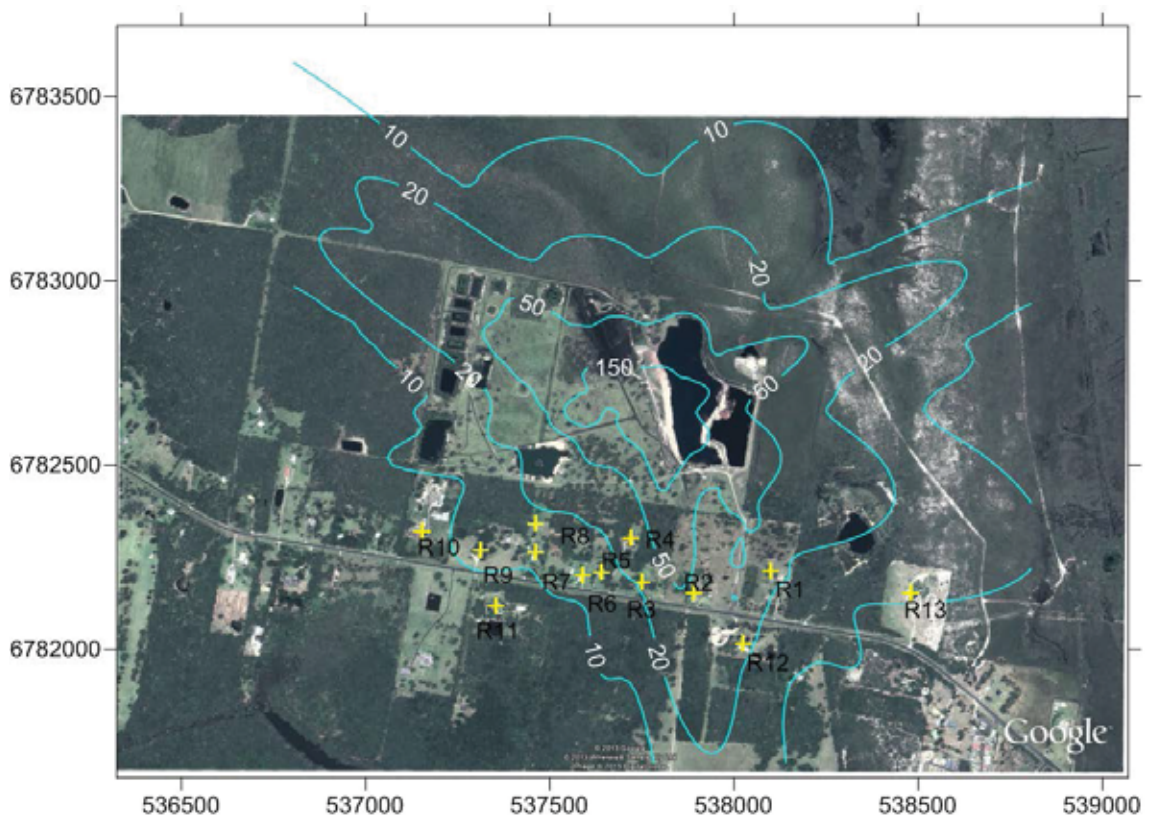


Figure 5-14 PM₁₀ 24-hour average highest concentrations, with controls (µg/m³)

Predictions of maximum ground level TSP concentrations were made based on peak and average production rates without dust control measures and an unsealed access road.

Modelling indicated that even without dust control measures, the predicted incremental impact at the most exposed sensitive receptor is well below the TSP criterion of $90 \mu\text{g}/\text{m}^3$. It is also evident from the results that even with the addition of a typical TSP background concentration of $30 \mu\text{g}/\text{m}^3$, the total (cumulative) impact would still be below the assessment criterion.

Dust deposition

Predictions of dust deposition rates were made based on the peak production rates and an unsealed access road.

In the absence of site-specific dust deposition data, a conservative background dust deposition level of $2 \text{ g}/\text{m}^2/\text{month}$ was adopted. The incremental dust deposition criterion of $2 \text{ g}/\text{m}^2/\text{month}$ is expected to be readily met at all identified receptors.

Future movement of activities within the proposal area

As the quarry working area progressively moves around the site, the signature of dust emissions from the site may also change. While the unsealed access road and location of the processing plant and stockpiles would not change, the dredge is mobile and would be moved to the active working area. Due to the infinite number of potential operating configurations on site, only one configuration has been assessed in this report, with processing equipment towards the centre of the site and the dredge located at the centre of stage 4 operations. The operation of the dredge is not expected to significantly contribute to the total air emissions from the site.

Based on the predicted dust impacts under worst-case operating conditions, the relocation of equipment around the proposal site is not anticipated to greatly affect the potential for adverse dust impacts at identified receptors. This is supported by the fact that the processing plant and haul routes have been identified as the primary sources of dust generation on site. The locations of the sources will not change as the quarry stages progress. However, when some quarrying activities (such as manual excavation using a mobile excavator) are located closer to off-site sensitive receptors, it would become increasingly important to implement appropriate dust control measures, particularly during dry and windy conditions (and when maximum, rather than typical, plant throughput).

5.4.3 Greenhouse gas

The greenhouse gas assessment estimated the emissions associated with construction activities and quarry operation (including downstream emissions) based on previous similar projects.

The following scopes of emissions were considered:

- Scope 1: Emissions from direct energy use.
- Scope 2: Indirect energy use from imports and exports of electricity, heat or steam.
- Scope 3: Limited to emissions associated with Scope 1 and 2 emissions and downstream emissions from the transportation of material from the quarry.

The greenhouse gas estimate considered emissions from the major emission sources during construction and operation activities as follows:

Construction emission sources:

- Fuel consumption during construction activities.
- Vegetation removal.

Operation emission sources:

- Fuel consumption during operation of the plant.
- Transport of product 50 km off site.

The greenhouse gas emissions are estimated to be approximately 44,500 t CO₂-e over a 20 year life (approximately 2,225 t CO₂-e per annum on average). Emissions associated with the transportation of material from the facility were estimated to be about 66% of emission for the proposal. The next greatest source of emissions at 32% was fuel consumption during operations.

The proposal emissions are minor compared with Australia's and New South Wales total GHG emissions. In 2011/12 Australia's greenhouse gas emissions were estimated as 554.6 Mt CO₂-e and New South Wales' greenhouse gas emissions were 154.7 Mt CO₂-e. The emissions from the proposal per annum would be approximately 0.001% of New South Wales' total greenhouse gas emissions and 0.0004% of Australia's total GHG emissions in 2010/11. Emissions during peak operation could be as high as double the average annual emissions. These high emissions would still be minor compared with total emissions for NSW and Australia.

5.4.4 Mitigation measures

General measures that will be implemented as part of the existing dust control management plan include:

- Rehabilitated areas will be revegetated as early as possible after completion.
- Newly stripped topsoil stockpiles will be immediately watered and revegetated with a grass cover or similar.
- Haul truck routes will be watered as required, particularly during peak periods of vehicle movements and extended dry spells.

Additional dust management measures are provided below in Table 5-18.

Table 5-18 General management of air emissions

Emission Source	Proposed Management
Dust generated from transport activities on-site and off-site	Use of water sprays/trucks and sprays to wet down access roads. Clean sealed roads at access and egress points regularly to minimise the re-suspension of dust on sealed roads. Continue to control on-site traffic by designating specific routes for haulage and access and limiting vehicle speeds to below 25 km/hr. All trucks hauling material should be covered before exiting the site and should maintain a reasonable amount of vertical space between the top of the load and top of the trailer.
Dust generated from loading, unloading and storage/stockpiling of material on-site	Use water sprays to minimise truck dust emissions. Ensure materials are appropriately stored and contained to prevent releases to the atmosphere (e.g. wind fences, water sprays).
Dust from wind erosion	Aim to minimise the size of storage piles where possible and re-vegetate inactive storage piles to assist in reducing wind erosion emissions. Limit cleared areas of land and clear only when necessary to reduce fugitive dust emissions. Re-vegetate cleared areas of land that are no longer used.
Reactive dust management	On days of peak production, coincidental adverse weather has potential to cause off-site impact. Visual monitoring of movement of dust plumes will indicate if downwind receptors have an elevated risk of over-exposure to dust. Additional watering or adjustments to operational activity, including temporary cessation of production during the gustiest wind conditions, can be used to limit short-term excessive dust load beyond the site boundary.

Mitigation measures to reduce greenhouse gas emissions are:

- Opportunities for the use of biodiesel should be further investigated and used where possible
- Efficient plant and vehicles would be used where reasonable and feasible to do so.

5.5 Traffic

To assess the impact of the increased vehicle numbers a *Traffic Impact Assessment* (GHD, 2014e) (Appendix H) has been prepared in accordance with the Roads and Maritime Services (RMS) *Guide to Traffic Generating Developments* (October 2002) (GTGD).

5.5.1 Existing conditions

Key roads in the surrounding area include the Woodburn Evans Head Road, and Alfred Street.

Woodburn Evans Head Road

Woodburn Evans Head Road is a classified road owned by Richmond Valley Council, but maintained by the NSW Roads and Maritime Services. It is a two-way single carriageway road and provides access from the Pacific Highway and the township of Woodburn to Evans Head, running generally east-west. The road has an 80km/hr speed limit, recently reduced from 100 km/hr.

The roadway is approximately 7.5m wide, generally with grassed verges and table drains and no road shoulders.

Alfred Street

Alfred Street is the western extension of Woodburn Evans Head Road, and connects to the Pacific Highway in the town of Woodburn. The intersection with the Pacific Highway is a T-intersection, with a channelised right turn and auxiliary left turn lane provided. There are no acceleration lanes on either departure, although traffic speeds on the Pacific Highway through Woodburn are relatively low. Traffic exiting Alfred Street is controlled by a give way sign.

Alfred Street is signposted at 50km/hr and provides direct property access for residential properties. The road is generally level and has a straight alignment between the Pacific Highway and Grafton Street. One travel lane is provided in each direction, with approximate lane widths of 3 metres.

South of the Grafton Street intersection, Alfred Street curves to the east and intersects with Wagner Road. East of this intersection, Alfred Street becomes Woodburn Evans Head Road.

An alternate, but less direct, route between the Pacific Highway and Woodburn Evans Head Road is available via Whyratta Street, Woodburn Street and Wagner Street.

Doonbah Quarry access

The access to the existing Doonbah Quarry is located on Woodburn Evans Head Road, approximately 4.4 kilometres east of Wagner Street. This access is directly opposite a private driveway. The westbound lane has been widened to allow a vehicle to bypass another vehicle waiting to turn right into the site (Figure 5-15).

The access road is 6.5 metres wide at the intersection, with a wide splay. A gate restricts access into the site (Figure 5-16). The access road is sealed for approximately 80m from Woodburn Evans Head Road.



Figure 5-15 Existing site access, looking west



Figure 5-16 Site access road and gate

Daily traffic volumes

Richmond Valley Council provided traffic data for Woodburn Evans Head Road. This data is shown in Figure 5-16.

Table 5-19 Woodburn Evans Head Road traffic data

Year	Location	Average Daily Traffic Volume ¹	%HV	85 th percentile speed	Peak Hour (2-way)
2013	East of quarry	2,691	7.0%	86.8 km/hr	255
2013	West of quarry	2,675	4.9%	86.4 km/hr	255

Doonbah Quarry traffic

The traffic accessing the existing quarry varies considerably based on demand. Under the current extraction rates, the number of heavy vehicles accessing the site generally ranges from one to ten per day (2-20 vehicle movements).

There were no crashes recorded in the vicinity of the quarry access.

Other transport modes

Northern Rivers Bus Lines operates public bus services between Evans Head and Ballina, and Evans Head and Lismore. There are 5 daily services from Evans Head, and 6 returning to Evans Head. There are also daily school bus services that use Woodburn Evans Head Road.

There is no provision for cyclists on Woodburn Evans Head Road.

There is no provision for pedestrians on Woodburn Evans Head Road.

5.5.2 Potential impacts

Quarry operations

During operation, it is likely that there would be a maximum of five employees or plant operators on the site at any one time. This would yield a daily workforce traffic generation in the order of 10 vehicle trips per day (vtpd). It is assumed the majority of the workforce would arrive between 6:30 am and 7:30 am and depart generally between 4:00 pm and 6:30 pm.

The typical tasks requiring heavy vehicle movements during operation are:-

- Export of material for customer orders
- Import of rock, topsoil or landscaping products for blending.

The quarry is expected to operate for 40 weeks per year. This allows for equipment breakdowns and wet weather.

The hours of operation would depend on demand, with some periods of high activity and other times when activity is limited to the occasional loading of haulage trucks. The proposed hours of operation are:

- Weekdays - 7.00am - 6.00pm
- Saturdays - 8.00am - 1.00pm
- Saturday afternoons and Sundays – maintenance only
- Public holidays - No work

¹ Average Daily Traffic (ADT) volume is the average volume of traffic recorded at a point each day over a specific period. Note that AADT (Annual Average Daily Traffic) requires a 12-month count, or an understanding of seasonal variations in traffic volumes across the year.

Operation phase traffic volumes

The traffic generated by the proposal will vary based on material demand.

At its peak, the quarry is expected to win and haul about 2,250 tonnes of material per day. An average rate of production would be approximately 1,600 tonnes per day.

Truck and dog trailer combinations, with a capacity of approximately 32 tonnes, would be used. The peak rate of truck activity would be approximately 70 trucks per day (140 daily truck movements). The number of movements may be reduced through the use of back-loading, with some trucks bringing in blending material as well as taking export material out, rather than separate trucks required for each task. The use of haulage vehicles to return to site with imported blending material will, where feasible, reduce the number of truck movements.

Impact assessment

At its peak, the quarry would be expected to generate 140 truck movements per day, and 10 staff movements. Current levels of activity are around 20 truck movements per day.

As a result of the proposal, daily traffic volumes on Woodburn Evans Head Road would be expected to increase from the existing average of 2691 vehicles per day to some 2821 vehicles per day. This level of activity would represent an increase of some 5% on the current traffic volumes on Woodburn Evans Head Road. The proportion of heavy vehicles on Woodburn Evans Head Road would increase from 7% currently to approximately 11%, as shown in Table 5-20.

Table 5-20 Impacts on traffic volumes: Woodburn Evans Head Road

Scenario	Total Vehicles	Light Vehicles	Heavy Vehicles	% HV
Existing	2691	2501	190	7%
Less current quarry activities	20		20	
Plus Proposal	150	10	140	
Future	2821	2511	310	11%

The existing access road is relatively narrow and does not allow for inbound and outbound vehicles to pass each other without leaving the formed roadway. With the proposed increase in truck activity, there will be increased potential for trucks to meet each other on the access roadway. This could result in degradation of the road edges, and deterioration of the roadway surface.

An assessment of the intersection with the Austroads Guide to Road Design Part 4A indicated that even with background growth in traffic volumes on the Woodburn Evans Head Road, or with an increase in the volume of truck activity at the quarry, this type of intersection is likely to be suitable for many years to come.

There is, however currently no widening of the eastbound lane on approach to the intersection. It is appropriate for some widening to be provided at this location, to allow left-turning trucks to begin the movement out of the eastbound through lane earlier than is currently possible.

Sight lines are good in both directions, and significantly exceed the requirements for sight distance specified in the Austroads Guide to Road Design Part 4A.

Haulage of quarry materials would primarily be between the site and the Pacific Highway via Woodburn Evans Head Road, for distribution onto the wider network. Precise routes will depend on the location of works utilising quarry outputs.

It is unlikely that a formal road safety audit process will identify any major issues with this section of road. However, if required by Council, a Road Safety Audit of the proposed haulage route should be completed prior to commencement of haulage activities.

It is noted that there is the potential for a 'rat run' through Woodburn. The use of this route by haulage vehicles may create a hazard on narrow residential streets adjacent to Woodburn Primary School. It is recommended that haulage vehicle drivers be directed to use only Alfred Street to travel between the Pacific Highway and Woodburn Evans Head Road.

The quarry site is remote from any source of vulnerable road user (pedestrians and cyclists) activity. Given the relatively low traffic volumes on the road, the scale of traffic increase expected, and the physical characteristics of the road that provide for good forward sight distance, there is not expected to be any deterioration in safety for pedestrians or cyclists. Similarly, there will be no direct impact on any existing bus stops, or bus services.

Schools, with associated school zones, are located in Woodburn and Evans Head. It is recommended that trucks en route to or from the quarry should avoid travelling through the school zone on Woodburn Street (Woodburn Primary School). There may be an increase in traffic travelling through the school zone on the Pacific Highway side of the school, but this remains the most appropriate route for this traffic.

Haulage activity is unlikely to impact directly on the school zone outside the Evans Head school.

The quarry area will be accessed via the access road, with a weighbridge proposed at the entry to the quarry area. A site office and amenities block will be located nearby. At this location, there is expected to be sufficient space for the manoeuvring and parking of staff vehicles, and other site vehicles as required.

Traffic movement within the quarry will depend on the area being excavated at the time. Vehicle access paths will be established to suit the specific activities being undertaken.

5.5.3 Mitigation measures

To minimise potential impacts to traffic and access due to the proposal, the following measures are required:

- Subject to detailed survey, upgrade of the existing quarry access intersection to provide a BAL-type treatment for left turns into the site.
- Passing bays are to be provided on the quarry access road to minimise potential conflict between inbound and outbound traffic, and to minimise damage to the road edge.
- A 10km/hr speed limit is to be maintained on the access road to the quarry to minimise dust production by traffic entering and leaving the quarry.
- Heavy vehicle access between the Pacific Highway and the quarry should be via Alfred Street. Haulage trucks should not use the route via Woodburn Street and Wagner Street, to avoid impacts on the Woodburn Primary School and the surrounding residential area.
- As a result of the proposal, no potential road safety issues were identified and it is considered a Road Safety Audit is not warranted at this stage.
- Where practicable, haulage vehicles should be backloaded to carry loads on both inward and outward journeys, to minimise vehicle movements.

5.6 Heritage

5.6.1 Introduction

Everick Heritage Consultants Pty Ltd (Everick) prepared a *Cultural Heritage Due Diligence Assessment* (Everick, 2014) for the proposed quarry expansion. The assessment, contained in Appendix I and summarised below, addressed both historic (non- Indigenous) and Aboriginal cultural heritage.

5.6.1 Existing conditions

Aboriginal Heritage

A Due Diligence Assessment was carried out in accordance with the relevant administrative and legislative standards for NSW. The methods employed in this assessment included:

- Searches of applicable Indigenous heritage registers
- A review of current and historic satellite imagery
- Archaeological survey of the Project Area
- Desktop assessment
- Assessment of the Project Area in accordance with the Due Diligence Code
- Reporting of findings and recommending management strategies

A search was conducted of the OEH Aboriginal Heritage Information Management System centring on the Project Area with a 1000 m buffer. There are no sites registered on the AHIMS register within the proposed expansion to the Doonbah Quarry extraction areas.

The Due Diligence Code identifies particular landforms as having a higher potential to contain archaeological sites. Ridgelines, elevated areas adjoining alluvial plains, dune fields and river/creek foreshores for example, are known to have a higher association with Aboriginal archaeological sites than slopes and seasonally or permanently inundated wetlands. The Project Area is cleared and drained former swamp forest in the midst of seasonally inundated marsh and swamp. The Evans River is approximately 1km to the south where Aboriginal campsites are more commonly found in the form of artefact scatters, middens, scarred trees, ceremonial grounds. The courses of rivers and creeks were also commonly transit corridors through the vast swamps that characterise the coastal plain of this locality, prior to European settlement.

The review of *Previous Aboriginal Archaeological Assessments* for this area indicated that all Aboriginal archaeological sites to date, between the Richmond River the Evans River and Iluka have been identified on high ground features e.g. Cooks Hill Broadwater, coastal dune fields and estuarine foreshores. Scarred trees are the most common if only type of site to be found in wetland/swamp conditions. Wetlands specifically do not have the landscape characteristics that would warrant an assessment of moderate to high potential for archaeological sites, as might a ridge or spur line or elevated level areas close to water and food/material resources. There are no particular parts of the Project Area which because of access to permanent water, food or material resources would make the areas 'attractive' as camp sites or 'lucrative' as a source of a particular resource. As Doug Wilson Bunjalang Traditional Owner stated during the field survey, referring to the Project Area "...my people didn't camp in wetlands..." (Doug Wilson pers comm).

Ethnographic sources quoted in McBryde (1978) by Campbell, Sullivan and Pierce, indicate the coastal wetlands/swamps as distinct from sand rises and dune fields, were exploited by Aboriginal People for raw material procurement of wood/fibre, medicinal plants and a vast catalogue of birds, reptiles and terrestrial animals. Access to these resources was via established transit corridors the Evans River and or the dune fields to the east. The archaeological evidence for these activities within extant or former wetlands/swamp is restricted to a small number of scarred trees. There can be no doubt that a background scatter of stone artefacts lost or broken may be randomly scattered throughout the area. However devising a strategy to recover such items prior to the proposed extension to sand extraction is impractical and would be purely speculative. While the topography may not have altered to a marked degree, with the exception of drainage excavations and top soil/sand spreading, the current vegetation regime within the Project Area bears no resemblance to the original mosaic. Therefore it is impossible to draw specific conclusions as to whether the Project Area contained flora and fauna resources of significance to Aboriginal people.

As a result of a desktop study and field inspection of the proposed expansion to the Quarry extraction areas and consultation with Bogal LALC Sites Officer Daryl Knight and Bundjalang Traditional Owner representatives Doug Wilson and Lewis Williams, the following were agreed to:

- No Indigenous cultural heritage sites or relics were identified within the proposed expansion to the Doonbah Quarry extraction areas.
- No areas have been identified that are considered to potentially contain subsurface deposits of significant Aboriginal heritage.
- All of the Project Area has been disturbed in a manner which constitute 'disturbance' within the meaning of the Due Diligence Code and is consistent with the Due Diligence Code.
- The Bundjalang Traditional Owners and Bogal LALC representative agreed in discussion that no further Aboriginal cultural heritage investigation was required.

Historic cultural heritage

The following heritage databases were reviewed 11 March 2014 to assess the potential for non-Indigenous heritage attributes within the Richmond Valley LGA and specifically for the Doonbah area:

- The World Heritage List: Contains no historic heritage listings within or within close proximity to the Project Area.
- Register of the National Estate: returned four (4) historic heritage listings all of which were located in Woodburn, with the closest being the Broadwater National Park, situated northeast of the Project Area.
- Commonwealth Heritage List (Australian Heritage Council): Contains no historic heritage listings within or within close proximity to the Project Area.
- The National Heritage List (Australian Heritage Council): Contains no historic heritage listings within or within close proximity to the Project Area.
- The National Trust Register: Contains no historic heritage listings within or within close proximity to the Project Area.
- The State Heritage Register (NSW Heritage Office): Contains no historic heritage listings for Doonbah. One historic heritage item is listed for Evans Head under Section 1 (Heritage Council) and will not be impacted by the Project. Section 2 (Local Councils,

Shires and State Agencies) lists one item for Evans Head and seven listings for Woodburn, none of which will be impacted by the Project.

- Richmond Valley Local Environment Plan 2012: Contains no historic heritage listings for the Doonbah area. Seventeen items are listed for Evans Head and twelve items are listed for Woodburn, none of which will be impacted by the Project.

A historic heritage field survey indicated there are no places of historic heritage listed in heritage lists or have there been places of historic heritage found within the Project Area as a result of the field survey.

5.6.2 Potential impacts

A potential impact exists for previously unrecorded Aboriginal sites uncovered during the excavation activities however the potential impact on potential Aboriginal sites in that area is deemed to be minimal.

The desktop review concluded that no historically significant cultural heritage sites would be impacted by the Project.

5.6.1 Mitigation measures

- If it is suspected that Aboriginal material has been uncovered as a result of earth working activities within the Project Area:
 - Work in the surrounding area is to stop immediately.
 - A temporary fence is to be erected around the site, with a buffer zone of at least 10 metres around the known edge of the site.
 - An appropriately qualified archaeological consultant is to be engaged to identify the material.
 - If the material is found to be of Aboriginal origin, the Aboriginal community is to be consulted in a manner as outlined in the OEH guidelines: Aboriginal Cultural Heritage Consultation Requirements for Proponents (2010).
- If Aboriginal cultural materials are uncovered as a result of development activities within the Project Area, they are to be registered as Sites in the AHIMS database managed by the OEH. Any management outcomes for the site will be included in the information provided to the OEH.
- If human remains are located at any stage during earthworks within the Project Area, all works must halt in the immediate area to prevent any further impacts to the remains. The location where they were found should be cordoned off and the remains themselves should be left untouched. The nearest police station (Woodburn), the Bogal LALC, Bangalang Traditional Owners and the OEH Regional Office (Coffs Harbour) are to be notified as soon as possible. If the remains are found to be of Aboriginal origin and the police release the scene, the Aboriginal community and the OEH should be consulted as to how the remains should be dealt with. Work may only resume after agreement is reached between all notified parties, provided it is in accordance with all parties' statutory obligations.
- In the unlikely event that Aboriginal cultural heritage is identified during Project works, it is recommended that all effort must be taken to avoid any impacts on Aboriginal Cultural Heritage values. Should a situation arise where impacts to Aboriginal cultural heritage is unavoidable, mitigation measures should be negotiated between the Proponent, OEH and the Aboriginal Community.

There are no recommendations with regard to historic heritage. The Project does not impact on places of historic heritage significance

5.7 Visual amenity

A visual impact assessment reviews the existing visual character of the site and its surrounds, the expected impacts of the quarry on the existing visual character of the surrounds, nearby existing residences and publicly accessible locations. More specifically, the visual assessment considers the following:

- Existing views to the proposed site
- The visual character of the surrounding landscape
- The sensitivity of the landscape to alteration by the proposal
- The visual character and extent of the proposed expansion of the quarry
- Viewer sensitivity to alteration of the environment by the proposal

5.7.1 Existing conditions

The site is located approximately 350 metres north of the Woodburn-Evans Head Road. The site is relatively flat and is visually dominated by current quarrying machinery and stockpiles of quarried material from the construction of dams and drainage channels. Although the site also contains two 'lakes' (existing quarry), a settling pond, several drainage channels and several man-made dams, these are not readily visible from offsite due to being below the ground level.

The site is surrounded primarily by undeveloped bushland and National Park to the north and east and grazing land (farm land) immediately to the west. No identified visual receptors exist to the north, east or west of the site.

Visual receptors in the form of residential properties are located along the Woodburn-Evans Head Road to the south of the site as shown in Figure 5-17. These properties are primarily rural residential in nature.

Table 5-21 Identified potential visual receptors

Receiver	Receiver type	Nearest potential visual impact	Approximate distance to nearest visual impact (m)
R1	Residential	Access road, stockpiles, machinery	85
R2	Residential	Access road, stockpiles, machinery	100
R3	Residential	Access road, machinery	240
R4	Residential	Access road, stockpiles, machinery	310
R5	Residential	Stockpiles, machinery	400
R6	Residential	Stockpiles, machinery	430
R7	Residential	Access road, stockpiles, machinery	460
R8	Residential	Access road, stockpiles, machinery	410
R9	Residential	Negligible	580
R10	Residential	Stockpiles, machinery	680
R11	Residential	Negligible	640
R12	Residential	Access road, stockpiles, machinery	90
R13	Residential	Negligible	470



Figure 5-17 Potential visual receivers

5.7.2 Potential impacts

The proposal would increase the area of the current excavation by approximately 12 hectares and increase the depth of the excavation by approximately 11 metres, effectively increasing the extent of the lake currently found onsite. The vegetation in the southern portion of the site provides a visual barrier.

Potentially negative visual impacts may result from the following:

- A larger number of stockpiles
- Larger sized stockpiles
- Larger numbers of machinery
- More truck movements
- Dust (as addressed in Section 5.4)

Photographs showing the views of the site (as available during the site inspection) are presented in Figure 5-18 to Figure 5-23.

The photographs and site inspection were used to determine the potential visual impacts of the quarry on affected public locations and properties. Sensitivity and magnitude measures as shown in Table 5-22 using the rankings defined in Table 5-23.

Table 5-22 Visual impact matrix

Assessment Factors	Criteria	Definition	Rating
Sensitivity	Duration of View		
	Long Term	> 1hr	H
	Moderate Term	10 minutes to 1hr	M
	Short Term	< 10 minutes	L
	Number of Viewers		
	High	>1000	H
	Moderate	100 - 999	M
	Low	<100	L
	Viewer Sensitivity (Type)		
	Resident		H
Magnitude	Pedestrian / Cyclist / Visitor		M
	Motorist		L
	View Distance		
	Short	<500m	H
	Medium	500m - 1km	M
	Long	>1km	L
	Surrounding Landscape		
	Pristine Landscape		H
	Moderately Modified Landscape		M
	Significantly Modified Landscape		L

Table 5-23 Visual impact ratings

Rank	Description
High	The proposal would be the dominant feature in the landscape and would significantly affect and change its character
High to Moderate	The proposal would form a significant and immediately apparent part of the landscape that affects and changes its character
Moderate to Low	The proposal would form a visible and recognisable new element and may be readily noticed by the observer
Low	The proposal constitutes a minor component of the wider view
Negligible	Only a small part is discernible or at such a distance that it is scarcely appreciated
None	No part of the proposal is discernible



Figure 5-18 View of existing quarry operation from Woodburn-Evans Head Road, between R2 and R3, looking north



Figure 5-19 View of existing quarry operation from the quarry entrance, looking north



Figure 5-20 View of existing quarry operation from quarry access road to the north west of R1, looking north west



Figure 5-21 View of existing quarry operation from the southern portion of the site, adjacent to R8, looking north east



Figure 5-22 View of existing dam and proposed quarry expansion area from the southern portion of the site, adjacent to R8, looking north



Figure 5-23 View of existing quarry operation from the south western boundary of the site, adjacent to R10, looking north east

Table 5-24 provides a summary of each of the potentially affected locations and the visual impact in relation to the quarry extent. In general, the assessment has found that the potential visual impacts are not deemed significant based on limited view points, the majority of the quarry being below ground level (as opposed to a large cut face), existing visual impact of the quarry operations and presence of vegetation. The most significant visual impact would be on residence R1, located to the east of the access road.

Table 5-24 Potential visual impact assessment

Visual receptor	Summary of findings	Potential visual impact
Users of Woodburn-Evans Head Road	- Refer Figure 5-18 and Figure 5-19 - Short term view (passing by) - Limited views of quarry due to distance and presence of vegetation - Landscape already modified by presence of existing quarry - Future vegetation buffers will provide additional screening - Views of trucks entering provides low level visual impact	Low
Residential property R1	- Refer Figure 5-20 - Views of site visible from residence - Long term impact (life of quarry) - The quarry will expand in a westerly direction, away from R1 - Landscape already modified by presence of existing quarry - Main impact will be from increased truck movements, larger stockpiles and more machinery. - Future vegetation buffers will provide additional screening	Moderate to low

Visual receptor	Summary of findings	Potential visual impact
Residential property R2	• Refer Figure 5-18 • Obscured, distant views visible from residence • Long term impact (life of quarry) • Landscape already modified by presence of existing quarry • The quarry will expand in a westerly direction, away from R2, where adjacent vegetation will provide additional screening. • Main impact will be from increased truck movements, larger stockpiles and more machinery. • Future vegetation buffers will provide additional screening	Low
Residential property R5 to R6	• Very limited views of quarry and access road from residences due to presence of vegetation • Long term impact (life of quarry) • Landscape already modified by presence of existing quarry • Future vegetation buffers will provide additional screening	Low
Residential property R7 and R8	• Refer Figure 5-21 and Figure 5-22 • Limited views of quarry from residences due to distance and presence of vegetation and dam (including existing dam stockpiles) • The quarry will expand in a westerly direction, towards these residences but remain mostly obscured • Long term impact (life of quarry) • Future vegetation buffers will provide additional screening	Low
Residential property R9 to R11	• Limited views of quarry from residences due to distance and presence of vegetation • Future vegetation buffers will provide additional screening	Negligible
Residential property R12	• Refer Figure 5-19 • Obscured, distant views visible from residence • Long term impact (life of quarry) • Landscape already modified by presence of existing quarry • The quarry will expand in a westerly direction, away from R12, where adjacent vegetation will provide additional screening. • Main impact will be from increased truck movements, larger stockpiles and more machinery. • Future vegetation buffers will provide additional screening	Low

5.7.3 Mitigation measures

Whilst the visual impact from the proposed quarry extension is considered to be low at most sensitive receivers, the following mitigation measures are proposed to minimise future visual impacts:

- Maintain and enhance the existing vegetation between the project site and property boundary to provide ongoing screening to the quarry.
- Maintain the site in a clean and tidy condition at all times.
- Progressively revegetate disturbed areas where quarrying is complete.

5.8 Waste management

5.8.1 Introduction

The proposal has the potential to generate waste from quarry activities and general site use.

This section describes the type and classification of waste that would be handled/ stored/ disposed of at the site. The potential impacts of the proposal in regard to waste generation during the establishment, operation and decommissioning of the quarry is also assessed.

A description of the measures that would be implemented to avoid, minimise, mitigate, offset, manage and/ or monitor the potential impacts associated with the waste generated, as a result of the proposal, are provided.

5.8.2 Existing environment

The existing quarry generates various waste streams including construction and excavation waste, vegetation waste, packaging materials and liquid wastes. The volumes of solid wastes are relatively small as most waste is reused or recycled on site e.g. excavation waste and vegetation waste. General construction waste is the most significant and this is currently managed, where possible, in accordance with the waste management hierarchy of avoid, reuse, recycle and dispose.

Minor sources of liquid wastes are also currently produced, including oil, paint, lubricants and glue. Stormwater can also be considered a liquid waste but is addressed in Section 5.1.

5.8.3 Impact assessment

Quarrying involves the stripping and emplacement of topsoil and overburden, extraction, screening and stockpiling the raw materials and product loading and distribution. The types of waste generated are not expected to change as a result of the expansion of the quarry but the volumes of some wastes would.

The operation of the proposal would generate the following waste types:

- Excavated material (topsoil and overburden not suitable for sale)
- Domestic waste
- Green waste
- Construction waste
- Effluent from staff ablutions facilities

- Used lubricants and oils
- Contaminated soil

The classification and description of each of the general waste types to be potentially generated by the proposal is summarised in Table 5-25.

Table 5-25 Potential waste description

Waste Type	Waste Classification ²	Details
Excavated material	General Solid Waste (non-putrescible)	Excavated material waste is likely to consist of topsoil and sand. The volume of waste excavated material would be small as excess excavated material would generally be utilised on-site as backfill or for rehabilitation and other site works.
Green Waste	General Solid Waste (non-putrescible)	Clearing would be limited. All cleared vegetation would be mulched and stockpiled on site for revegetation works.
Construction waste	General Solid Waste (non-putrescible)	Waste from construction would include excess concrete, metal, timber, fittings and packaging. Waste would be collected and disposed of appropriately. All attempts would be made to reuse or recycle building products hence the volume of construction material waste is expected to be minimal.
Liquid waste	Liquid Waste	A limited amount of liquid waste is expected to be generated by the proposal. The waste is expected to consist of oil, paint, lubricants, glue etc. Liquid wastes would be stored and disposed of appropriately.
Contaminated Soil	To be determined	Any spills of chemicals or fuel could result in contaminated soil that would require disposal at an appropriately licenced landfill or trade waste facility.
Wastewater	Liquid Waste	Wastewater may be generated as a result of dewatering of pits and sediment basins. Management of this wastewater is outlined in Section 5.1.
Biological waste (Sewage)	Liquid Waste and General Solid Waste (putrescible)	The site would be equipped with a portable toilet that is pumped out on an as needs basis by a licensed contractor.
Domestic waste	General Solid Waste (non-putrescible and putrescible)	The limited general waste generated on-site would be collected and disposed of appropriately. Waste would consist of everyday items such as paper, aluminium cans, plastics, packaging and other material generated by onsite staff.

Potential impacts from the production and inappropriate disposal of waste generated from the proposal includes:

- Contamination of land
- Pollution of waterways
- Air pollution
- Overuse of scarce resources
- Human and animal health impacts

² As per Waste Classification Guidelines (DECC 2008)

5.8.4 Mitigation measures

All waste would continue to be managed in accordance with the requirements of the *Waste Avoidance and Resource Recovery Act 2001*, the *Protection of the Environment Operations Act 1997*, the *OEH Waste Classification Guidelines* (DECCW, 2009) and the principles of the waste management hierarchy.

Mitigation measures are summarised in Table 5-26 for the types of wastes likely to be produced on site. These measures would be used as the basis for a Waste Management Plan (WMP) to be prepared for the site. The WMP would be communicated to all employees and contractors during site induction, prior to commencing works at the site and a copy should remain on-site for reference purposes during operation.

Table 5-26 Proposed waste management measures

Waste type	Waste management hierarchy		
	Avoid	Reuse/ Recycle/Recover	Dispose
Excavated material	Avoid excess excavation	Use excess material on site as fill and/or in rehabilitation works	Excess excavated material to be classified and disposed in accordance with the Waste Classification Guidelines
Green waste	Minimise clearing	Mulch cleared vegetation and use on site	Excess material to be classified and disposed in accordance with the Waste Classification Guidelines
General construction waste	Materials to be sourced and ordered in appropriate quantities	Reuse excess material on-site wherever possible. All recyclables (including aluminium, paper & cardboard, steel, glass, rigid plastic, organics) to be collected and recycled accordingly	Excess material to be classified and disposed in accordance with the Waste Classification Guidelines
Contaminated soil	Proper storage of all chemicals and fuels (e.g. bunded areas with 110% capacity)	Utilise bioremediation for large quantities of fuel-impacted soil. Tracking during transportation would be carried out where required	Disposed in accordance with the Waste Classification Guidelines
Liquid waste	Materials to be sourced and ordered in appropriate quantities	Reuse excess material on-site wherever possible e.g. store and reuse lubricants	Excess material to be classified and disposed in accordance with the Waste Classification Guidelines
Wastewater	Divert clean water from the site	Waste water to be pumped to a holding pond and used on-site e.g. for dust suppression/ plant watering etc	Discharge wastewater, in accordance with EPL requirements

Waste type	Waste management hierarchy		
	Avoid	Reuse/ Recycle/Recover	Dispose
Biological (sewage) waste	Minimise use of site facilities e.g. toilets	Consider using composting toilet	Sewage waste to be disposed at an appropriately licensed facility
Domestic waste	Materials to be sourced and ordered in appropriate quantities	Reuse excess material on-site wherever possible. All recyclables (including aluminium, paper & cardboard, steel, glass, rigid plastic, organics) to be collected and recycled accordingly	Excess material to be classified and disposed in accordance with the Waste Classification Guidelines

5.9 Hazards and risks

5.9.1 Introduction

A risk and hazard assessment provides a framework for identifying and analysing potential environmental impacts of the proposal. This section describes the measures that would be implemented to avoid, minimise, mitigate, offset, manage and/or monitor the potential impacts from hazards and risks, including any storage of dangerous goods.

Risks generated in relation to traffic and transport, soil and water, flooding, flora and fauna, noise, air quality, heritage, visual amenity, waste management, and social and economic impacts, along with measures to avoid, minimise, mitigate, offset, manage and/or monitoring the potential impacts are addressed in each relevant section of the EIS. Selected hazard and risk factors have been addressed in this Section to address the overall hazard and risk management strategy.

5.9.2 Existing environment

The existing quarry site is subject to various risks and hazards, including:

- **Contamination and Dangerous Goods** – The use of heavy machinery at the site presents the risk of contamination as a result of spills from the machinery and during refuelling and maintenance.
- **Bushfire** - The site has been mapped by RVC as being bushfire prone, and is surrounded by large areas of vegetation (particularly to the north). Bushfire poses a potential risk to the site as it could damage structures and impact on safety of employees and visitors.
- **Safety** – The quarry presents various safety risks to employees and subcontractors working at the site. Safety risks include open excavations, surface water, uneven surface, heavy machinery, traffic and storage, handling and use of explosives.

5.9.3 Impact Assessment

Table 5-27 identifies the potential environmental hazards for the proposal and assesses the risk involved before and after implementation of proposed mitigation measures.

Table 5-27 Environmental risk assessment

Issue	Hazard	Preliminary Risk			Proposed Control Measures	Residual Risk		
		Consequence	Likelihood	Rank		Consequence	Likelihood	Rank
Contamination and dangerous goods	Contamination of the site could occur as a result of spills from machinery, refuelling or dangerous goods storage.	B	3	Medium	Store dangerous goods in an appropriately banded area. Keep and maintain appropriate spill control kit and ensure all staff are trained in its use. Maintain a register of dangerous goods on site. If available, use a safe alternative to the dangerous good.	B	1	Low
Bushfire	The site is surrounded by large areas of vegetation and bushfire poses a potential risk to the proposal. Bushfire could damage structures and impact on safety of employees and visitors to the site. The proposal also presents a risk of being the source of a bushfire.	D	3	High	Refer to Table 3-3	C	2	Medium
Safety	The site presents various safety hazards including open excavations, surface water, uneven surface, heavy machinery, traffic and storage, handling and use of dangerous goods.	E	3	High	Prepare and implement a Health and Safety Plan.	C	2	Medium

Table 5-28 Risk Assessment Matrix

RISK ASSESSMENT MATRIX		CONSEQUENCE				
		MINOR	MAJOR	SEVERE	CRITICAL	CATASTROPHIC
LIKELIHOOD		A	B	C	D	E
VERY UNLIKELY	1	Low	Low	Medium	Medium	Medium
UNLIKELY	2	Low	Low	Medium	Medium	High
POSSIBLE	3	Low	Medium	High	High	High
LIKELY	4	Medium	Medium	High	High	Extreme
ALMOST CERTAIN	5	Medium	High	High	Extreme	Extreme

Safety, Health and Environment Consequence (C)		Likelihood (L)	
		Safety	Environment
A	First Aid / Limited direct ecosystem harm.	1 Occurs > 100 jobs	Highly unlikely, but could occur in very exceptional occasions.
B	Medical treatment/minor injury/ Localised environmental impact	2 Occurs in 0-100 jobs	Not expected to occur but there is a slight possibility that the impact could occur on some occasions.
C	Lost time injury / Significant impact environmental with reversible impacts	3 Occurs in 1-10 jobs	It is possible that the impact could occur
D	Sever irreversible damage/impairment/health effects/ disabling illness/ Serious long term environmental impact	4 Occurs 1 per job	The impact will probably occur in most circumstances
E	Fatality /Ecosystem Collapse	5 Occurs < 1 per job	The impact is expected to occur in most circumstances

5.9.4 Mitigation measures

The risk assessment has found that all risks for the selected factors can be mitigated to achieve a residual ranking of “Low” or “Medium” provided the following mitigation measures are implemented:

- Store dangerous goods in an appropriately bunded area.
- Keep and maintain appropriate spill control kit and ensure all staff are trained in its use.
- Use a specific refuelling vehicle equipped with an approved fuel dispenser, for refuelling.
- Maintain a register of dangerous goods on site.
- If available, use a safe alternative to the dangerous good.
- Prepare and implement a Health and Safety Plan.

5.10 Agricultural impacts

5.10.1 Introduction

Historically, agriculture is a significant industry in the Richmond-Valley region and plays an important role in both the social and economic wellbeing of constituents. Richmond Valley LGA has a long history of beef cattle, sugar, dairy and horticultural activities. Many of the coastal communities within the LGA also support a sustainable fishing industry.

The location and intensity of the dominant agricultural enterprises is largely determined by topography, soil type and the availability of water for irrigation and livestock supplies. Access to more fertile soils where productive, high quality pastures can be grown, has favoured dairy production while the less fertile soils on terrain that is less suitable for intensive cropping, horticultural enterprises and improved pasture establishment is used for beef production.

Casino, the major administrative and business centre in the region also has a number of related agricultural processing industries and is a major centre for beef production. Casino is host to the annual Beef Week festival and is also home to the Northern Rivers Livestock Exchange, the sixth largest saleyard in the state.

The importance of agriculture can be gauged by employment statistics which show that of all employed people in Richmond Valley LGA, the majority are employed in meat and meat product manufacturing (7.2%), followed by school education (5.4%), cafes, restaurants and takeaway food services (3.7%) and sheep, beef cattle and grain farming (3.6%).

The economic value of agriculture is indicated by the gross value of the major agricultural commodities for Richmond Valley LGA (Table 5-29). The main agricultural commodity, livestock slaughtering, had a gross value of \$67.8m in 2011 and includes processing of poultry (\$40.6m), cattle (\$20.3m) and pigs (\$6.4m). Milk accounted for \$8.7 million which reflects the number of dairy farms across the landscape. Sugarcane accounted for \$4.6m, while nurseries, cut-flowers and cultivated turf contributed \$5.4m.

There are approximately 606 agricultural businesses operating within the Richmond Valley LGA.

Table 5-29 Gross value of major commodities 2011 (\$ million)

Commodity	Richmond Valley LGA
Broadacre crops - hay	1.0
Broadacre crops – sugarcane	4.6
Broadacre crops – other	3.7
Horticulture - nurseries, cut flowers and cultivated turf	5.4
Horticulture - vegetables	2.9
Horticulture - fruit and nuts	0.6
Livestock slaughterings – cattle	20.3
Livestock slaughterings – pigs	6.4
Livestock slaughterings - poultry	40.6
Livestock products - whole milk	8.7
Total (\$ million)	94.2

Source: ABS Agricultural Commodities Small Area Data, Australia, 2011

Land use for agriculture in the Richmond Valley LGA accounts for approximately 52% of total land area (Table 5-30). The predominant use of agricultural land is for grazing industries followed by cropping land. The second largest land use is conservation and natural environments accounting for 35% of total land use within the LGA.

Table 5-30 Agricultural land use in Richmond Valley LGA 2011

Land use type	Area (ha)	%
Total LGA land area	305,100	
Agricultural land use area	159,658	52%
Agricultural land use by industry		
Land under crops	14,847	9.3%
Grazing land (including pastures and rangelands)	115,721	72.4%
Land used for other agricultural purposes	353	
Remnant vegetation and woodland not suitable for grazing	2,768	1.7%
Forestry plantations	2,233	1.4%
Other areas not used for agricultural production	3,983	2.5%

Source: ABS Agricultural Commodities Small Area Data, Australia

5.10.2 Existing conditions

History of Agriculture on this site and adjoining site

The subject site has operated as a quarry since 1961 with approval granted in 1997 to expand the quarry to extract up to 35,715m³. The quarry has since exhausted the resources granted under that approval. Under the proposal, the extraction area would increase to 18.3 hectares or approximately 32% of the site. The subject site is heavily timbered in the north-east corner with scattered timber along the southern boundary. The area is relatively flat with an approximate elevation of 5 metres AHD. The site is dominated by the presence of two adjacent 'lakes'. The site also contains several man-made dams for provision of water to livestock and from a former aquaculture venture.

Over the past seven years the site has been extensively used for cattle agistment with approximately 10-25 head of cattle agisted on an annual basis. The property is currently running 14 cows and calves. It is planned to reduce cattle numbers if approval is granted for the quarry expansion.

The property is equipped with a set of cattle yards, which will not be affected by the quarry expansion. Currently the property is divided into two paddocks allowing the grazing operations to be separate from the quarry with a new fence to be erected around the proposed quarry expansion area.

The subject site is surrounded by dense vegetation on the northern, eastern and western boundaries. There are approximately 10 residential properties located along the southern boundary of the property with frontage to the Woodburn to Evans Head road. There is no evidence of existing agricultural practices being conducted on these adjoining properties. One of these adjoining properties is currently used as a pre-cast concrete manufacturing business.

5.10.3 Potential impacts

Assessment of Impacts

The quarry is proposed to be operated in four stages with the expansion focused towards the northern boundary in the cleared areas with retention of vegetative buffers along the southern boundary. Appropriate sediment and erosion control measures and other environmental safeguards will be established to prevent run-off to adjoining properties.

It can be concluded that Doonbah Quarry would not significantly reduce the agricultural potential of adjoining lands or agricultural land within the broader Richmond-Valley LGA. Given that this site has been used as a quarry for over 50 years, agricultural activities have been limited on this site with grazing primarily used to control vegetation for fire management purposes. Grazing has primarily occurred when quarrying activities on site have been minimal.

The proposed quarry is for a single definable development that is not likely to lead to an immediate or future decline in the area of prime agricultural land or to a decrease in the socio-economic outcomes for the residents of Richmond-Valley LGA.

Land use conflict risk assessment

Any potential for incompatible land use requires assessment to ensure that agricultural land is preserved to the extent that is required in the planning policies and strategies through minimising land use conflicts.

Land use conflict risk assessment matrix

The following risk assessment matrix has been adopted to assess potential land use conflict risks from the residential development.

Table 5-31 Land use conflict risk matrix

Likely consequence from a dispute or conflict arising over the land use or activity		Likelihood of a dispute or conflict arising over the land use or activity		
		Very likely	Likely	Unlikely
	Major consequences & impacts likely	HIGH	HIGH	MEDIUM
	Modest or periodic consequences & impacts likely	HIGH	MEDIUM	LOW
	Minimal consequences & impacts likely	MEDIUM	LOW	LOW

Source: Living and Working in Rural Areas – A handbook for managing land use conflict issues on the NSW North Coast. DPI (2007)

Assumptions for adjoining agricultural land use

The following assumptions have been used when completing the land use conflict risk assessment (LUCRA):

- Adjoining agricultural properties along Woodburn Evans Head Road will continue to be used for rural residential purposes, with limited agricultural activities.
- Land adjacent to the eastern, northern and southern boundaries remain as densely timbered areas.

Land use conflict risk assessment (LUCRA)

The following table lists the potential sources of land use conflict from the development, the assessment of the risk based on the above matrix, and suggested management to reduce possible conflicts. The list is adapted from the DPI Living and Working in Rural Areas handbook. Note that only those issues listed in the DPI document that are considered to pose a risk from this development are included.

Table 5-32 Land use conflict risk assessment

Issue	Risk Assessment	Issue Management
Catchment management	Low	The development will have no to minimal impact on natural resource management of surrounding properties. The operators of the quarry are responsible for ensuring site plans (eg stormwater) meet guidelines for discharges into waterways. Appropriate erosion control measures would be required on this site to minimise impacts on adjoining properties.
Dogs	N/A	
Drainage	Low	See catchment management.
Dust	Low	Routine quarry operations could cause short term dust accretion on adjoining pastures. If this occurs it would be of short duration as dust would be removed by rain events. There would be nil to minimal impact on production. Management to reduce dust is via appropriate buffers (distance and vegetative screenings) - the quarry is buffered by a vegetative buffer along the boundaries.
Dwellings	Low	The existing quarry is adjacent to an existing rural-residential area and the proposed development will have minimal additional impact on existing rural pursuits or routine land use practices on surrounding agricultural land. Retention of the vegetative buffer

Issue	Risk Assessment	Issue Management
		between the quarry and rural-residential areas is recommended.
Fencing	Medium	Fences with adjoining agricultural land will need to be maintained in a condition to avoid the possibility of livestock straying off the site onto any adjoining properties. The maintenance of shared boundary fencing is the responsibility of land owners. A visual inspection of the fences has not been conducted
Fire	Medium	The vegetative nature of the site and operation of heavy machinery is a fire risk. A fire could escape and enter neighbouring properties in the south. The operators of the quarry should have knowledge of fire issues and ensure appropriate plans and controls are in place. Grazing of cattle on areas not used for quarry operations will also assist in keeping vegetation levels low.
Flies	N/A	
Lights	Low	The quarry is proposed to be operated during daylight hours from 7am – 6pm Monday to Friday and 8am – 1pm on Saturdays. This risk is assessed as low, as agricultural activities are currently not conducted on the adjoining properties. The vast majority of routine agricultural activities will be mainly conducted during daylight hours. Loading and unloading of stock and some workshop operations may also occur infrequently at night. The distance from neighbouring properties and the vegetative buffers means the potential conflict is assessed as low.
Noise	Medium	As per lights. Noise and associated impacts have further been discussed in Section 5.3 and will result from the daily movement of trucks to and from the site. Rural dwellings in this area are located within 500m of the quarry which is inside the minimum buffer distance of 500m for extractive industries.
Odours	N/A	
Pesticides	Low	Pesticide use within the subject site is likely to be minimal such as for weed control. Application of pesticides needs to be in accordance with the Pesticides Act 1999 such that only registered pesticides are used based on label instructions that are designed to minimise impacts on surrounding land. The distance from neighbouring properties and the presence of vegetative buffers means the potential conflict is assessed as low.
Roads	Low	There is expected to be increased traffic volumes along Woodburn Evans Head Road, however this is expected to have minimal impact on existing agricultural operations and the potential conflict is assessed as low. Consideration will need to be given to any enterprises which currently move livestock across Woodburn Evans Head Road.
Straying livestock	Low	See Fencing.
Theft/vandalism	Low	The existing nature of the quarry operation means that the risk posed by theft/vandalism is considered low as the area would be off limits to the general public.
Visual amenity	Low	The subject area is adjacent to existing rural-residential development and is well screened from these areas due to existing vegetative buffers. It is therefore considered low risk.
Weeds and pests (rabbits)	Low	Weed and pest control on the subject site is the responsibility of the quarry operator. The risk from noxious weeds and pests is understood to be low but will require future monitoring.

5.10.4 Mitigation measures

In order to reduce any potential land use conflicts arising with adjoining agricultural enterprises, appropriate mitigation measures recommended are for:

- a. The site to be appropriately fenced to ensure that livestock are effectively controlled.
- b. Routine weed and pest control.
- c. Noise and dust mitigation measures as discussed in Sections 5.3.4 and 5.4.4 respectively.

5.11 Socio-economic

The following section describes the social and economic impacts of the proposal. The potential social and economic impacts assessed are as follows:

- Alteration of social activities or employment due to employment generation and capital expenditure.
- Perceived or real impacts on local amenity of neighbouring properties.
- Reduction in property values due to the presence of the quarrying operation.
- Implications of the increased workforce on the need for services and infrastructure.
- Actual or perceived reduction in quality of life.

The statistical data referenced in this section is drawn from the census data compiled by the Australian Bureau of Statistics (ABS) for 2011.

5.11.1 Existing conditions

Geographic location

The site is located approximately 350 metres north of the Woodburn-Evans Head Road adjacent to the village of Doonbah. The site is surrounded primarily by undeveloped bushland and National Park to the north, east and west. Rural residential houses are located along the Woodburn-Evans Head Road.

Doonbah does not have any services. The nearest services to the site are Woodburn (approximately 4 km west) and Evans Head (approximately 5 km east).

Social characteristics

Results of the 2011 Census found that Doonbah has 244 residents living in 123 residences. RVC LGA has a population of 22,037 consisting of 49.5% males and 50.5% females. Aboriginal and Torres Strait Islander people made up 6.6% of the population.

The median age of people in RVC was 43 years (approximately six years older than the national median). Children aged between 0 and 14 years made up 19.2% of the population and people aged 65 years and over made up 19.6% of the population. Of people in the area aged 15 years and over, 47.6% were married and 13.8% were either divorced or separated.

Other relevant census data is presented in Table 5-33.

Table 5-33 Relevant census data for RVC

	2001	2006	2011
Total Persons	20,551	21,828	22,312
Median age of persons	38	41	43
Median total family income (\$/week)	648	824	956
Median mortgage repayment (\$/month)	672	927	1,300
Median rent (\$/week)	110	145	200

Economic characteristics

The Richmond Valley is mainly supported by primary industries and food manufacturing enterprises, with the NSW Sugar Mill located at Broadwater and Richmond Dairies and the Northern Rivers Meat Cooperative at Casino. This is supported by a number of agricultural businesses located across the Richmond Valley specialising in grain, dairy, beef, fruits, vegetables, timber and tea-tree. In terms of business numbers by industry, the Agriculture, Forestry & Fishing sector is by far the largest in the Richmond Valley with 37.1% of total businesses, followed by the Property & Business Services with 12.3%, Construction at 12.3% and Retail Trade on 11.6% (Regional Development Australia 2013).

RVCs Gross Regional Product is estimated at \$668.5 million and there was considerable annual growth in GRP for Mining (19%) during the 2007/2008 financial year (Sustainable Options 2009).

Overall the LGA is in a weak socio-economic position, with low educational levels and economic resources and considerable dependence on a small number of businesses within the local economy. These businesses form part of the Basic economy and therefore are subject to external factors and will be clearly impacted by government policy and national and global trends and factors (Sustainable Options 2009).

To operate the quarry, it is anticipated that five full time employees would be required during periods of maximum extraction. Haulage of the material would also provide employment for truck drivers. The haulage trucks would be engaged or operated by clients external to the quarry operations. Additional off site employment would also be generated, in the maintenance and support services for equipment and machinery.

The market for materials gained from the quarry derives largely from demand within the construction and building industries, driven by population growth, economic activity and specific infrastructure projects particularly the Pacific Highway upgrade.

The quarry is well positioned to supply part of the demand for several up-coming committed and planned major residential, commercial and infrastructure projects within its core supply area.

5.11.2 Potential impacts

Social

Noise, vibration, air quality and traffic impacts on the surrounding community are assessed in Sections 5.3, 5.4 and 5.5. Mitigation measures have been provided to minimise potential impacts in this regard.

In addition, natural vegetation buffers and other management measures for noise, dust, traffic and other amenity factors, associated with the quarry's operation, would be well established. The longer the quarry can remain in production, the greater the likely benefits to the community with respect to efficient use of a scarce economic resource and the greater the likelihood of conserving greenfield areas.

A related positive social impact of the proposal is the upgrade of the Pacific Highway. The proposal would not be occurring if it was not for the large demand, from the upgrade of the Pacific Highway, for suitable material, which Doonbah Quarry contains. The proposal would provide a valuable resource to this major infrastructure project which is significantly reducing travel times, crashes and fatalities. The relatively close proximity of the site to the Pacific Highway is also a benefit to the wider community because it avoids transporting materials over a longer distance and potentially impacting on a greater number of people.

Economic

Employees working at the quarry would have an economic impact through expenditures from their weekly earnings.

A potential negative impact which may be perceived by some adjoining landowners is the degradation of the road from truck movements and creation of potholes. It is anticipated that this impact would be minimal as the operation currently exists and the quarry would pay a levy for the maintenance of the road.

Economic benefits would stem from the supply of high grade materials to various markets including the upgrade of the Pacific Highway. Given the sites location to the highway this would be a significant source of material. The relatively short transport distance to the Pacific Highway, compared to other quarries with suitable material, would reduce the cost of the upgrade works which would ultimately benefit Australian tax payers.

Such a resource is critical to the continued sustained growth of the area. Additionally, the production of the quarry proposed would reflect positively in ongoing local operational expenditure in respect of the maintenance of equipment and supply of services.

Flow on and multiplier effects would also importantly occur as a result of the additional expenditure injection into the local economy. Additionally, the relative location of the quarry would decrease transportation required and reflect relatively in product pricing and diminished fossil fuel consumption. The narrow economic base of the Richmond Valley would also be expanded from a dependency on agriculture and manufacturing.

A second significant impact on the local economy comes from expenditure on materials and equipment by the quarry - everything other than expenditure on labour. The term "materials" covers items including equipment and materials for site preparation, conveyors and other earth moving equipment, contractors, transport and marketing, and the ongoing use of materials such as repairs and replacement parts and fuel. The expenditure on materials during both the construction and operations phases is spread more widely than expenditure by employees. This is to be expected with materials and equipment being sourced from outside the surrounding area, and outside of NSW.

State Governments can expect economic benefits to continue from the quarry at an enhanced level, including revenue from taxes and payments for service from statutory bodies.

The NSW Department Trade and Investment (Primary Industries) recognises that extractive resources are essential to state and regional economies and to the community as materials for the construction industry. As such, there is a need to ensure these valuable, and finite, extractive resources and nearby areas are protected from developments that would prevent their future extraction and land use, and that they are not compromised by encroaching incompatible land uses.

5.11.3 Mitigation measures

Mitigation strategies are processes, programs or plans designed to address the perceived issues and impacts stakeholders raised during the assessment program. The strategies may serve to enhance the positive impacts associated with a Project, or mitigate or ameliorate negative impacts.

The mitigation measures to address socio-economic issues include the following:

- The quarry's operational staff are recruited from local areas. To ensure local residents are aware of upcoming employment opportunities, management would advertise vacant positions in the local paper.
- The quarry has an informal 'buy local' practice whereby goods and services are usually purchased from local businesses provided that they are competitive in terms of quality and price. It is proposed that the informal policy be formalised to ensure local suppliers and contractors are able to tender for all contract, supplier and service opportunities.
- Traffic, visual, noise, dust and vibration impacts which may affect the quality of life of nearby residents are discussed in detail in other sections of this EIS. Any mitigation measures associated with these assessments should be implemented.

6. Environmental management

6.1 Introduction

Environmental management at Doonbah Quarry would be undertaken in accordance with an Environmental Management Plan (EMP), which would be prepared to provide an overall framework for the management of environmental impacts that could potentially arise from the proposed extension of the quarry. All mitigation measures identified throughout this EIS would be incorporated into the EMP, which would provide:

- An environmental operations manual for Doonbah Quarry staff and contractors throughout construction and operation of the quarry.
- Identification of potential impacts of the proposed quarry and the measures proposed to mitigate these impacts as described in the preceding chapters of this EIS.
- Details of how environmental safeguards are to be implemented.
- Details of the timing of the implementation of the mitigation measures.
- Clearly defined allocations of environmental responsibilities of all staff and contractors.
- Monitoring and reporting requirements to demonstrate compliance with licensing and approval requirements.
- Procedures for review and updating of the EMP.

Adherence to the EMP would enable environmental safeguards and mitigation measures to be effectively implemented and sustainable work practices adopted throughout the duration of the project. This would demonstrate how Rixa intend to comply with relevant environmental legislation, prevent environmental pollution and minimise the impact of the proposal on the environment.

6.2 Summary of Environmental Controls

Environmental safeguards outlined in this document are to be incorporated into the EMP. The safeguards would minimise any potential adverse impacts arising from the proposed works on the surrounding environment. The safeguards and management measures are summarised in Table 6-1.

Table 6-1 Summary of site specific environment safeguards

No.	Impact	Environmental safeguards	Responsibility	Timing
1	Land and water resources	An environmental protection licence must be obtained for the quarry. All relevant conditions relating to soil and water management would be implemented as required by the licence.	Quarry Manager	Construction
2		A groundwater licence will be obtained from NSW Office of Water. All relevant conditions relating to soil and water management will be implemented as required by the licence.	Quarry Manager	Construction
3		An Environmental Management Plan would be compiled for the quarry which would contain a Soil and Erosion Management Plan. Training would be provided to all quarry staff including relevant sub-contractors on erosion and sediment control practices and the requirements of the Plans through inductions, toolboxes and targeted training.	Quarry Manager	Construction
4		Implement erosion and sediment controls in accordance with Managing Urban Stormwater Soils and Construction – Volume 2e Mines and quarries (DECC, 2008).	Quarry Operator	Operation
5		Develop an Acid Sulfate Management Plan (ASSMP) for the site in accordance with the Acid Sulfate Soils Assessment Guidelines (Ahern et al 1998).	Quarry Manager	Construction
6		The installed groundwater bores should be monitored.	Quarry Manager/ Quarry Operator	Construction/ Operation
7		Excavate the quarry with similar batter slopes as the existing quarry and maintain a 5-10 metre buffer within the proposed excavation extent until the full depth of the quarry is reached and stable.	Quarry Operator	Operation
8	Biodiversity	OEI or RVC do not have an official offsetting policy, so it is suggested that a suitable offset proposal be negotiated with RVC and the applicant, if required.	Quarry Manager	Construction
9		The FFMP should include the following: - Delineation and protection of exclusion zones around native vegetation to be retained. - Communication with operational personnel regarding the conservation value of surrounding habitats and their responsibilities with regards to protecting these	Quarry Manager	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		habitats during operations. - Hygiene procedures to prevent the introduction and spread of pathogens such as Phytophthora and Myrtle Rust in areas of native vegetation. These would include exclusion zones around retained areas of native vegetation and/or provision of machine and footwear washdown stations for all equipment and personnel working in areas of native vegetation. - Proposed weed control methods and targeted areas and weed disposal protocols. - Identification and mapping of sensitive receivers (such as native vegetation and water bodies) adjacent to the subject site. - Identification of mature and/or hollow-bearing trees to be retained. - Measures to reduce impact on hollow-bearing trees from operational traffic and equipment such as exclusion zones. - A tree felling protocol, including pre-clearing surveys for nests or sheltering terrestrial fauna and rescue and salvage of fauna where possible, and progressive clearing approaches. - Re-use of fallen trees with hollows within adjacent vegetation areas that are to be retained. - Installation of hollows of appropriate sizes to facilitate use by the identified species likely to occur within the area. - Measures to avoid impacts of the expansion upon Broadwater National Park, including exclusion zones for stockpiling and limitations on vehicle movements.		
10	Noise and vibration	During peak daily production noise walls provide effective shielding at a height of 2.8 m.	Quarry Operator	Operation
11		During average daily production noise walls provide effective shielding at a height of 2.0 m.	Quarry Operator	Operation
12		During peak daily production (140 truck movements per day) the following measures are recommended, in addition to the access road noise walls discussed above: - A mound is erected in front of the screening plant. The mound would need to be approximately 3.5 m high and approximately 20 m long. - A mound is erected in front of the loader. The mound would need to be approximately 4.5 m high and approximately 20 m long.	Quarry Operator	Operation

No.	Impact	Environmental safeguards	Responsibility	Timing
		A mound is erected adjacent to the haul route, within the access road gates. The mound would need to be approximately 2.5 m high and 150 m long.		
13		During average daily production (100 truck movements per day) the following measures are recommended: - A mound is erected in front of the screening plant. The mound would need to be approximately 3.5 m high and approximately 20 m long. - A mound is erected in front of the loader. The mound would need to be approximately 4.5 m high and approximately 20 m long. - A mound is erected along the western and southern banks of the lake during stage 1 operations. The mound would need to be approximately 1.0 m high and 150 m long. The mound would provide shielding from the noise associated with the dredge. The mound would only be necessary during stage 1 of operations, however, as the dredge moves further away from receivers as operations progress through stages 2, 3 and 4.	Quarry Operator	Operation
14		The following measures are also recommended to assist in reducing potential impacts: - Ensure operations do not begin before 7 am or continue after 6 pm, including vehicles arriving on site and leaving the site. - As far as possible, materials dropping heights into or out of trucks should be minimised. - All equipment would be selected to minimise noise emissions. Equipment would be fitted with appropriate silencers and be in good working order. Machines found to produce excessive noise compared to normal industry expectations would be removed from the site or stood down until repairs or modifications can be made. - Machines found to produce excessive noise compared to industry best practice should be removed from the site or stood down until repairs or modifications can be made. - To reduce the annoyance associated with reversing alarms, broadband reversing alarms (audible movement alarms) should be considered for all site equipment. Satisfactory compliance with occupational health and safety requirements would need to be achieved and a safety risk assessment may need to be undertaken to determine that safety is not compromised. Refer to Appendix C of the NSW Interim Construction Noise Guideline (OEH, 2009) for	Quarry Operator	Operation

No.	Impact	Environmental safeguards	Responsibility	Timing
		more information. Surfacing the haul road from the weighbridge to Woodburn – Evans Head Road would assist in reducing noise during haul truck movements. Although it is out of the control of Rixa Quarries, it would also be recommended to resurface or smooth Woodburn – Evans Head Road in areas adjacent to noise receivers. This would assist in minimising banging/bumping noise from haul trucks as they travel to and from the quarry, particularly when they are unloaded.		
15	Air quality and greenhouse gas emissions	Rehabilitated areas will be revegetated as early as possible after completion.	Quarry Operator	Operation
16		Newly stripped topsoil stockpiles will be immediately watered and revegetated with a grass cover or similar.	Quarry Operator	Operation
17		Haul truck routes will be watered as required, particularly during peak periods of vehicle movements and extended dry spells.	Quarry Operator	Operation
18		Opportunities for the use of biodiesel should be further investigated and used where possible	Quarry Operator	Operation
19		Efficient plant and vehicles would be used where reasonable and feasible to do so.	Quarry Operator	Operation
20	Traffic	Subject to detailed survey, upgrade of the existing quarry access intersection to provide a BAL-type treatment for left turns into the site.	Quarry Manager	Construction
21		Passing bays are to be provided on the quarry access road to minimise potential conflict between inbound and outbound traffic, and to minimise damage to the road edge.	Quarry Manager	Construction
22		A 10km/hr speed limit is to be maintained on the access road to the quarry to minimise dust production by traffic entering and leaving the quarry.	Quarry Operator	Operation
23		Heavy vehicle access between the Pacific Highway and the quarry should be via Alfred Street. Haulage trucks should not use the route via Woodburn Street and Wagner Street, to avoid impacts on the Woodburn Primary School and the surrounding residential area.	Quarry Operator	Operation

No.	Impact	Environmental safeguards	Responsibility	Timing
24		Where practicable, haulage vehicles should be backloaded to carry loads on both inward and outward journeys, to minimise vehicle movements.	Quarry Operator	Operation
25	Heritage	- If it is suspected that Aboriginal material has been uncovered as a result of earth working activities within the Project Area: - Work in the surrounding area is to stop immediately. - A temporary fence is to be erected around the site, with a buffer zone of at least 10 metres around the known edge of the site. - An appropriately qualified archaeological consultant is to be engaged to identify the material. - If the material is found to be of Aboriginal origin, the Aboriginal community is to be consulted in a manner as outlined in the OEH guidelines: Aboriginal Cultural Heritage Consultation Requirements for Proponents (2010).	Quarry Operator	Operation
26		If Aboriginal cultural materials are uncovered as a result of development activities within the Project Area, they are to be registered as Sites in the AHIMS database managed by the OEH. Any management outcomes for the site will be included in the information provided to the OEH.	Quarry Operator	Operation
27		If human remains are located at any stage during earthworks within the Project Area, all works must halt in the immediate area to prevent any further impacts to the remains. The location where they were found should be cordoned off and the remains themselves should be left untouched. The nearest police station (Woodburn), the Bogal LALC, Bangalang Traditional Owners and the OEH Regional Office (Coffs Harbour) are to be notified as soon as possible. If the remains are found to be of Aboriginal origin and the police release the scene, the Aboriginal community and the OEH should be consulted as to how the remains should be dealt with. Work may only resume after agreement is reached between all notified parties, provided it is in accordance with all parties' statutory obligations.	Quarry Operator	Operation
28		In the unlikely event that Aboriginal cultural heritage is identified during Project works, it is recommended that all effort must be taken to avoid any impacts on Aboriginal Cultural Heritage values. Should a situation arise where impacts to Aboriginal cultural heritage is unavoidable, mitigation measures should be negotiated between the Proponent, OEH and the Aboriginal Community.	Quarry Operator	Operation

No.	Impact	Environmental safeguards	Responsibility	Timing
29	Visual amenity	• Maintain and enhance the existing vegetation between the project site and property boundary to provide ongoing screening to the quarry.	Quarry Operator	Operation
30		• Maintain the site in a clean and tidy condition at all times.	Quarry Operator	Operation
31		• Progressively revegetate disturbed areas where quarrying is complete.	Quarry Operator	Operation
32	Waste management	Management measures for excavated material are: – Avoid excess excavation – Use excess material on site as fill and/or in rehabilitation works – Excess excavated material to be classified and disposed in accordance with the Waste Classification Guidelines	Quarry Operator	Operation
33		Management measures for green waste are: – Minimise clearing – Mulch cleared vegetation and reuse on site – Excess material to be classified and disposed in accordance with the Waste Classification Guidelines	Quarry Operator	Operation
34		Management measures for general construction waste are: – Materials to be sourced and ordered in appropriate quantities – Reuse excess material on-site wherever possible. All recyclables (including aluminium, paper & cardboard, steel, glass, rigid plastic, organics) to be collected and recycled accordingly – Excess material to be classified and disposed in accordance with the Waste Classification Guidelines	Quarry Operator	Operation
35		Management measures for contaminated waste are: – Proper storage of all chemicals and fuels (e.g. bunded areas with 110% capacity)	Quarry Operator	Operation

No.	Impact	Environmental safeguards	Responsibility	Timing
		- Utilise bioremediation for large quantities of fuel-impacted soil. Tracking during transportation would be carried out where required. - Disposed in accordance with the Waste Classification Guidelines		
36		Management measures for liquid waste are: - Materials to be sourced and ordered in appropriate quantities - Reuse excess material on-site wherever possible e.g. store and reuse lubricants - Excess material to be classified and disposed in accordance with the Waste Classification Guidelines	Quarry Operator	Operation
37		Management measures for wastewater are: - Divert clean water from the site - Waste water to be pumped to a holding pond and used on-site e.g. for dust suppression/ plant watering etc. - Discharge wastewater, in accordance with EPL requirements	Quarry Operator	Operation
38		Management measures for biological waste are: - Minimise use of site facilities e.g. toilets. - Consider using composting toilet. - Consider using composting toilet.	Quarry Operator	Operation
39		Management measures for domestic waste are: - Materials to be sourced and ordered in appropriate quantities. - Reuse excess material on-site wherever possible. All recyclables (including aluminium, paper & cardboard, steel, glass, rigid plastic, organics) to be collected and recycled accordingly - Excess material to be classified and disposed in accordance with the Waste Classification Guidelines	Quarry Operator	Operation

No.	Impact	Environmental safeguards	Responsibility	Timing
40		Management measures for excavated material are: – Avoid excess excavation – Use excess material on site as fill and/or in rehabilitation works – Excess excavated material to be classified and disposed in accordance with the Waste Classification Guidelines	Quarry Operator	Operation
41	Hazards and risks	• Store dangerous goods in an appropriately bunded area.	Quarry Operator	Operation
42		• Keep and maintain appropriate spill control kit and ensure all staff are trained in its use.	Quarry Operator	Operation
43		• Use a specific refuelling vehicle equipped with an approved fuel dispenser, for refuelling.	Quarry Operator	Operation
44		• Maintain a register of dangerous goods on site.	Quarry Operator	Operation
45		• If available, use a safe alternative to the dangerous good.	Quarry Operator	Operation
46		• Prepare and implement a Health and Safety Plan.	Quarry Operator	Operation
47	Agricultural impacts	• The site to be appropriately fenced to ensure that livestock are effectively controlled.	Quarry Operator	Operation
48		• Routine weed and pest control.	Quarry Operator	Operation
49	Socio-economic	• The quarry's operational staff are recruited from local areas. To ensure local residents are aware of upcoming employment opportunities, management would advertise vacant positions in the local paper.	Quarry Operator	Operation
50		• Ensure local suppliers and contractors are able to tender for all contract, supplier and service opportunities.	Quarry Operator	Operation

6.3 Licensing and approvals

Licences, approvals or other requirements from stakeholders are presented in Table 6-2.

Table 6-2 Licencing, approvals and other requirements

Statutory Authority	Licence, approval or other requirement
EPA	Environmental Protection Licence under POEO Act 1997
NOW	Groundwater licence under Part 5 of the Water Act 1912 for potential aquifer interference
RMS	Section 138 approval for construction of a left turn lane

7. Project justification

7.1 Introduction

This chapter provides an overview of the alternatives which were considered in the development of the proposed quarry operations and throughout the preparation of the EIS. The reasons for justifying the final proposal are presented, having regard to biophysical, economic and social considerations and the principles of ecologically sustainable development (ESD).

7.2 Justification/need for the extraction operation

7.2.1 Socio-economic

The North Coast Region of New South Wales has been experiencing steady growth over the past few decades and this is expected to continue into the future. This growth results in increased demands for new dwellings, both urban and rural residential, which in turn leads to an increase in the need for the provision of new infrastructure and the upgrading of existing services and roads.

This growth is also reflected in an increase in commercial, tourist and industrial developments and associated industries which are vital for the continued employment of the expanding population, the local economy and to the future growth of the region. By providing a local source of sand, the proposal will help to reduce the costs of development in the area whilst minimising environmental impacts.

The proposal would provide a valuable resource required for the northern portion of the Woolgoolga to Ballina Pacific Highway Upgrade which is designed to significantly reduce travel times, crashes and fatalities (RMS, 2013). The relatively close proximity of the site to the Pacific Highway is also a benefit to the wider community because it avoids transporting materials over a longer distance and potentially impacting on a greater number of people (through increased traffic). The relatively short haulage distance to the highway also has associated economic and environmental benefits to the community.

7.2.2 Demand for products

The Pacific Highway has a significant demand for material. The material required for the upgrade of the Pacific Highway needs to meet strict RMS specifications and local sources are limited. Doonbah Quarry is located relatively close to the Pacific Highway and the material can comply with the RMS specifications.

In addition to the demand from the Pacific Highway upgrade, local development is anticipated to require about 65,000 tonnes per annum. Although the local demand is significantly less than the Pacific Highway upgrade, it will be sustained over a longer timeframe.

The existing quarry is located in close proximity to existing demand centres (Ballina and Lismore), whilst maintaining effective isolation from populated areas. The quarry would be able to provide an affordable, high quality material sought by Government Authorities and private developers.

7.2.3 Established extraction site

The site has previously operated as a quarry. Many of the environmental protection measures have been effective during the past operations. The site has a proven record of minimal impact on adjacent landholders and the environment. The proposal would avoid establishing a new site which may have potentially more significant impacts.

7.3 Project alternatives

Alternatives to the proposal are summarised in the following subsections.

7.3.1 Extraction from alternative resource

Extracting another resource (quarry) may have similar or greater impacts than the proposal and establishing a new quarry would also add higher level of uncertainty of impacts in comparison to an established source. A new quarry may require extensive vegetation clearing, create water quality issues or add heavy vehicles to a road that was previously used mainly by light vehicles. The site of the current proposal has been used sporadically as a quarry since 1961 with limited environmental or community impacts, suggesting it is a suitable site for a quarry.

The proposal is also located in close proximity to the northern portion of the Woolgoolga to Ballina Pacific Highway Upgrade and can supply material suitable for this project thereby minimising the environmental impacts associated with longer travel distances. Alternative resource extraction locations would likely require additional travel distances when supplying the Pacific Highway projects and the suitability of the material may be less certain.

7.3.2 Reduced extraction rate

A reduced extraction rate is an alternative. A reduced rate of extraction, sufficient to meet the demand of local development, may not meet the demand from the Pacific Highway upgrade. This could result in additional quarries being needed to be established which may result in greater environmental impacts than the proposal.

The proposed maximum extraction rate of up to 490,000 tonnes per annum is considered to accommodate the demand from the Pacific Highway upgrade whilst minimising potential environmental and social impacts. Once the Pacific Highway upgrade is complete the extraction rate would reduce significantly in line with demand.

7.3.3 Do nothing

The “do nothing” option would negate the need for any further clearing of the existing vegetation and reduce the established environmental impacts at the site but would also have the following consequences:

- The high quality resources, identified at the subject site, would not be utilised.
- The potential economic and social benefits to the community, through local employment and indirect purchasing of goods and services, would not be realised.
- There may be pressure to establish new quarries that contain less suitable resources with greater environmental consequences or uncertainties.

7.4 Ecologically sustainable development

7.4.1 Introduction

The Commonwealth of Australia (2008) defines ESD as “using, conserving and enhancing the community’s resources so that the ecological processes, on which life depends, are maintained and the total quality of life, now and in the future, can be increased”.

The main thrust behind ESD is that current and future generations should leave a natural environment that functions as well or better than the one inherited. Each of the principles of ESD are considered in the following subsections.

7.4.2 Precautionary principle

Interpretation

According to the *PoEO Act*, 1991, the precautionary principle means that if there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

This principle was developed in response to difficulties in interpreting scientific data. The scientific method produces results based on confidence limits. These are controlled by the scope of data acquisition, interpretation methods and general understanding within a particular scientific discipline. This has been used as a way of validating a lack of response to a potential threat of serious or irreversible environmental degradation.

In the application of this principle:

- Careful application should always be undertaken to avoid serious or irreversible environmental damage.
- An assessment of consequences of various options should be undertaken in formulating a proposal

ESD requires that uncertainty and the associated risk level be considered in decision making.

Justification

The environmental consequences of the proposed quarry have been assessed as accurately as possible using appropriate specialists in relevant disciplines where required to satisfy the DGRs. The assessment process involved computer modelling, scientific analysis and interpretation of the potential environmental impacts associated with the proposal. This process has enabled impacts of the proposal to be predicted within a reasonable degree of certainty. All predictions, however, contain a degree of variability, which reflects the nature of the environment. Where there has been any uncertainty in the prediction of impacts throughout the EIS process, a conservative approach was adopted to ensure the worst case scenario was predicted in the assessment of impacts.

The proposal is consistent with the precautionary principle to the extent that all potential threats to the environment have been identified and appropriate mitigation measures have been developed to minimise such impacts. Environmental monitoring would be undertaken as a precautionary measure to reduce any uncertainty regarding the potential for environmental damage.

7.4.3 Social equity including inter-generational equity

Interpretation

Social equity involves value concepts of justice and fairness so that the basic needs of all sectors of society are met and there is a fair distribution of costs and benefits to improve the well-being and welfare of the community, population or society. Social equity does not imply equality but there should be equal access to opportunities for improved welfare, with a bias towards benefiting the least well-off sectors of society.

Social equity includes inter-generational equity, which requires that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

Justification

The proposal is consistent with the principles of social equity and inter-generational equity through the efficient use of a resource that provides a number of benefits to society.

Doonbah Quarry has an identified and proven resource which would allow for the provision of materials for the Pacific Highway upgrade and local demand. The proposed mitigation measures would ensure resources are extracted sustainably and would not disadvantage any part of the community or future generations.

7.4.4 Conservation of biological diversity and maintenance of ecological integrity

Interpretation

Biological diversity refers to the diversity of genes, species, populations, communities and ecosystems, and the linkages between them. Biological resources provide food, medicines, fibres and industrial products. They are also responsible for vital ecological services such as maintaining soil fertility and the supply of clean and fresh water. Maintaining biological diversity safeguards life support functions and can be considered a minimal requirement for intergenerational equity.

Justification

The primary new impact on biodiversity associated with the proposed expansion is the clearing of 1.3 ha of native vegetation. This would reduce the area of the modified Pink Bloodwood - Red Mahogany Open Forest and Paperbark Swamp Forest vegetation types, which are both considered to be consistent with the description of the EEC Swamp Sclerophyll forest by approximately 1.3 ha. This would also reduce the area of habitat available within the subject site for threatened species.

Potential indirect impacts, such as habitat degradation have previously occurred at the site as a result of the quarry operation. Potential environmental impacts associated with quarry operations are to be managed by implementation of controls detailed within an EMP for the operation of the quarry. The EMP would also include controls to manage any potential indirect impacts upon Broadwater and Bundjalung National Parks.

Assessments of significance were undertaken for species recorded or that were considered highly likely to occur within the subject site against State and Commonwealth guidelines. The outcome of these assessments was that the proposed expansion would be unlikely to have a significant impact upon species, populations or endangered ecological communities or their habitats.

It is therefore considered that the proposal would not have a significant impact upon biological diversity or maintenance of ecological integrity in the locality.

7.4.5 Improved valuation and pricing of environmental resources

Interpretation

The environment has conventionally been considered a free resource, with the true cost to the environment not factored into cost of production or use of that resource. This principle involves placing a monetary or social value on the environment that ultimately increases its value so as to decrease future exploitation. Pollution and future exploitation can be controlled under the 'polluter pays' principle, whereby polluters who degrade the natural environment are responsible and accountable for returning it to its previous condition.

Justification

Doonbah Quarry would be subject to licences and approvals for the protection of the environment to ensure the ongoing sustainability of the operations. The cost of licences together with the cost of implementing a range of mitigation and monitoring requirements, as part of the proposal, demonstrates accountability and places a monetary value on environmental protection.

8. Conclusion

The proposed quarry expansion at Lot 2 DP 1040274, 405 Woodburn Evans Head Road, Doonbah (Doonbah Quarry) is subject to assessment under Part 4 of the EP&A Act. This EIS has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

A number of potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal, as described in the EIS, best meets the project objectives but would still result in some impacts on biodiversity via vegetation clearing, impacts on soil and water via erosion and sedimentation, impacts on noise, dust and traffic and social impacts via increased vehicle movements. Mitigation measures as detailed in this EIS would ameliorate or minimise these expected impacts. The proposal would also provide sustained employment and provide a local source of suitable material for the Pacific Highway upgrade and local construction projects. On balance the proposal is considered justified.

The proposal is unlikely to affect threatened species, populations or ecological communities or their habitats, within the meaning of the *Threatened Species Conservation Act 1995* or *Fisheries Management Act 1994* and therefore a Species Impact Statement is not required. The proposal is also unlikely to affect Commonwealth land or have an impact on any matters of national environmental significance.

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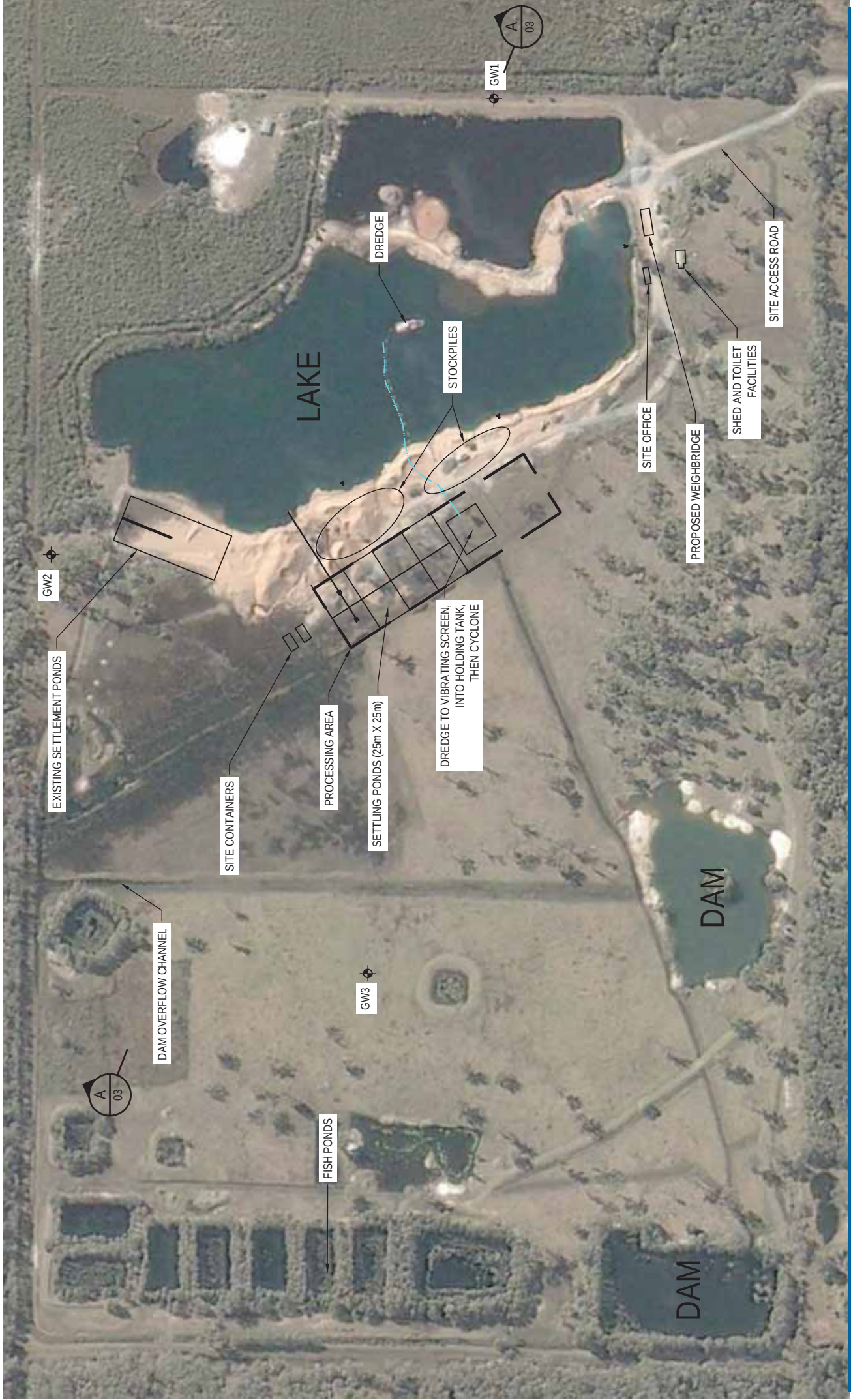
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Appendices

Appendix A – Quarry plans





RIXA QUARRIES
DOONBAH QUARRY
WOODBURN, EVANS HEAD ROAD
EXISTING QUARRY

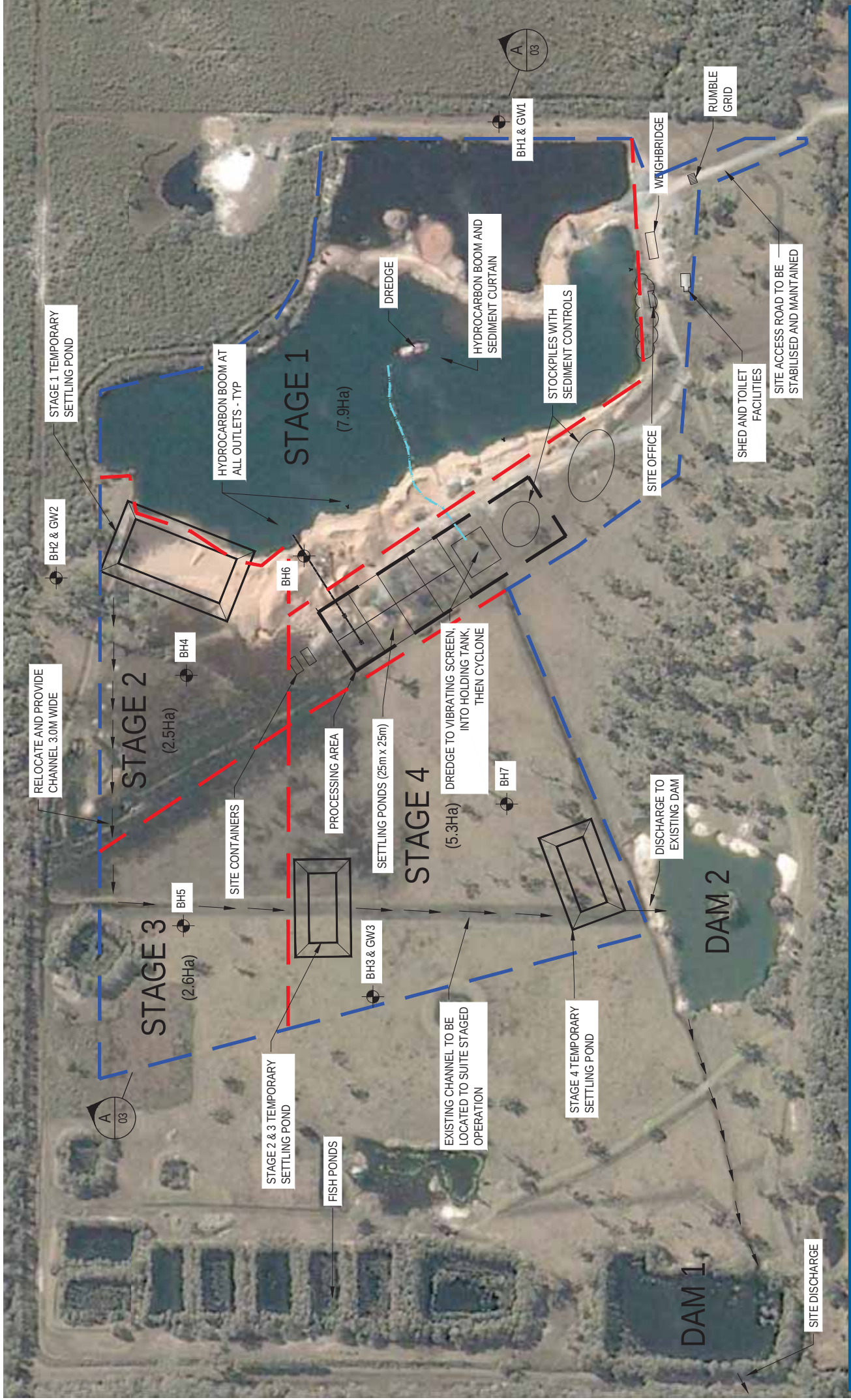
Job Number 22-17200
Revision A
Date MAR.2014

Figure 01



230 Harbour Drive Coffs Harbour NSW 2450 Australia T 61 2 6650 5600 F 61 2 6650 5601 E cfsmail@ghd.com W www.ghd.com

Proj Date: 14 March 2014 - 11:31 AM
Property: Milla Milla
Call File No: G:\2017\200\2450\milla\2017200.R01.dwg



Appendix B – Director Generals Requirements

Mr Warren Wells
Balmain Lawyers
PO Box 286
HUNTERS HILL NSW 2110

RECEIVED
19 JUL 2013

BY: _____

Dear Mr Wells

**Doonbah Sand Quarry (DGR 748)
Director-General's Requirements**

I refer to your request for the Director-General's Requirements (DGRs) for the above development, which is designated local development under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). I have attached a copy of the DGRs for the Environmental Impact Statement (EIS) required for this development. These requirements have been prepared in consultation with relevant State agencies and are based on the information your company has provided to date. I have also attached the agencies' input into the formation of the DGRs, which you are also advised to consider closely during your preparation of the EIS. Detailed requirements for the EIS were not received from the NSW Rural Fires Service (RFS), consequently you are advised to liaise directly with RFS and obtain any further requirements.

In your request for DGRs, it was indicated that the proposal will require approval under the *Protection of the Environment Operations Act 1997*, *Rural Fires Act 1997*, *Water Management Act 2000*, and *Heritage Act 1977*. Accordingly, the proposal is classified as integrated development under section 91 of the EP&A Act. If further integrated approvals are identified, you must undertake your own consultation with the relevant public authorities, and address their requirements in the EIS.

When you lodge your DA for the proposal, you must provide:

- two hard copies and one electronic copy of the EIS to the Department;
- one hard and one electronic copy of the EIS to each identified integrated approval authority; and
- a cheque for \$320 to each identified integrated approval authority, to offset costs involved in the review of the DA and EIS. Do not send a cheque to the Department of Planning and Infrastructure as it is not an integrated approval authority.

If your proposal contains any actions that could have a significant impact on matters of National Environmental Significance, then it will require an additional approval under the Commonwealth's *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). This approval is in addition to any approvals required under NSW legislation. If you have any questions about the application of the EPBC Act to your proposal, you should contact the Department of Sustainability, Environment, Water, Population and Communities in Canberra (6274 1111 or www.environment.gov.au).

Should the consent authority approve the proposal, then under section 22 of the *Mine Health and Safety Act 2004*, the owner or general manager of a mine or quarry must not undertake mining or quarrying operations without first nominating a person as the operator of the mine or quarry to the Chief Inspector of Mines. The Applicant should contact the local Mine Safety Operations Branch of the Division of Resources and Energy within the Department of Trade, Investment, Regional Infrastructure and Services in regard to this and other matters relating to compliance with the *Mine Health and Safety Act 2004*.

If you have any enquiries about these requirements, please contact Matthew Di Maggio.

Yours sincerely

 16/7/13

David Kitto
Director
Mining & Industry Projects
as delegate for the Director-General

Director-General's Requirements

Section 78A(8) of the *Environmental Planning and Assessment Act 1979* and Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*.

Designated Development

DGR Number	748
Proposal	Expansion of existing sand quarry to extract up to 490,000 tonnes of material per year, for a period of up to 10 years.
Location	405 Woodburn Evans Head Road, Doonbah (Lot 2 DP 1040274)
Applicant	Rixa Quarries Pty Ltd
Date of Expiry	16 July 2015
General Requirements (refer Schedule 2 of the <i>Environmental Planning and Assessment Regulation 2000</i>)	The Environmental Impact Statement (EIS) must include: • an executive summary; • a full/detailed description of the proposal, including: - identification of the resource; - description of the site; - a history of any previous quarrying operations on the site; - the proposed works (including rehabilitation works); - the duration and intensity of extraction operations; - any likely interactions between the proposed operations and existing/approved development and land use in the area; and - a detailed justification for the development; • a conclusion justifying the development on economic, social and environmental grounds, taking into consideration whether the proposal is consistent with the objects of the <i>Environmental Planning & Assessment Act 1979</i>; and • a signed declaration from the author of the EIS, certifying that the information contained within the document is neither false nor misleading.
Key Issues	The EIS must also assess the potential impacts of the proposal during the establishment, operation and decommissioning of the proposal. The EIS must describe what measures would be implemented to avoid, minimise, mitigate, offset, manage and/or monitor the potential impacts on: • Land Resources – including an assessment of the potential impacts on: - soils and land capability, including an assessment of activities that would cause erosion and the measures proposed to minimise erosion and sedimentation; - landforms and topography, including cliffs, rock formations, steep slopes, etc; and - land use, including agricultural, forestry and conservation lands; • Water Resources – including: - identification of any licensing requirements or other approvals under the <i>Water Act 1912</i> and/or <i>Water Management Act 2000</i>; - an assessment of potential impacts on the quality and quantity of existing surface and ground water resources, including impacts from the exposure of potential acid sulphate soils; - a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant Water Sharing Plan or water source embargo; - an annual site water balance for representative years of the proposed life of the project; and - a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts; - a flood impact assessment which identifies impacts on local and regional flood regimes;

	• Biodiversity – including: - accurate predictions of any vegetation clearing on site or for any road upgrades; - a detailed assessment of the potential impacts of the development on any threatened species or populations or their habitats, endangered ecological communities and groundwater dependent ecosystems; - a detailed assessment of any indirect impacts on the biodiversity values of the Broadwater and Bundjalung National Parks; - a detailed description of the measures to maintain or improve the biodiversity values within the site in the medium to long term; and - consideration of a Biodiversity Offset Strategy; • Heritage – including: - 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; and - a Historic heritage assessment (including archaeology) which must include a statement of heritage impact (including significance assessment) for any State significant or locally significant historic heritage items; • Traffic and Transport – including: - an assessment of potential traffic impacts on the capacity, efficiency and safety of the road network, in particular the assessment must include a Road Safety Audit to review the condition of the proposed routes and identify any safety issues which may exacerbated by the development; and - a description of the measures that would be implemented to maintain and/or improve the capacity, efficiency and safety of the road network in the surrounding area over the life of the project; • Noise and Vibration - particularly any potential noise impacts on nearby private receptors due to construction, operation or road haulage; • Air Quality – particularly any potential dust impacts on nearby private receptors from construction, operation or road haulage; • Rehabilitation – including: - a detailed description of the proposed rehabilitation measures that would be undertaken during quarry closure; - a detailed rehabilitation strategy, including justification for the proposed final land form and consideration of the objectives of any relevant strategic land use plans or policies; and - the measures that would be undertaken to ensure sufficient financial resources are available to implement the proposed rehabilitation strategy; • Waste Management – including importation of any waste material to the site; • Hazards and Risks – including any transport or storage of dangerous goods; • Visual Amenity; • Agricultural Impacts; • Utilities and Services; and • Social and Economic Impacts.
Environmental Planning Instruments	The EIS must assess the proposal against the relevant environmental planning instruments, including (but not limited to): • <i>State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007;</i> • <i>State Environmental Planning Policy No. 33 – Hazardous and Offensive Development;</i> • <i>State Environmental Planning Policy No. 44 – Koala Habitat Protection;</i> • <i>State Environmental Planning Policy No. 55 – Remediation of Land;</i> • <i>Richmond Valley Local Environmental Plan 2012;</i> and • relevant development control plans and section 94 plans, strategies and management plans.

Guidelines	The EIS must take into account relevant State Government policies and guidelines, in particular the <i>Industrial Noise Policy</i> (EPA 2001), <i>Aquifer Interference Policy</i> (DPI 2012), <i>Soils and Construction: Managing Urban Stormwater</i> (Landcom 2004), <i>Guidelines for Fresh and Marine Water Quality and Guidelines for Water Quality Monitoring and Reporting</i> (ANZECC), <i>Using the ANZECC Guideline and Water Quality Objectives in NSW</i> (DEC), <i>Approved Methods for the Modelling and Assessment of Air Pollutants</i> (DEC), <i>Approved Methods for Sampling and Analysis of Air Pollutants</i> (DEC), <i>Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft</i> (DECC 2004), <i>The Threatened Species Assessment Guideline – The Assessment of Significance</i> (DECC 2007), <i>Draft Guidelines for the Assessment of Aquatic Ecology in EIA</i> (DUAP 1998) <i>Guide to investigation, assessing and reporting on Aboriginal cultural heritage in NSW</i> (OEH 2011), <i>Code of Practice of the Archaeological Investigation of Aboriginal Objects in New South Wales</i> (DECCW 2010), <i>Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010</i> (DECCW 2010), <i>Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation</i> (DEC 2005), <i>Guide to Traffic Generating Development</i> (RTA), <i>Road Design Guide</i> (RTA) or latest versions. During the preparation of the EIS you must consult the Department's EIS Guideline – Extractive Industries – Quarries. This guideline is available for purchase from the Department's Information Centre, 23-33 Bridge Street, Sydney or by calling 1300 305 695.
Consultation	During the preparation of the EIS, you must consult with Council and should consult with the relevant local, State and Commonwealth government authorities, service providers and community groups, and address any issues they may raise in the EIS. In particular, you should consult surrounding landowners and occupiers that are likely to be impacted by the proposal. Details of the consultations carried out and issues raised must be included in the EIS.

Appendix C – Stakeholder consultation

Doonbah Quarry Community Consultation

Date: Saturday, 15th November 2014

Please fill in details below.

[illegible]

GOOD
INFO

Appendix D – Soil and Water Management Plan



Rixa Quarries Pty Ltd

Proposed Expansion of Doonbah Quarry

Soil and Water Management Plan

November 2014

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1. Introduction

1.1 Background

GHD has been engaged by Rixa Quarries Pty Ltd (Rixa) to prepare an Environmental Impact Statement (EIS) for the proposed expansion of the Doonbah Quarry ('the quarry'), an existing sand quarry located at Lot 2 DP 1040274 on Woodburn Evans Head Road, Doonbah, NSW (the 'subject site'). The location of the quarry is shown in Figure 2-1 and is within the Richmond Valley Council (RVC) Local Government Area (LGA). The quarry would be operated under a 'profit a prendre' (royalty) arrangement with the owner of the property.

Quarry operations at the site date back to 1961. In 1997, the quarry was granted approval to extract up to 35,715m³ (approximately 57,000 tonnes) per annum (DA 128/95). The quarry has now exhausted the resources available under this approval.

The proposal is to expand the existing quarry to have an extraction rate of up to 490,000 tonnes per annum. The primary purpose of the quarry would be to supply sand to the current and proposed Pacific Highway upgrade works, and for supply to local councils and contractors. The quarry is well located to service the Pacific Highway upgrade works between Woolgoolga and Ballina which is to take place over a timeframe of approximately 5 years.

To provide the required material, the extraction area of the quarry would need to be expanded from 6.28 ha to approximately 18.3 ha, with a depth of 15 metres below ground level or -12 metres Australian Height Datum (AHD). It is estimated that the quarry would have an available resource of 4,000,000 tonnes which, depending on demand, could result in an extraction period of between 20 and 30 years.

1.2 Aim

This report presents the results of a soil and water management assessment of the proposed expansion, and has been prepared as supporting information to the EIS. It addresses the Director General's Requirements (DGRs) for the EIS in relation to soil and water management as described below.

The EIS is required for the proposed expansion in accordance with the Environmental Planning and Assessment Act 1979 (EP&A Act) and the Environmental Planning and Assessment Regulation 2000, to assess the significance of the potential environmental impacts of the proposal.

1.3 Objectives and Scope

1.3.1 Surface Water

- An assessment, review and description of the existing hydrological conditions. This included a review all available information, review of the topography and information provided by the geotechnical (and other) assessments. Consideration was given to the Water Management Act 2000.
- An assessment of potential surface water quantity/quality impacts associated with the proposed works. This required a review of the proposed site conditions, to determine potential impacts. The annual site water balance was reviewed for representative hydrological years to assess any impacts on the water budget together with an assessment on any likely local and regional flood conveyance, based on available information.

- Nomination of measures to mitigate any potential impacts associated with the proposed works. The mitigation measures would address impacts for both construction and operational phases of the project. Treatment measures would generally be consistent with the Landcom 'Blue Book' and would nominate conceptual sizes and locations of the management facilities. Monitoring and maintenance requirements for the facilities would be listed.

1.3.2 Groundwater

- Review of the existing local and regional hydrogeological environment including the main aquifer units, groundwater levels and groundwater quality.
- Review of the relevant water management legislation for the site (Water Act 1912 and Water Management Act 2000). It is understood that there is a draft Water Sharing Plan currently under development (Northern Coastal Sands Groundwater Sources) that is expected to commence in 2014 and will regulate the interception of groundwater at the site after this time.
- Identification of the sensitive groundwater receptors, including Groundwater Dependent Ecosystems (GDEs) and registered groundwater bore users. This will involve searches of the Australian Atlas of Groundwater Dependent Ecosystems as well as the NSW Groundwater Bore Database.
- Install three groundwater wells. The groundwater wells would be developed and the surface water level recorded. Water samples would be collected and analysed for pH, EC, anions, cations and dissolved metals.
- Predict drawdown in groundwater levels as a result of the proposed development. This will be undertaken using analytical calculations. Numerical groundwater modelling will not be undertaken for this assessment. Assess changes to groundwater quality that may occur as a result of groundwater drawdown and proposed mining activities.
- Assess potential water table and groundwater quality impacts against the relevant criteria in the NSW Aquifer Interference Policy (2012). The criteria for Highly Productive Coastal Sands Water Sources will be adopted.
- Identify avoidance and mitigation measures that should be adopted to keep impacts below the Level 1 impact criteria under the NSW Aquifer Interference Policy.

1.4 Limitations

This report has been prepared by GHD for Rixa Quarries Pty Ltd and may only be used and relied on by Rixa Quarries Pty Ltd for the purpose agreed between GHD and the Rixa Quarries Pty Ltd as set out in Section 1 of this report.

GHD otherwise disclaims responsibility to any person other than Rixa Quarries Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

GHD has prepared this report on the basis of information provided by Rixa Quarries Pty Ltd and others who provided information to GHD (including Government authorities), which GHD has

not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

2. Site description

2.1 Location

The site is located at 405 Woodburn-Evans Head Road, Doonbah, NSW, about 5 kilometres north west of Evans Head (see Figure 2-1). It legally described as Lot 2 DP 1040274 and covers an area of about 50 hectares. Richmond Valley Council is the local government authority.

2.2 Description of quarry operations (previous and proposed)

The sand quarry was originally established in 1961. Approval to increase the extraction rate to 50,000 tpa was granted on 19 February 1997 (DA128/95).

In the past, sand was extracted by excavator, screened, stockpiled and loaded onto trucks for transport. This limited the depth of the extraction pit to about 5m. More recently, a suction dredge was employed to extract material from the base of the excavation. The material was transported via a pipeline to a turkeys nest dam where the sand was collected by an excavator, screened, stockpiled and loaded onto trucks for transport. The water flowed from the turkeys nest to a settling pond which then overflowed back into the extraction pit. The excavation pit overflowed into a series of drainage channels and a dam before discharging from site in the south west corner of the site.

For the expansion, a screening plant consisting of a screen and cyclone will be used for separating the sand into different sizes. The sand will then be stockpiled and loaded onto trucks for transport, as before. Water and sediment from the cyclone will flow into a series of settling ponds before overflowing back into the excavation pit, as shown in Figure 1, Appendix A. The excavation pit will overflow through a series of drainage channels, to an existing settlement pond, before discharging via existing dams from the site.

A site office, amenities and car parking will be located at the entrance to the site. Water for the site office is collected in a rainwater tank and the portable toilet is pumped out on an as needs basis. A series of containers will be used to store miscellaneous tools and equipment.

All plant and equipment proposed for use at the site would either be diesel or petrol driven. Fuel would not be stored on the site but transported to site when necessary, in a designated refuelling vehicle.

A weighbridge is proposed to be installed and would be located along the access road in order to accurately monitor the volume of material exiting the site.

Access to the site is from Woodburn-Evans Head Road via an existing gravel driveway in the south-eastern corner of the site.

2.3 Surrounding land use

To the north, east and west the site is surrounded by heavily vegetated wetland. A row of small rural residential properties are located along the southern boundary and separate the site from the Woodburn-Evans Head Road.

2.4 Climate

The region is best described as sub-tropical with warm, wet summers and dry, mild winters. Mean summer temperatures range from a maximum of about 28°C and a minimum of about 19°C. Mean winter temperatures range from a maximum of about 19°C and a minimum of about 10°C. The mean annual rainfall is 1,573mm. This falls relatively evenly for the first six months,

with June having the highest mean of 203mm. Rainfall then eases during July to September before slowly increasing again from October.

2.5 Topography

The site is low lying and relatively level with elevations ranging from about 2.5m Australian Height Datum (AHD) in the west to about 3.5m AHD in the east. The low point and site discharge is in the south-western corner of the site.

Figure 2, Appendix A shows the previous quarry operations have created two excavations approximately 6.7 ha in total area and 1 m to 5 m deep. A series of smaller basins have been constructed, which include two larger dams along the southern boundary of the site (one along the southern boundary and one in the south western corner of the site) together with 8 to 9 smaller ponds along the western boundary. The ponds along the western boundary are reported to be fish ponds and not used for the quarry operation.

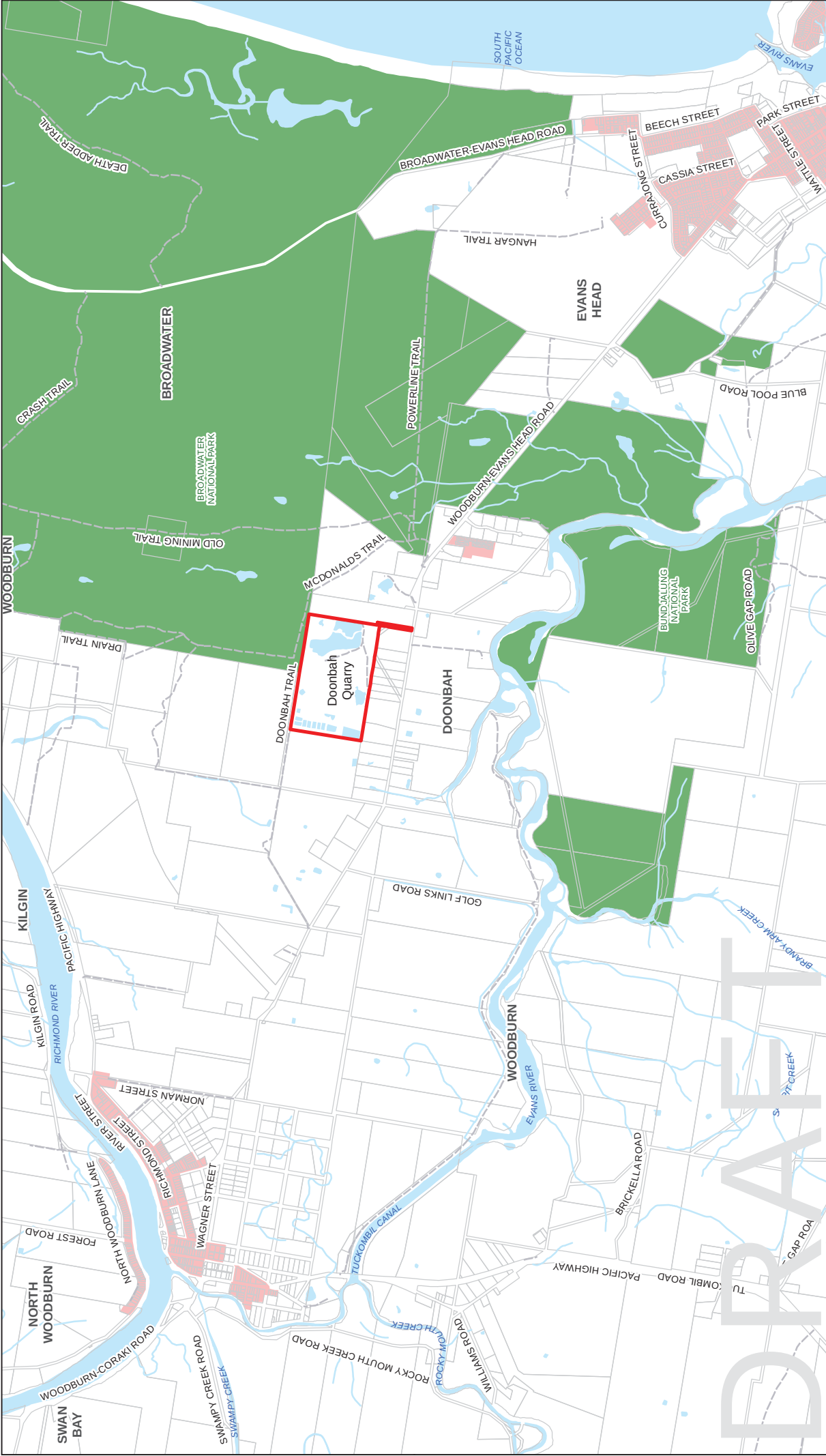
2.6 Geology and soils

According to the Lismore 1:100,000 and 1:25,000 Coastal Quaternary Geology Map Series (Hashimoto and Troedson, 2008) the site is defined as being Estuarine Plain System where the Quaternary layer of the site is a layer of Pleistocene tidal-delta flat which consists of marine sand, silt, minor clay, indurated sand and shell. The North East corner of the site is defined as being Coastal Barrier System with Pleistocene beach-ridge swale and dune-deflation hollow which consists of marine sand, indurated sand, organic mud and peat.

Between 24 February 2014 and 28 February 2014, a total of seven boreholes (BH1 – BH7) were drilled within or on the edge of the proposed area to be excavated, as shown in Figure 2-2. Boreholes were drilled to depths ranging from 15.95m to 16.45m below ground level (bgl). Borehole logs are presented in Appendix B.

As shown by the borehole logs, the boreholes encountered a number of sandy layers extending to over 15m bgl. These layers were described as generally dark grey sandy topsoil to a depth of 0.2m bgl, a layer of yellow to brown sand that increases in depth across the site from west to east. The layer of yellow to brown sand has varying thickness that reaches a maximum of approximately 13m in the east. Below this layer there is a layer of pale grey sand. The pale grey sand extends from 0.2 to over 16 m bgl in the east while in the most western borehole it extends from 14 m bgl to 15.2 m bgl. One borehole encountered sandstone bedrock.

The site has been mapped as Class 3 acid sulfate soils (ASS) and the assessment contained in Appendix C confirms the soils are ASS.



Paper Size A4

0 250 500 750 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

LEGEND

- Doonbah Quarry
- Track
- Watercourse
- Waterbody
- Cadastre
- Built Up Area
- National Park

Rixa Quarries Pty Ltd
Doonbah Quarry

GHD

Job Number 22-17200
Revision A
Date 07 Apr 2014

Study Area

Figure 2-1

2.7 Surface water

Surface water runoff generally collects within the extraction areas (which have become lakes), dams, ponds and drainage lines. Should the excavation lake overflow, this would discharge to an overflow channel along part of the northern boundary, which thereafter bisects the site in a north-south direction, bypassing the dam along the southern boundary and discharging to the dam in the south-western corner of the site. The excavation lakes currently act as sediment control structures for the quarry operation.

Once offsite, the stormwater is reported to discharge to a dish drain and flow west through the adjacent wetland, ultimately draining to the Richmond River. Water quality of excavation lake appears relatively clear. Limited water quality data exists, but results from a sample (SW1) collected from the main lake are presented in Table 1. The results indicate the water is moderately acidic, is sodium chloride/sulfate dominant and has elevated aluminium, copper and zinc concentrations compared to the ANZECC (2000) guidelines.

Table 1 ANZECC assessment

Parameter	Units	LOR	ANZECC	Large Lake (SW1)	Small Lake
Temperature	C ^o	0.1	–	27.1	27.7
DO	%	0.1	8.5–110	83.4	69.4
Conductivity	µS/cm	0.1	2,200	257.7	132.5
pH	pH Units	0.01	6.5–8.0	4.14	5.06
Aluminium	mg/L	0.01	0.055	3.84	
Arsenic	mg/L	0.001	0.024	0.002	–
Cadmium	mg/L	0.0001	0.0002	<0.0001	–
Chromium	mg/L	0.001	0.001	<0.001	–
Copper	mg/L	0.001	0.0014	0.022	–
Nickel	mg/L	0.001	0.011	0.01	–
Lead	mg/L	0.001	0.0034	<0.001	–
Zinc	mg/L	0.005	0.008	0.024	–

Note: **GREY** cells indicate parameters outside of ANZECC/ARMCANZ (2000) 95% default trigger values

2.8 Groundwater

The primary groundwater source in the vicinity of the Project Application Area is the coastal sand aquifer, which is considered to be a highly productive coastal sands water source due to its high yield and low salinity. A minor groundwater source would occur in the porous and

fractured rock underlying the sand layers. The porous and fractured groundwater source will not be intercepted by the project and therefore is not discussed further.

2.8.1 Coastal sand water source

The coastal sand groundwater source throughout the Project Application Area and its vicinity forms an unconfined aquifer of thickness of 15 m or greater. The regional aquifer is recharged by rainfall and discharges to surface waterbodies including the Richmond River, Evans River and Pacific Ocean.

Standpipe piezometers were installed in boreholes BH1, BH2 and BH3 (named GW1, GW2 and GW3) to depths of approximately 4m bgl to allow for ongoing groundwater monitoring. Groundwater levels measured in March 2014 ranged from -0.8 to -0.99 m AHD. These levels were used to plot local groundwater elevation contours shown in Figure 2-2. Based on the contours, the local groundwater flow direction at this time was to the west. A coastal unconfined sand aquifer is likely to have natural variation in groundwater levels in the order of 2m based on review of NSW Office of Water bores adjacent to the site.

Groundwater samples collected from the site in March 2014 indicate that the coastal sand groundwater source is fresh and slightly acidic to neutral. The Piper Diagram shown in Figure 2-3 indicates that the groundwater is sodium chloride/sulfate dominant at GW1 and sodium bicarbonate/sulfate dominant at GW2 and GW3. The groundwater quality at GW1 is similar to the main lake and appears to be influenced by rainfall and some acidification of Acid Sulfate Soil (ASS). Groundwater quality at GW2 and GW3 is influenced by rainfall and possibly by carbonate minerals within the sand layers. Based on this monitoring data, it appears that the existing impact of ASS on groundwater quality due to sand mining extends less than 100m from the excavation area.

Dissolved metal concentrations, pH and electrical conductivity (EC) at GW1, GW2 and GW3 have been assessed against ANZECC/ARMCANZ (2000) default freshwater trigger values (Table 2). Aluminium, chromium, copper and zinc concentrations are currently elevated when compared to default trigger values.

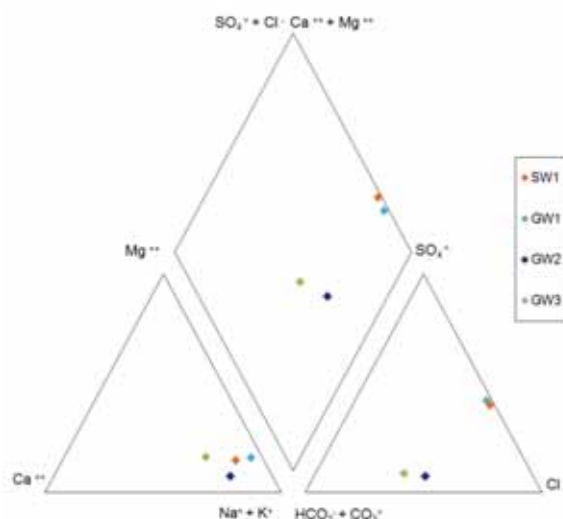


Figure 2-3 Piper Diagram

Table 2 Groundwater Quality Assessment

Parameter	Units	LOR	ANZECC	GW1	GW2	GW3
pH	pH Units	0.01	6.5-8.0	4.8	6.7	7.1
Conductivity	µS/cm	0.1	2,200	132	271	336
Aluminium	mg/L	0.01	0.055	1.93	1.37	0.83
Arsenic	mg/L	0.001	0.024	0.013	0.006	0.012
Cadmium	mg/L	0.0001	0.0002	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.001	0.003	0.002	0.009
Copper	mg/L	0.001	0.0014	0.005	0.076	0.005
Nickel	mg/L	0.001	0.011	0.002	0.004	0.004
Lead	mg/L	0.001	0.0034	0.003	<0.001	0.001
Zinc	mg/L	0.005	0.008	0.098	0.048	0.193

Note: GREY cells indicate parameters outside of ANZECC/ARMCANZ (2000) default trigger values

2.8.2 NSW Bore Database Search

A search of the NSW Groundwater Bore Database was undertaken to identify registered bores within a 2km radius of the Project Application Area. The search identified 39 bores, with almost half the bores (18) registered as monitoring/test bores, four bores uses were unknown, three bores were registered for town water supply and the remainder (14) being registered for domestic, recreational, irrigation and / or stock use. Approximate bore location information and bore details are outlined in Appendix D. Note that the new monitoring bores installed as part of this project did not appear in the NSW Groundwater Bore Database at the time of the search. Bore logs for these bores are shown in Appendix B.

The registered domestic and stock bores that were identified primarily extract groundwater from the coastal sand aquifer. Most of the domestic and stock bores were located to the south east and south west of the site, with two bores to the far north. All of these bores had yields of 2.6L/s or less.

Of the four Town Water Supply bores identified, all are located to the far west of the site. The closest of these bores was approximately 1km from the site. Three of these bores extracted groundwater from the sand layer and all had yields greater than 5L/s. The fourth bore (GW032024) had no yield or water bearing zone data.

The location of the monitoring bores ranged from the north, west and to the south east. Most of these bores lacked yield data. Of the bores that had recorded yields, all had high yields greater than 5L/s.

Overall, the search of the NSW Groundwater Bore Database indicates that there is groundwater usage and reliance for domestic, irrigation, stock watering and town water supply purposes in the vicinity of the Project Application Area.

2.8.3 Groundwater Dependant Ecosystems

The potential vegetation GDEs within the vicinity of the Project Application Area have been mapped by Bureau of Meteorology in the Groundwater Dependant Ecosystem Atlas. They include ecosystems that rely on the surface presence of groundwater and ecosystems that rely on the subsurface presence of groundwater.

Ecosystems that rely on the surface presence of groundwater include:

- Coastal lagoons and lakes
- Broadwater National Park: Coastal lagoons and lakes
- Ecosystems that rely on the subsurface presence of groundwater include:
 - Melaleuca quinquenervia, Eucalyptus tereticornis, Lophostemon suaveolens woodland on coastal alluvial plains
 - Closed heath on seasonally waterlogged sand plains
 - Eucalyptus tereticornis woodland to open forest on alluvial plains
 - Corymbia citriodora, Eucalyptus crebra open forest on sedimentary rocks
 - Complex notophyll vine forest on Cainozoic igneous rocks. Altitude <600m
 - Open Coastal Brushbox
 - Paperbark

It is considered that all or parts of these vegetation communities are potentially GDEs. It is noted that there are no known GDEs inside the Project application area. Based on the findings of the search of the Groundwater Dependant Ecosystem Atlas the closest distance between a potential GDE and the Project application area is approximately 250m to the south of the site.

2.9 Flooding

Referring to Figure 2-1, the site is located between Evans River to the south and the Richmond River to the north-west. The site is subject to backwater flooding from the Richmond River, with flood events discharging from north-west to south-east across the site. A review of the flood data shows that:

- The site is mostly noted as being in a High Depth Hazard flood zone, where floodwaters are deep but are not flowing with high velocity. The excavation lake areas on the site are designated Rare High Floodway Hazard areas and may carry significant volumes of floodwater during a 500-year ARI flood.
- In a 20-year event flood levels are approximately 3.85m AHD across most of the site, with flood depths of approximately 0.8m. In a 100-year event flood levels are approximately 5m AHD across most of the site, with flood depths of approximately 1.5m.
- Flood velocities are very slow moving at approximately 0.2 m/s.

In consideration of the above and the proposed operation, impacts to local and regional flood regimes is considered to be negligible. Since the operation would remove soil from the site, more flood storage may be available on the site reducing flood risk offsite. However this is likely to be marginal, since antecedent conditions before the flood arrival may well fill available flood storages on the site.

2.10 Water balance

A site water balance has been undertaken, with estimates of site operational water requirements (amenities, road/site dust control) provided in Table 3 and Table 4. Due to the recyclable nature of the water used in the dredging process, the dredging process was not considered as part of the water balance calculations.

Table 3 Site Operational Assumptions

Item	Existing	Developed
Staff On Site	1	5
Length of unsealed road	420m	0m
Site Operational Area	4.70 Ha	4.70 Ha
Basin Surface area	6.76 Ha	16.94 Ha
Operational Days (per year)	200	200

Table 4 Water usage Assumptions

Item	Usage rate	Usage	
		Existing	Developed
Amenities for staff	0.03 KL/Day/Person	0.03 KL/Day	0.15 KL/Day
Road Dust Suppression	15 KL/Day/km	6.30 KL/Day	0 KL/Day
General Dust Control	3 KL/Ha/Day	14.10 KL/Day	14.10 KL/Day
TOTAL (for 200 days)		4.09 ML/ Year	2.85 ML/Year

A MUSIC model was developed to represent the existing and developed scenarios for the site. Daily rainfall data for the nearest rainfall station with a considerable length of observations (Alstonville – 058131) was used to simulate rainfall at the site. Similarly nearby historical rainfall records were used to determine representative wet, dry and average rainfall years to model the site under various conditions.

The results in Table 5 show that sufficient runoff would be generated from the operational area to meet operational water requirements. Surplus water captured in the new excavation on site would discharge via the existing flow paths to the south-west corner of the site.

Table 5 Quarry operational site water balance

Scenario	Water Demand (ML/Year)	Evaporative Loss (ML/Year)	Runoff Captured by Basin (ML/Year)	Runoff overflow from Basin. (ML/Year)
Existing	4.09	102.41	161.96 (average year) 89.59 (dry year) 272.98 (wet year)	65.18 (average year) 15.88 (dry year) 169.46 (wet year)
Developed	2.85	257.65	334.83 (average year) 193.22 (dry year) 548.35 (wet year)	113.09 (average year) 18.36 (dry year) 306.62 (wet year)

3. Legislative context

3.1 Director General's requirements

The DGRs for the EIS in relation to water resources are shown in Table 6 with a reference to the location of the details addressing each DGR within this report.

Table 6 Director General's Requirements and section reference

Director General's Requirements	Section Addressed
Identification of any licencing arrangements or other approvals under the Water Act 1912 and/or Water Management Act 2000	Section 4.2.2
An assessment of potential impacts on the quality and quantity of existing surface and groundwater resources, including impacts from the exposure of potential acid sulphate soils	Section 4.1
A description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant Water Sharing Plan or water source embargo	Section 3.2
Annual site water balance for representative years of the proposed life of the project	Section 2.10
A detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts	Section 3.3
A flood impact assessment which identifies impacts on local and regional flood regimes	Section 2.9

3.2 Water Act 1912

The *Water Act 1912* governs access, trading and allocation of licences associated with both surface and underground water for water sources where a Water Sharing Plan (WSP) has not been put in place. The elements to which the Water Act 1912 applies include extraction of water from a river, extraction of water from underground sources, aquifer interference and capture of surface runoff in dams.

At this point in time, the *Water Act 1912* applies to groundwater interference, bore installation and extraction of groundwater within the Project Application Area. Currently the site does not have a licence to extract groundwater under the *Water Act 1912*. Any interference and/or removal of groundwater as a result of the Project will need to be licenced under the *Water Act 1912*.

3.3 Water Management Act, 2000

The objectives of this Act are to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations and, in particular:

- a. to apply the principles of ecologically sustainable development

- b. to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality
- c. to recognise and foster the significant social and economic benefits to the State that result from the sustainable and efficient use of water, including:
 - (i) benefits to the environment
 - (ii) benefits to urban communities, agriculture, fisheries, industry and recreation
 - (iii) benefits to culture and heritage
 - (iv) benefits to the Aboriginal people in relation to their spiritual, social, customary and economic use of land and water
- d. to recognise the role of the community, as a partner with government, in resolving issues relating to the management of water sources
- e. to provide for the orderly, efficient and equitable sharing of water from water sources
- f. to integrate the management of water sources with the management of other aspects of the environment, including the land, its soil, its native vegetation and its native fauna
- g. to encourage the sharing of responsibility for the sustainable and efficient use of water between the Government and water users
- h. to encourage best practice in the management and use of water

At this stage, it is envisaged that a Controlled Activity Approval under the Water Management Act 2010, will not be required. The reason being, that there do not appear to be any drainage lines that meet the definition of a “river” under this Act.

The Project Application Area is not currently covered by a WSP, although a draft WSP for the Northern Coastal Sands Groundwater Sources is currently being prepared by NSW Office of Water. This WSP will include the Project Application Area and is anticipated to commence in 2014. Therefore, at this point in time any interference and extraction of alluvial groundwater throughout the Project Application Area will not require a water access licence (WAL) under the WM Act. Groundwater licences granted under the Water Act 1912 will be converted to licences under the WM Act once the WSP commence.

3.4 NSW Aquifer Interference Policy

The NSW Aquifer Interference Policy was finalised in September 2012 and clarifies the water licencing and approval requirements for aquifer interference activities in NSW, including the taking of water from an aquifer in the course of carrying out mining. Many aspects of this Policy will be given legal effect in the future through an Aquifer Interference Regulation. Stage 1 of the Aquifer Interference Regulation commenced on 30 June 2011.

This Policy outlines the water licensing requirements under the *Water Act 1912* and WM Act. A water licence is required whether water is taken for consumptive use or whether it is taken incidentally by the aquifer interference activity (such as groundwater filling a void) even where that water is not being used consumptively as part of the activity’s operation. Under the WM Act, a water licence gives its holder a share of the total entitlement available for extraction from the groundwater source. The water access licence must hold sufficient share component and water allocation to account for the take of water from the relevant water source at all times.

Sufficient access licences must be held to account for all water taken from a groundwater or surface water source as a result of an aquifer interference activity, both for the life of the activity and after the activity has ceased. Many mining operations continue to take water from groundwater sources after operations have ceased. This take of water continues until an aquifer system reaches equilibrium and must be licensed.

The NSW Aquifer Interference Policy requires that potential impacts on groundwater sources, including their users and GDEs, be assessed against minimal impact considerations, outlined in Table 1 of the Policy. If the predicted impacts are less than the Level 1 minimal impact considerations, then these impacts will be considered as acceptable. The minimal impact considerations relevant to the Project are outlined in Appendix F.

3.5 NSW State Groundwater Policy

The objective of the NSW State Groundwater Policy Framework Document (NSW Government 1997) is to manage the State's groundwater resources so that they can sustain environmental, social and economic uses for the people of NSW. NSW groundwater policy has three component parts:

- NSW Groundwater Quantity Protection Policy.
- NSW Groundwater Quality Protection Policy.
- NSW Groundwater Dependent Ecosystems Policy.

3.5.1 NSW Groundwater Quantity Protection Policy

The principles of this policy include:

- Maintain total groundwater use within the sustainable yield of the aquifer from which it is withdrawn.
- Groundwater extraction shall be managed to prevent unacceptable local impacts.

All groundwater extraction for water supply is to be licensed. Transfers of licensed entitlements may be allowed depending on the physical constraints of the groundwater system.

3.5.2 NSW Groundwater Quality Protection Policy

The objective of this policy is the ecologically sustainable management of the State's groundwater resources so as to:

- Slow and halt, or reverse any degradation in groundwater resources.
- Direct potentially polluting activities to the most appropriate local geological setting so as to minimise the risk to groundwater.
- Establish a methodology for reviewing new developments with respect to their potential impact on water resources that will provide protection to the resource commensurate with both the threat that the development poses and the value of the resource.
- Establish triggers for the use of more advanced groundwater protection tools such as groundwater vulnerability maps or groundwater protection zones.

3.5.3 NSW Groundwater Dependent Ecosystems Policy

This policy was designed to protect ecosystems which rely on groundwater for survival so that, wherever possible, the ecological processes and biodiversity of these dependent ecosystems are maintained or restored for the benefit of present and future generations.

4. Soil and water management

4.1 Potential impacts

4.1.1 Surface water

The main surface water related soil and water management risks associated with the operation of the expanded Doonbah Quarry are assessed to be:

- The proposed quarry would alter the local topography at the site, which would affect the drainage of surface water. It is likely that surface water from beyond the quarry area would be diverted around the quarry operational area if temporary bunds and stockpiles are located in strategic areas. This could lead to a concentration and discharge of flows rather than distributed discharges. The impact of this could be increased risk of erosion and sedimentation if not adequately managed.
- Surface water discharging from the quarry area could entrain sediment from disturbed areas. If these are not adequately managed, decreased water quality could enter waterways. The sediment could include dust generated from the operation and sediment tracked by vehicular movements on the site.
- Day to day operations would require the handling of chemicals or hydrocarbons, and other contaminants. If management practices are not adequately implemented, then risk of accidental spillage with potential contamination of surface water could exist.
- In consideration of the rainfall and evaporation at the site, after completion of the extraction, it is likely that the quarry pit would remain filled with surface runoff and groundwater. Depending on weather and climate conditions this could take a number of years and water levels could fluctuate.
- Flooding of the site may result in flood risk to staff, result in off-site flood impacts, erode stockpiles and entrain sediment and damage equipment.

4.1.2 Groundwater

Impacts on groundwater of 10 potential situations were analysed. The methodology is provided in Appendix F. The results are displayed in Table 7.

Simulation 1 would be considered the base case where best estimate for hydraulic conductivity, mean recharge and mean evaporation were used. Simulation 2 involved increasing evaporation to the recorded mean December evaporation. Simulation 3 involved increasing evaporation to the maximum monthly recorded value. The monthly maximum recorded evaporation was 229.9 mm recorded in January 1977. Simulation 4 involved reducing the evaporation to the recorded mean June evaporation.

Simulation 5 and 6 were sensitivity analysis of the horizontal conductivity, which involved modifying the horizontal conductivity. Decreasing the horizontal hydraulic conductivity increases the drawdown in the pit. Simulation 7 and 8 were sensitivity analysis of the initial water level in the pit. Varying the water level by 0.5 m had little impact on the level of drawdown in the pit. Simulation 9 and 10 were sensitivity analysis of the Distributed Recharge Flux. Increasing the recharge from rainfall slightly decreased the drawdown in the pit.

Table 7 Results of Groundwater Simulations

Simulation	Horizontal Hydraulic Conductivity Kh1 (m/d)	Initial Saturated Thickness ho (m)	Distributed Recharge Flux W (m/d)	Evaporation (m/d)	Horizontal Groundwater Inflow Q1 (m3/d)	Radius of Influence ro (m)	Saturated Thickness at pit wall hp (m)	Drawdown in Pit (m) (ho – hp)
1	5	12.5	7.50 x10-5	4.145 x10-3	154.8	842.2	12.14	0.36
2	5	12.5	7.50 x10-5	5.800 x10-3	198.5	946.0	11.98	0.52
3	5	12.5	7.50 x10-5	7.416 x10-3	238.3	1031.4	11.82	0.68
4	5	12.5	7.50 x10-5	2.324 x10-3	101.2	694.1	12.31	0.19
5	10	12.5	7.50 x10-5	4.145 x10-3	155.5	843.9	12.32	0.18
6	2.5	12.5	7.50 x10-5	4.145 x10-3	153.5	838.9	11.77	0.73
7	5	13	7.50 x10-5	4.145 x10-3	158.4	851.2	12.64	0.36
8	5	12	7.50 x10-5	4.145 x10-3	151.1	832.9	11.63	0.37
9	5	12.5	1.88 x10-4	4.145 x10-3	196.9	621.8	12.17	0.33
10	5	12.5	3.70 x10-4	4.145 x10-3	238.5	504.7	12.19	0.31

Groundwater Quality

The ASS assessment found potential ASS (PASS) to be present throughout the sand profile at the site. It is likely that the proposed sand extraction will result in a lowering of groundwater pH in the vicinity of the pit lakes due to exposure of the PASS to the atmosphere. Based on monitored impacts from existing sand extraction, it is likely that the reduction in groundwater pH will be limited to a distance of approximately 100 m from the pit lakes. Impact on Water Supply Bores

Under the NSW Aquifer Interference Policy the Level 1 minimal impact considerations for Highly Productive Coastal Sands Water Sources specify that the allowable predicted impact must be less than a 2 m water table decline cumulatively at any water supply work. The predicted drawdown at the pit is less than 2 metres and therefore the predicted impacts of this work will fall within this criterion. It is predicted that under average evaporation conditions the works will have likely have no impact (in terms of level or quality) on existing private bores. The closest of the town water supply bores is approximately over a kilometre from the Project Application Area which lies outside the predicted radius of influence under average evaporation conditions.

Impact on Groundwater Dependant Ecosystems

Under the NSW Aquifer Interference Policy the Level 1 minimal impact considerations for Highly Productive Coastal Sands Water Sources specify that the allowable predicted impact must be less than or equal to 10% cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, at a distance of 40 m from any high priority groundwater dependent ecosystem or high priority culturally significant site listed in the schedule of the relevant WSP.

The likely typical climatic variations for sand are estimated to be in the order of 2 m based on review of NSW Office of Water bores adjacent to the site. Based on the results of the search of the Groundwater Dependant Ecosystem Atlas the closest identified potential GDE lies approximately 250 metres from the Project Application Area boundary. This is likely to be within the radius of influence. The profile of the drawdown is unknown but the maximum drawdown under average evaporation conditions will be 0.36 m. Therefore, it is likely that the drawdown 40 m from the closest GDE will be approximately equal to or less than 10% of cumulative variation in the water table.

In addition as no WSP exists the predicted drawdown could not exceed the Level 1 criterion from the NSW Aquifer Interference Policy. However if it was desired to determine the precise impact on any potential GDEs; the location of any GDEs should be accurately mapped. Monitoring of groundwater levels in the installed bores should be continued to ascertain the actual impact.

4.2 Management measures

The key objective of the soil and water management is to ensure that the potential impacts to soil and water quality are minimised and in accordance with the relevant legislation. To achieve this objective, Rixa Quarries will undertake the following:

- An environmental protection licence must be obtained for the quarry. All relevant conditions relating to soil and water management would be implemented as required by the licence.
- An Environmental Management Plan would be compiled for the quarry which would contain a Soil and Erosion Management Plan. Training would be provided to all quarry staff including relevant sub-contractors on erosion and sediment control practices and the requirements of the Plans through inductions, toolboxes and targeted training.
- Where available, and of appropriate quality, the quarry operation would use recycled runoff for quarry activities.

4.2.1 Surface water

Erosion and sedimentation control

Erosion and sediment controls are to be implemented in accordance with *Managing Urban Stormwater Soils and Construction – Volume 2e Mines and quarries* (DECC, 2008) and include, as a minimum:

- Quarry activities would be programed to minimise the extent and duration of disturbance to vegetation. This would include leaving clearing and initial earthworks in future quarrying areas, until extraction is about to commence.
- Catchment and quarry area runoff would be separated to avoid contamination. This would be achieved by diverting catchment runoff drains around the quarry area. The operational exposed areas would be minimised and all quarry runoff would be treated before discharge from site.
- A hydrocarbon boom will be placed at the outlet of drainage lines from the processing area and around the dredge operation.
- Overflow and runoff from any operational area would be collected and treated in a new settling basin located within the Profit a Prendre boundary, at the south-western point of discharge from Stage 4. The new settling basin would be located immediately upstream of the dam along the southern boundary of the site. Runoff collected in the basin would be used for onsite purposes (dust suppression and operational water) in the first instance. Any additional water would be discharged to the dam along the southern boundary of the site after appropriate treatment.
- All overflow water would be conveyed via the existing drainage channel on the site to the new settling basin. Along the northern boundary the existing channel will be relocated to within the Profit a Prendre boundary. The channel will be located to suite the stage progression of the operation.

- Catch drains, contour and diversion drains across exposed areas would be installed, immediately following clearing, and maintained until the site is stabilised. Key areas of flow concentration would be provided with rock protection to prevent erosion.
- The active work areas and access roads would be stabilised and maintained. Runoff from these areas would be directed to drains that lead to buffer strips. Loose rock, soil, debris etc. would be removed from road surfaces (including sweeping of the road), when required.
- Long term soil stockpiles, access tracks, disturbed areas would be protected from erosion by the implementation of appropriate measures including, but not limited to:
 - Seeding with cover crops
 - Covering with tarp or similar
- Hardstand material, rumble grids or similar would be provided at exit points to minimise the tracking of soil and particulates by vehicles.
- Disturbed areas where work has been completed would be rehabilitated, as soon as possible, to a condition equal to or better than they were before being disturbed.

Material storage and management

- Designated impervious bunded facilities would be provided for cleaning and/or maintenance of vehicles, plant or equipment. These facilities would be located at least 20 metres away from natural and built drainage lines.
- All chemicals and fuels associated with quarry would be stored in roofed and bunded areas. Spill kits would be provided at all chemical storage facilities/compound sites.
- Where refuelling on site is required, the following management practices would be implemented:
 - Refuelling would be undertaken on level ground and at least 20 metres from drainage lines, waterways and/or environmentally sensitive areas
 - Refuelling would be undertaken within the designated refuelling areas with appropriate bunding and/or absorbent material
 - Refuelling would be via a designated refuelling truck
 - Will be attended at all times
 - Spill kits would be readily available and personnel trained in their use. A spill kit would be kept on the refuelling truck at all times
 - Hand tools would be refuelled within lined trays of site vehicles wherever possible
 - An emergency spill kit (such as oil absorbent material) would be available on site at all times to contain and clean up any accidental hydrocarbon spill
 - Any contaminated material would be disposed at an appropriately licensed facility and used spill kit materials replaced.
- Regular checks of vehicles working at the quarry would be conducted to ensure that no oils or fuels are leaking.

4.2.2 Groundwater controls

Licensing of volumes

Currently a WSP is not in place for the Project Application Area. Licence under the WM Act will not be required for water taken from the groundwater. A licence will be required under the Water

Act 1912 for the volume of groundwater taken. Predicted total groundwater inflows under average evaporation conditions is 679.8 m³/d. This would require a yearly licence of 248 ML.

Groundwater monitoring

The installed groundwater bores should be continued to be monitored. Bores should be monitored for groundwater levels, pH and EC. The monitoring of these bores should occur at a minimum of once a month throughout the life of the project.

Storage of fuels

All fuels stored on site must be appropriately stored. Storage of fuels will require bunding around storage containers and any locations where refuelling occurs.

4.2.3 Soil and water management control summary

To mitigate potential impacts, a series of management measures have been identified in the above sections. Table 8 provides a summary of controls, implementation time and responsibility. The controls include a combination of planning, training, physical alterations and monitoring measures that are both proactive and reactive.

Table 8 Summary of soil and water management controls

ID	Measure / Requirement	When to implement	Responsibility
GENERAL			
SW1	Training will be provided to all quarry staff, including relevant sub-contractors on sound erosion and sediment control practices and the requirements from this plan through inductions, toolboxes and targeted training.	Pre-operation Operation	Manager
SW2	An environmental protection licence will be obtained for the quarry. All relevant conditions relating to soil and water management will be implemented as required by the licence.	Pre-operation Operation	Manager
SW3	A groundwater licence will be obtained from NSW Office of Water. All relevant conditions relating to soil and water management will be implemented as required by the licence.	Pre-operation Operation	Manager
SW4	Where available, and of appropriate quality, Rixa Quarries shall use stormwater, recycled water or other water sources in preference to potable water for quarry activities.	Operation	Manager
SOIL EROSION CONTROL			
SW5	Quarry activities will be programmed to minimise the extent and duration of disturbance to vegetation. This will include leaving clearing and initial earthworks in future quarrying areas until extraction is about to commence.	Pre-operation Operation	Site Manager
SW6	Clean and dirty water runoff will be separated to avoid mixing where possible through the use of diversions and clean water drains around the excavation, dams and drainage channels.	Operation	Site Manager
SW7	Wastewater or "dirty" water generated during the operation process will be collected and treated by the settling ponds. The overflow from the settling ponds would be directed into the main excavation before travelling through a series of overflow channels and dams before flowing offsite. See Figure 1, Appendix A.	Operation	Site Manager
SW8	Catch drains, contour and diversion drains across exposed areas will be installed, immediately following clearing, and maintained until the site is stabilised.	Operation	Site Manager
SW9	The active work areas and access roads will be stabilised by sealing or providing a gravel surface that is compacted. Runoff from these areas will be directed to a series of drains that lead to the main excavation. See Figure 1, Appendix A.	Operation	Site Manager
SW10	Long term stockpiles e.g. those not accessed for greater than 10 days, access tracks, disturbed areas will be protected from erosion by the implementation of appropriate measures including, but not limited to: - Seeding with cover crops. - Covering with tarp or similar.	Operation	Site Manager
SW11	Hardstand material, rumble grids or similar will be provided at exit points to minimise the tracking of soil and particulates onto public roads.	Operation	Site Manager
SW12	Vehicle movements from site will be minimised during wet weather if the tracking of mud becomes an issue.	Operation	Site Manager
SW13	Loose rock, soil, debris etc. will be removed from road surfaces (including sweeping of the road), when required.	Operation	Site Manager
SW14	Disturbed areas where work has been completed will be rehabilitated, as soon as possible, to a condition equal to or better than they were before being disturbed.	Operation / Post-operation	Site Manager
ACID SULFATE SOILS			

ID	Measure / Requirement	When to implement	Responsibility
SW15	All ASS or PASS disturbed during quarry activities will be managed in accordance with Acid Sulfate Soil Manual (ASSMAC, 1998) and an ASS Management Plan prepared.	Pre-operation / Operation	Site Manager
DRAINAGE AND WATERWAY			
SW16	Drainage lines will be stabilised against erosion by appropriate selection of channel dimensions, slope and lining, and the inclusion of drop structures and energy dissipaters, as necessary.	Operation	Site Manager
SW17	Drainage lines will incorporate check dams or native vegetation to act as a sediment control.	Operation	Site Manager
SW18	When required, liming and mixing of water will be undertaken at two points, following discharge from the excavation, to achieve a pH of 6.5 – 8.5. See Figure 1, Appendix A.		
MATERIAL STORAGE AND MANAGEMENT			
SW19	Designated impervious bunded facilities will be provided for cleaning and/or maintenance of vehicles, plant or equipment. These facilities will be located at least 20 metres away from natural and built drainage lines and be above the 20 year ARI flood level of 4m AHD.	Operation	Site Manager
SW20	All chemicals and fuels associated with construction will be stored in roofed and bunded areas that are above the 20 year ARI flood level. Spill kits will be provided at all chemical storage facilities/compound sites.	Operation	Site Manager
SW21	All machinery will be stored above the 20 year ARI flood level.		
SW22	A hydrocarbon boom will be placed at the outlet of drainage lines from the processing area and around the dredge.	Operation	Site Manager
SW23	Where refuelling on site is required, the following management practices will be implemented: - Refuelling will be undertaken on level ground and at least 20 metres from drainage lines, waterways and/or environmentally sensitive areas. - Refuelling will be undertaken within the designated refuelling areas with appropriate bunding and/or absorbent material. - Refuelling will be via a designated refuelling truck. - Will be attended at all times. - Spill kits will be readily available and personnel trained in their use. A spill kit will be kept on the refuelling truck at all times. - Hand tools will be refuelled within lined trays of site vehicles wherever possible.	Operation	Site Manager
SW24	An emergency spill kit (such as oil absorbent material) will be available on site at all times to contain and clean up any accidental hydrocarbon spill.	Operation	Site Manager
SW25	Any contaminated material will be disposed at an appropriately licensed facility and used spill kit materials replaced.	Operation	Site Manager
SW26	All site personnel will be trained in the use of spill kits.	Operation	Site Manager
SW27	Remediation of spills will be done as soon as possible after the event has occurred.	Operation	Site Manager
SW28	Regular checks of vehicles working at the quarry will be conducted to ensure that no oils or fuels are leaking.	Operation	Site Manager
MONITORING			

ID	Measure / Requirement	When to implement	Responsibility
SW29	Erosion and sediment controls will be inspected at least daily (with maintenance and/or modifications made as necessary). Inspections and/or maintenance during wet-weather maybe increased where necessary.	Operation	Site Manager
SW30	All sediment basin discharge points will be clearly identified and access made available at all times for inspections or management.	Operation	Site Manager
SW31	All surface water quality monitoring will be undertaken in accordance with the Water Quality Sampling Program (refer to Section 5)	Operation	Site Manager
SW32	All groundwater monitoring will be undertaken in accordance with the Ground Water Sampling Strategy (refer to Section 5)	Operation	Site Manager

5. Surface and groundwater sampling

Sampling of surface water and groundwater will be required to confirm the quarry operation is not impacting on the local environment and complies with the EPL requirements. The aim of the monitoring program will be to:

- Assess the quality of the water discharging from site.
- Determine if the quarry operations are impacting groundwater.
- Assess the effectiveness of the surface water management plan

5.1 Sampling Sites

The surface water sampling site would be at the discharge point identified on Figure 1, Appendix A. The quality of the surface water in the excavations, settling ponds, dams and drainage channels will also be regularly observed.

Three groundwater monitoring wells will be established on the perimeter of the proposed excavation, as shown on Figure 1, Appendix A. Another reference groundwater monitoring well would also be established on the western boundary.

Additional sampling sites may be required if an impact is detected or they are required by the EPL or Government Authorities.

5.2 Sampling frequency

Routine surface water quality sampling will be done at least quarterly with event based sampling following (within 24 hours) rainfall events greater than 20 mm or before discharge offsite.

Groundwater will be monitored quarterly.

Sampling should be undertaken by appropriately trained and qualified personnel to ensure quality monitoring procedures.

If the monitoring detects an impact, the sampling frequency will be increased in consultation with an appropriately qualified consultant or EPA, to further characterise the issue.

5.3 Analysis

The likely water quality impacts from the quarry operations are:

- Suspended solids from the dredging, processing and runoff from disturbed areas.
- Low pH from the disturbance of acid sulfate soils.
- Hydrocarbons from machinery.

To detect if any of the impacts have occurred, the following analysis will be undertaken:

- Total suspended solids or turbidity.
- pH.
- Visual observations of hydrocarbon sheen.

Additional analysis may be required by the EPL.

Turbidity, pH and visual observations of hydrocarbons could be analysed in the field. This would be with the appropriate meters that are regularly calibrated in accordance with the manufacturer's instructions.

Alternatively, samples will be submitted to a NATA accredited laboratory for analysis. Samples will also be submitted to the laboratory for confirmation, if an exceedance of the criteria is recorded. If a hydrocarbon sheen is observed, a sample will be collected and submitted to a NATA accredited laboratory for analysis of:

- Total recoverable hydrocarbons (TRH) (C6-C40).
- Benzene, toluene, ethylbenzene and xylene (BTEX).
- Polycyclic aromatic hydrocarbons (PAHs).

Groundwater level, as AHD, will also be recorded.

Table 9 Summary of monitoring requirements

Sample Type	Sample Location	Sample Method	Frequency	Analysis
Surface water	SW1	Grab sample	Quarterly and within 24hrs of >20mm or discharge offsite	TSS or turbidity pH hydrocarbon sheen (visual observation)
Groundwater	GW1	Bailer Interface probe or tape measure	Quarterly	pH hydrocarbon sheen (visual observation) water level
	GW2	Bailer Interface probe or tape measure	Quarterly	pH hydrocarbon sheen (visual observation) water level
	GW3	Bailer Interface probe or tape measure	Quarterly	pH hydrocarbon sheen (visual observation) water level
	GWREF	Bailer Interface probe or tape measure	Quarterly	pH hydrocarbon sheen (visual observation) water level

5.4 Assessment criteria

Surface water quality will be compared to ANZECC (2000) criteria for the protection of fresh and marine water quality, presented in Table 10. Additional criteria may be required by the EPL. In accordance with the *NSW Aquifer Interference Policy* (NOW, 2012) the “*groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity*”.

If a result exceeds the criteria, an appropriately qualified consultant will be consulted to determine the appropriate course of action to identify the cause of the exceedance. If the exceedance is associated with site activities, remediation measures may need to be investigated.

Groundwater levels will be compared to each other and the reference site GWREF. If a change in water level at any of the groundwater monitoring sites, compared to GWREF, is greater than 10%, allowing for natural variation (NOW, 2012), a hydrogeologist will be consulted to establish whether the groundwater drawdown is associated with site activities or an unrelated off-site activity. If the exceedance is associated with site activities, remediation measures may need to be investigated.

Table 10 Surface water quality criteria

Analyte	Criteria
Total Suspended Solids	50 mg/L
Turbidity	2-25 NTU
pH	6.5-8.0
TRH	7 µg/L
PAH	
Naphthalene	16 µg/L
BTEX	
Benzene	950 µg/L
Xylene (o)	350 µg/L
Xylene (p)	200 µg/L

5.5 Reporting

The results will be recorded in an appropriate database that will be available for inspection by EPA or other regulatory authorities on request. Additional reporting, such as a corrective action plan, will be required if an impact is detected. Depending on the results and the EPL requirements, notification of the EPA may be required. Information to be presented in the action plan includes:

- Description of impact
- Date of impact
- Location of impact
- Cause of impact
- Response to mitigate impact
- Corrective action to prevent recurrence of impact

6. Summary and conclusion

GHD has been engaged by Rixa Quarries Pty Ltd (Rixa) to prepare an Environmental Impact Statement (EIS) for the proposed expansion of the Doonbah Quarry ('the quarry'), an existing sand quarry located at Lot 2 DP 1040274 on Woodburn Evans Head Road, Doonbah, NSW (the 'subject site'). The location of the quarry is within the Richmond Valley Council (RVC) Local Government Area (LGA). The quarry would be operated under a 'profit a prendre' (royalty) arrangement with the owner of the property.

Quarry operations at the site date back to 1961. In 1997, the quarry was granted approval to extract up to 35,715 m³ (approximately 57,000 tonnes) per annum (DA 128/95). The quarry has now exhausted the resources available under this approval and the proposal is to expand the existing quarry to have an extraction rate of up to 490,000 tonnes per annum.

The proposed quarry could potentially have the following key impacts on surface water:

- The proposed quarry would alter the local topography at the site, which would affect the drainage of surface water and lead to a concentration and discharge of flows rather than distributed discharges. The impact of this could be increased risk of erosion and sedimentation if not adequately managed.
- Surface water discharging from the quarry area could entrain sediment from disturbed areas. Decreased water quality could enter waterways.
- Day to day operations would require the handling of chemicals or hydrocarbons, and other contaminants. If management practices are not adequately implemented, then risk of accidental spillage with potential contamination of surface water could exist.
- In consideration of the rainfall and evaporation at the site, after completion of the extraction, it is likely that the quarry pit would remain filled with surface runoff and groundwater.
- Flooding of the site may result in flood risk to staff, result in off-site flood impacts, erode stockpiles and entrain sediment and damage equipment.

The quarry would intercept the groundwater bearing layers. The drawdown at the quarry perimeter, groundwater flow patterns and directions in the immediate proximity of the quarry perimeter would also be impacted. It is unlikely the impact of the quarry on groundwater would affect sensitive receptors or water quality.

A number of management measures would be implemented to avoid potential impacts associated with the proposed quarry. In summary these include:

- An environmental protection licence must be obtained for the quarry. All relevant conditions relating to soil and water management would be implemented as required by the licence.
- A groundwater licence will be obtained from NSW Office of Water. All relevant conditions relating to soil and water management will be implemented as required by the licence.
- An Environmental Management Plan would be compiled for the quarry which would contain a Soil and Erosion Management Plan. Training would be provided to all quarry staff including relevant sub-contractors on erosion and sediment control practices and the requirements of the Plans through inductions, toolboxes and targeted training.
- Implement erosion and sediment controls in accordance with *Managing Urban Stormwater Soils and Construction – Volume 2e Mines and quarries* (DECC, 2008).

- Develop an Acid Sulfate Management Plan (ASSMP) for the site in accordance with the *Acid Sulfate Soils Assessment Guidelines* (Ahern *et al* 1998).
- The installed groundwater bores should be monitored.

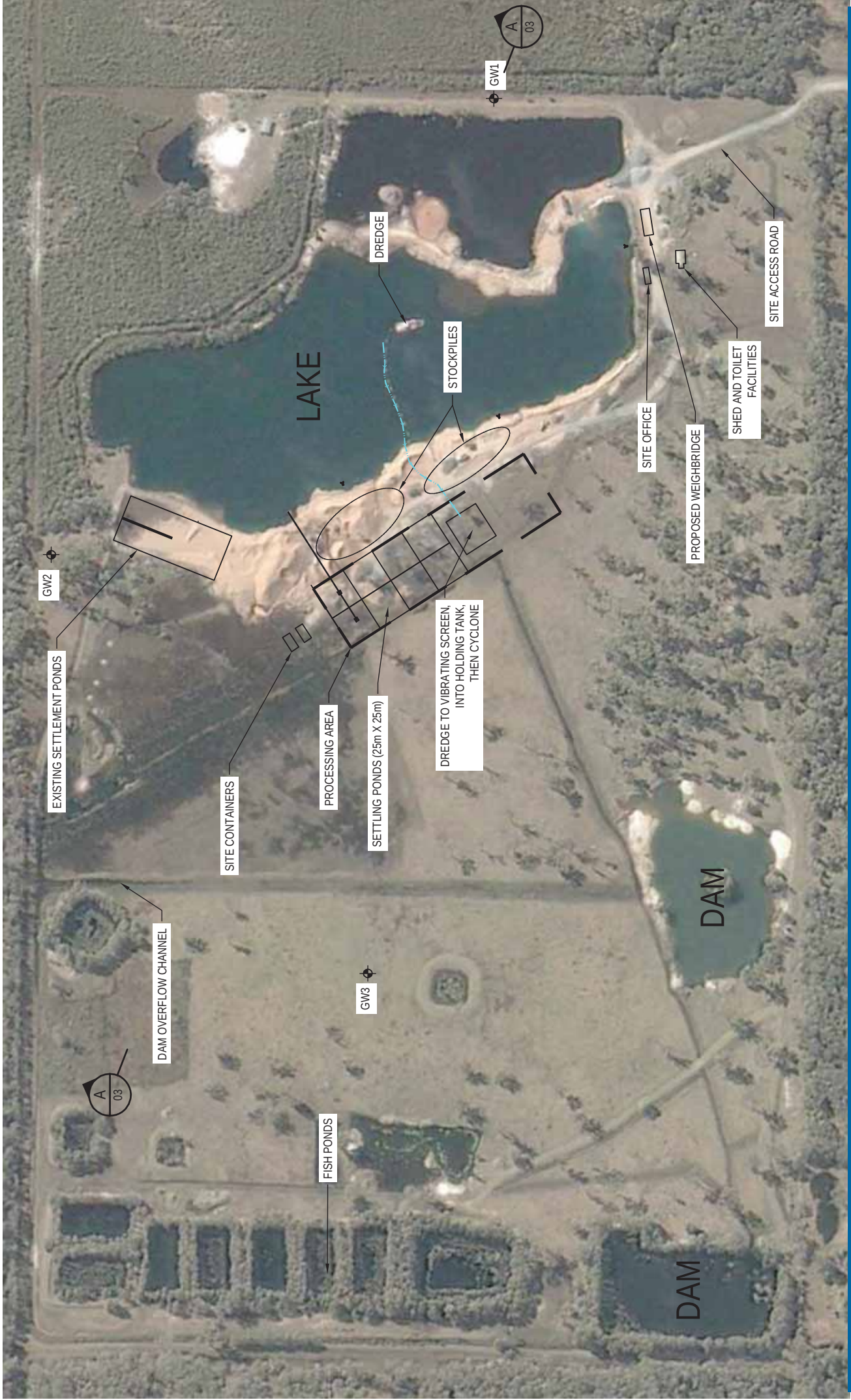
On the basis of implementing the management measures, it is considered that any impacts to surface and groundwater from the proposed quarry, would be adequately mitigated.

7. References

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Appendices

Appendix A – Existing and Proposed Quarry





RIXA QUARRIES
DOONBAH QUARRY
WOODBURN, EVANS HEAD ROAD
EXISTING QUARRY

Job Number 22-17200
Revision A
Date MAR.2014

Figure 01



230 Harbour Drive Coffs Harbour NSW 2450 Australia T 61 2 6650 5600 F 61 2 6650 5601 E cfsmail@ghd.com W www.ghd.com

Proj Date: 14 March 2014 - 11:31 AM
Property: Milla Milla
Call File No.: G:\2017\200\2450\22-17200\fig_01.dwg

Appendix B – Borehole Logs

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH1**SHEET 1 OF 3**

Position : 538051.0 E 6782581.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 25/2/2014 **Date Completed :** 25/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL						Comments/ Observations
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	
1	TC-bit auger	HW casing	▽	SPT 6 20/70mm N=ref ASS	0.20		SP	SAND; dark grey, fine grained, poorly graded, trace organics (TOPSOIL)	SM	MD	0.65m: PASS sub-sample
					0.50		SP	SAND; pale grey, fine grained (ALLUVIUM)	SM	MD	
2	Rotary Wash Boring			SPT 27 25/60mm N=ref	1.20		SP	SAND; dark brown, fine grained, poorly graded, moderate induration/cementation	SM	VD	1.2m: PASS sample
							SP	SAND; Dark grey-brown to black, fine to medium grained, poorly graded, minor induration/cementation	SM	VD	
3				SPT 27 25/60mm N=ref			1.8m: Grey lense 2.0m: Slight odour	VM		2.2m: PASS sub-sample	
4				SPT 27 25/60mm N=ref			From 3.0m: Dark brown, indurated			3.55m: PASS sub-sample	
5				SPT 30 30/100mm N=ref						5.1m: PASS sub-sample	
6				SPT 30 25/80mm N=ref			From 6.5m: Brown to dark brown			6.7m: PASS sub-sample	
7					8.00						

See standard sheets for
 details of abbreviations
 & basis of descriptions

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 CONSULTING GEOTECHNICAL ENGINEERS AND GEOLOGISTS

Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH1**SHEET 2 OF 3**

Position : 538051.0 E 6782581.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 25/2/2014 **Date Completed :** 25/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	
9 <										

See standard sheets for
 details of abbreviations
 & basis of descriptions

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BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH1**SHEET 3 OF 3**

Position : 538051.0 E 6782581.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 25/2/2014 **Date Completed :** 25/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index
17				N=44				End of BH1: 15.95m (Target depth) Monitoring well installed to 4m depth.			
18											
19											
20											
21											
22											
23											
24											

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Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH2**SHEET 1 OF 3**

Position : 537779.0 E 6782947.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 26/2/2014 **Date Completed :** 26/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations
SCALE (m)	Drilling Method	Hole Support Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition Consistency / Density Index	
1	TC-bit auger	HW casing		ASS	0.20	▲▲▲▲▲	SM	SILTY SAND; dark grey, fine grained, poorly graded, trace rootlets/organics (TOPSOIL)	D MD	0.2m: PASS sample
							SP	SAND; grey, fine grained, poorly graded, trace rootlets (ALLUVIUM)	D MD	
2				ASS	0.65		SP	SAND; orange, fine to medium grained poorly graded, minor iron oxide staining	D D	0.8m: PASS sample
				SPT 4 6 7 N=13						
3										1.4m: PASS sub-sample
4					2.00		SP	SAND; dark red-brown, fine to medium grained, poorly graded, iron induration, weakly cemented	M VD	2.3m: PASS sub-sample
				SPT 28 15/70mm N=ref						
5										4.2m: PASS sub-sample
6										5.9m: PASS sub-sample
				SPT 28 25/80mm N=ref						
7										7.4m: PASS sub-sample
				SPT 7 15 20 N=35						
8					6.80		SP	SAND; grey, fine grained, poorly graded, with coarse silt, non-cohesive, slight odour	VM MD	
				SPT 4 7 6 N=13						
					8.00					

See standard sheets for
 details of abbreviations
 & basis of descriptions

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Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH2**SHEET 2 OF 3**

Position : 537779.0 E 6782947.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 26/2/2014 **Date Completed :** 26/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations		
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index	
9	Rotary Wash Boring			SPT 6 18 18 N=36			SP	SAND AS PREVIOUS	VM	VD	8.9m: PASS sub-sample	
10				SPT 5 5 7 N=12				From 9.5m: Becoming pale grey-brown		MD	10.4m: PASS sub-sample	
11					11.00		SP	SAND; pale yellow-brown, fine grained, poorly graded, with coarse silt, slight odour	VM	VD		
12				SPT 9 20 24 N=44							D	11.9m: PASS sub-sample
13				SPT 9 13 19 N=32								13.4m: PASS sub-sample
14												
15				SPT 10 16 24 N=40				14.9m: Moderate odour			14.8m: PASS sub-sample	
16					16.00							

See standard sheets for
 details of abbreviations
 & basis of descriptions

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Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH2**SHEET 3 OF 3**

Position : 537779.0 E 6782947.0 N MGA94 56 **Surface RL:** 10.0m **AHD** **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 26/2/2014 **Date Completed :** 26/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index
				SPT 8 16 23 N=39	16.45		SP	SAND AS PREVIOUS	VM	VD	16.4m: PASS sub-sample
17								End of BH2: 16.45m (Target depth) Monitoring well installed to 3.9m depth.			
18											
19											
20											
21											
22											
23											
24											

See standard sheets for
 details of abbreviations
 & basis of descriptions

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Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH3**SHEET 1 OF 3**

Position : 537446.0 E 6782771.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 25/2/2014 **Date Completed :** 26/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL						Comments/ Observations		
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index			
1	TC-bit auger	HW casing			0.20		SM	SILTY SAND; dark grey, fine grained, poorly graded, trace rootlets/organic (TOPSOIL)	D	MD	1.4m: PASS sub-sample		
		SP			SAND; grey fine grained, poorly graded (ALLUVIUM)		D	MD					
	0.60	SP			SAND; pale grey, fine grained, poorly graded, trace silt, possible moderate coarse silt component, non-cohesive		M	VD					
2	Rotary Wash Boring								From 3.5m: Fine to medium grained, fine dominant. Grades to slightly paler shade (white-grey)	VM		D	2.85m: PASS sub-sample
3													
4													
5													
6													
7												VD	5.9m: PASS sub-sample
8													
					8.00						7.4m: PASS sub-sample		

See standard sheets for
 details of abbreviations
 & basis of descriptions

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 CONSULTING GEOTECHNICAL ENGINEERS AND GEOLOGISTS

Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH3**SHEET 2 OF 3**

Position : 537446.0 E 6782771.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 25/2/2014 **Date Completed :** 26/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	
9	Rotary Wash Boring			SPT 10 16 17 N=33			SP	SAND AS PREVIOUS; pale grey, fine to medium grained, poorly graded, trace silt <		

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Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH3**SHEET 3 OF 3**

Position : 537446.0 E 6782771.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 25/2/2014 **Date Completed :** 26/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index
				SPT 12 21 29 N=50	16.45		SP	SAND AS PREVIOUS, possible organic trace	VM	VD	16.3m: PASS sub-sample
17								End of BH3: 16.45m (Target depth) Monitoring well installed to 4.0m depth.			
18											
19											
20											
21											
22											
23											
24											

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BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH4**SHEET 1 OF 3**

Position : 537695.0 E 6782866.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 26/2/2014 **Date Completed :** 27/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index
1	TC-bit auger	HW casing	▽	ASS	0.20		CH	SANDY CLAY; dark grey, high plasticity, sand is fine grained, trace rootlets (DISTURBED TOPSOIL/FILL)	SM	St	0.1m: PASS sample
				0.50		SM	SILTY SAND; grey, fine grained, poorly graded (ALLUVIUM)	M	MD		
						SP	SAND; orange, fine grained, poorly graded, trace silt	M	VD		
2	Rotary Wash Boring		▽	SPT 5 8 12 N=20					VM		1.4m: PASS sub-sample
SPT 7 12 17 N=29									2.9m: PASS sub-sample		
SPT 6 10 15 N=25									4.4m: PASS sub-sample		
SPT 4 6 17 N=23									5.7m: PASS sub-sample		
SPT 9 11 14 N=25							7.2m: Trace coarse sub-rounded gravel		7.4m: PASS sub-sample		
8.00											

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BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH4**SHEET 2 OF 3**

Position : 537695.0 E 6782866.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 26/2/2014 **Date Completed :** 27/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL						Comments/ Observations						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index							
9	Rotary Wash Boring			SPT 7 13 17 N=30	9.50		SP	SAND; pale grey-brown, fine grained, poorly graded, trace silt, slight to moderate odour	VM	VD	8.9m: PASS sub-sample						
				SM			SILTY SAND; grey, fine grained, silt is low plasticity, moderate odour, possible organics	W	VL	10.4m: PASS sub-sample							
				SP			SAND; grey to pale grey, fine grained, trace silt, slight odour	VM	VD		11.9m: PASS sub-sample						
				SPT 8 17 25 N=42			11.00										
				SPT 13 23 30 N=53													
15				SPT 11 20 23 N=43	16.00			From 15.5m: fine to coarse grained			14.9m: PASS sub-sample						

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BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH4**SHEET 3 OF 3**

Position : 537695.0 E 6782866.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 26/2/2014 **Date Completed :** 27/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index
				SPT 17 25/120mm N=ref	16.27		SP	SAND AS PREVIOUS; pale grey, fine to coarse, poorly graded, trace silt, slight odour End of BH4: 16.27m (Target depth)	VM	VD	16.2m: PASS sub-sample
17											
18											
19											
20											
21											
22											
23											
24											

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Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH5**SHEET 1 OF 3**

Position : 537518.0 E 6782897.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 27/2/2014 **Date Completed :** 27/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL						Comments/ Observations		
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index			
1	TC-bit auger	HW casing		ASS	0.40		SM	SILTY SAND; dark grey, fine grained, trace rootlets and organics (TOPSOIL)	D	MD	0.3m: PASS sample		
							SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD			
				SPT 6 10 13 N=23				From 1.1m: White mottled orange	M	VD	13.m: PASS sub-sample		
2					2.00		SM	SILTY SAND; brown, fine grained, poorly graded	W	L-MD			
3	Rotary Wash Boring			SPT 2 1 2 N=3								2.9m: PASS sub-sample	
4					SPT 7 10 13 N=23							4.4m: PASS sub-sample	
6					SPT 11 14 22 N=36								5.9m: PASS sub-sample
7				SPT 8 11 13 N=24						D		7.4m: PASS sub-sample	
8						8.00							

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Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH5**SHEET 2 OF 3**

Position : 537518.0 E 6782897.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 27/2/2014 **Date Completed :** 27/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations		
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index	
9	Rotary Wash Boring			SPT 13 15 14 N=29			SP	SAND AS PREVIOUS 8.0m - 8.7m: Paler colouration. Distinct change to pale grey at 8.7m	VM	VD	8.9m: PASS sub-sample	
10				SPT 10 19 22 N=41							10.4m: PASS sub-sample	
11												
12					SPT 20 25/100mm N=ref							11.7m: PASS sub-sample
13					SPT 17 25/120mm N=ref							13.2m: PASS sub-sample
14												
15				SPT 13 30/150mm N=ref								14.7m: PASS sub-sample
16					16.00							

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BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH5**SHEET 3 OF 3**

Position : 537518.0 E 6782897.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 27/2/2014 **Date Completed :** 27/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition Consistency / Density Index	
				SPT 0 0 0 N=0	16.45			SAND/SILT - inferred very loose/soft zone, no sample recovery	W VL/VS	16.0m: SPT fell under sod weight, no recovery. Not enough water in mud tank to efficiently clean hole and retest.
								End of BH5: 16.45m (Target depth)		
17										
18										
19										
20										
21										
22										
23										
24										

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BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH6**SHEET 1 OF 3**

Position : 537766.0 E 6782769.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 24/2/2014 **Date Completed :** 25/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL						Comments/ Observations	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index		
1	TC-bit auger	HW casing			0.20		SP	SAND; yellow, fine grained, uniformly graded (FILL)	SM	MD	1.4m: PASS sub-sample	
					0.50		GP	GRAVEL; dark grey, medium grained, angular, with clay (FILL)	SM	D		
	Rotary Wash Boring	NW casing			1.00		SP	SAND; grey-brown, fine to medium grained, poorly graded, trace clay (ALLUVIUM)	SM	D-VD		
					1.00		SP	0.9m: Grey band SAND; yellow mottled pale brown, fine grained, poorly graded	SM	VD		
					2.00		SP	1.8m - 2.0m: Indurated, low to medium resistance	VM	VD		
					3.00							2.7m: PASS sub-sample
					4.00				W			4.1m: PASS sub-sample
					5.00				VM			
					6.00							5.9m: PASS sub-sample
					7.00							7.0m: Hole collapsing without casing. Clean hole and install NW casing 7.4m: PASS sub-sample
8.00												

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 & basis of descriptions

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BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH6**SHEET 2 OF 3**

Position : 537766.0 E 6782769.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 24/2/2014 **Date Completed :** 25/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations		
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition			Consistency / Density Index
8.20	Rotary Wash Boring	NW casing		SPT 13 17 23 N=40	8.20		SP	SAND AS PREVIOUS	VM	VD	8.5m: PASS sub-sample	
							CI	SANDY CLAY; grey, medium plasticity, sand is fine grained	VM	St		
8.55							SP	SAND; grey to pale grey, fine grained, poorly graded, with clay/silt	VM	VD		8.9m: PASS sub-sample
9				SPT 10 12 17 N=29							10.0m: SPT no recovery. Inferred clae fine sand, pale grey sand cuttings	
10				SPT 13 17 26 N=43								11.8m: PASS sub-sample
11				SPT 13 16 18 N=34								13.3m: PASS sub-sample
12				SPT 15 23 30 N=53								14.8m: PASS sub-sample
13												
14												
15												
16												

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BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH6**SHEET 3 OF 3**

Position : 537766.0 E 6782769.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 24/2/2014 **Date Completed :** 25/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index
				SPT 15 23 25/120mm N=ref	16.42		SP	SAND AS PREVIOUS	VM	VD	
17								End of BH6: 16.42m (Target depth)			16.4m: PASS sub-sample
18											
19											
20											
21											
22											
23											
24											

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GEO_BOREHOLE_221720005_BOREHOLE_LOGS.GPJ_GHD_GEO_TEMPLATE.GDT_1/8/14

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH7**SHEET 1 OF 3**

Position : 537567.0 E 6782654.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 27/2/2014 **Date Completed :** 28/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL						Comments/ Observations
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	
1 <											

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 & basis of descriptions

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Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH7**SHEET 2 OF 3**

Position : 537567.0 E 6782654.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 27/2/2014 **Date Completed :** 28/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		
9	Rotary Wash Boring			SPT 8 11 16 N=27			SP	SAND AS PREVIOUS; grey, fine to medium grained, poorly graded, trace silt	VM	D	8.9m: PASS sub-sample
10				SPT 10 16 23 N=39						VD	10.4m: PASS sub-sample
11								11.5m: Slight odour			
12				SPT 10 16 22 N=38							11.9m: PASS sub-sample
13				SPT 8 16 23 N=39				13.1m: Minor orange-brown iron oxide stained mottles			13.4m: PASS sub-sample
14								From 14m: Slightly paler colouration, pale grey to grey			
15				SPT 12 21 30 N=51							14.9m: PASS sub-sample
16					16.00						

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BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH7**SHEET 3 OF 3**

Position : 537567.0 E 6782654.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 27/2/2014 **Date Completed :** 28/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index
				SPT 13 20 29 N=49	16.45		SP	SAND AS PREVIOUS; pale grey, fine to medium grained, poorly graded, trace silt	VM	VM	16.4m: PASS sub-sample
17								End of BH7: 16.45m (Target depth)			
18											
19											
20											
21											
22											
23											
24											

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Appendix C – Acid Sulfate Soils Assessment



Rixa Quarries Pty Ltd
Proposed Quarry Expansion at Lot 2 DP 1040274 Woodburn
Evans Head Road, Doonbah
Acid Sulfate Soils Assessment

November 2014

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Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

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1. Introduction

GHD Pty Ltd (GHD) has been engaged by Rixa Quarries Pty Ltd (Rixa) to prepare an Acid Sulfate Soils (ASS) assessment to support the development application for the proposed expansion of Doonbah Quarry at Lot 2 DP 1040274, Woodburn Evans Head Road, Doonbah.

An ASS assessment is required because the site has been mapped as Class 3 ASS (NSW Natural Resource Atlas, 2014) and the proposed quarry would excavate beyond 1 m from the surface.

1.1 Scope of Work

The scope of works include:

- Collection of soil samples from seven boreholes to a maximum depth of 16 m below ground level (bgl).
- Transfer of soil samples to a NATA accredited laboratory for indicator tests.
- Analysis of soil samples with the lowest pH_{FOX} for sPOCAS (Suspension Peroxide Oxidisable Combined Acidity and Sulfide) analysis at a NATA accredited laboratory.
- Preparation of this report in accordance with the Acid Sulfate Soils Management Advisory Committee (ASSMAC) Guidelines (Ahern et al., 1998).

2. Proposal

Rixa proposes to expand the existing Doonbah Sand Quarry. The quarry would be operated under a 'profit a prendre' (royalty) arrangement with the owner of the property.

Quarry operations at the site date back to 1961. In 1997, the quarry was granted approval to extract up to 35,715 m³ (approximately 57,000 tonnes) per annum (DA 128/95). The quarry has now exhausted the resources available under this approval.

The excavation currently occupies an area of approximately 6.28 hectares and it is proposed to expand the excavation to approximately 18.3 hectares. The average depth of extraction would increase from approximately 4 m (-1m AHD) to 15 m (-12m AHD).

The proposal is to expand the existing quarry to an extraction rate of up to 490,000 tonnes per annum. The primary purpose of the quarry would be to supply sand to the current and proposed Pacific Highway upgrade works, and for supply to local councils and contractors.

3. Methodology

3.1 Sampling

A soil sampling program was designed to assist in characterising the extent and severity of ASS at the Site. Between 24 February 2014 and 28 February 2014, a total of seven boreholes were drilled and sampled within or on the edge of the area to be excavated, as shown in Figure 1. A summary of the boreholes is provided in Table 1. Borehole logs are presented in Appendix A.

Table 1 Borehole Summary

Testpit ID	Total Depth (m bgl)	No. Samples Collected
BH1	15.95	11
BH2	16.45	13
BH3	16.45	11
BH4	16.27	12
BH5	16.45	11
BH6	16.42	11
BH7	16.45	11

Sampling locations were selected with consideration of surface elevation and expected areas and depth of excavation. ASSMAC (1998) guidelines suggest two holes per hectare which equates to 32 holes for the investigation area. Due to part of the site being constrained by the previous excavation which is now under water, and the consistent topography and lithology of the investigation area, the number of sampling locations was reduced to 7.

The ASSMAC (1998) guidelines state that samples should be collected 1 m below the maximum extent of the proposed works. Since the maximum proposed depth of excavation is approximately 15 m below ground level (bgl), it was attempted to drill all boreholes to 16 m bgl.

3.1.1 Sampling and Storage

Sample collection was carried out by GHD environmental staff, in general accordance with the ASSMAC Guidelines (Ahern et al, 1998) and GHD's Standard Field Procedures. GHD's procedures address such aspects as equipment decontamination, documentation, equipment calibration, sample handling and preservation, quality control and quality assurance.

Soil samples were collected at intervals of approximately 1.5 m or change in strata at each location and placed in appropriately labelled ziplock bags. A total of 80 samples were collected. A record was retained of the depth of each sample and the borehole number. Air was excluded from the sample bags and they were then placed in an esky filled with ice to ensure minimal oxidation of the samples. Samples were frozen until transferred on ice to the NATA registered Australian Laboratory Services (ALS).

3.1.2 Preliminary Testing

ASS field pH (pH_F) and field peroxide pH (pH_{FOX}) indicator tests were carried out by the laboratory to assist in sample selection for further laboratory analysis so that analysis could be limited to those samples likely to be most severely impacted by ASS. Note that indicator tests are indicative only and not quantitative.

A total of 35 samples from a range of depths, boreholes and stratas were analysed. Samples were collected from above and below the groundwater table.

Results of the analysis are provided in Appendix B.

3.1.3 Soil Laboratory Analysis

Based on the results of the field pH tests, nine samples that meet the criteria from Ahern et al (1998) were selected for sPOCAS analysis at ALS. The Ahern et al. (1998) criteria are:

- The strength of the reaction with peroxide
- A pH_{FOX} value at least one unit below pH_F
- $pH_{FOX} < 3$

sPOCAS was selected as the recommended ASS laboratory testing method (rather than Chromium Reducible Sulfur (CRS) and Total Actual Acidity (TAA) only), as it provides data from both the sulfur trail, indicating the level of sulfur in the soil available for oxidation, and the acid trail, supplying the existing and predicted acid production, of the material. The acid base accounting approach of sPOCAS is considered more accurate than the standard POCAS (Peroxide Oxidisable Combined Acidity and Sulfide) method for calculating the net acidity of soils recommended by the ASSMAC guidelines (Ahern et al, 1998), and provides more information on the characteristics of these soils than the CRS test (Ahern et al., 2004). The net acidity generated from a soil sample, which is used to determine the ASS risk, is derived using the following generalised equation:

$$\begin{array}{ccccc} \text{Net} & \text{Potential} & & & \\ \text{Acidity} & \text{Sulfidic} & + \text{ Actual} & + & - \text{ Acid} \\ = & \text{Acidity} & \text{Acidity} & \text{Retained} & \text{Neutralising} \\ & & & \text{Acidity} & \text{Capacity} \end{array}$$

3.2 Assessment Criteria

The ASSMAC (Ahern et al, 1998) action criteria for treatment of actual ASS (AASS) and potential ASS (PASS) are presented in Table 2. Although these action criteria relate to soil

disturbances and the requirement for soil treatment regimes and management plans, they can be used as a basis for this ASS assessment. The nominated criteria for the Site would be 0.03% for sulfur content and 18 mol H⁺/tonne for acidity.

Table 2 Action Criteria for Treatment of AASS and PASS

Soil Texture	Clay Content %	< 1000 Tonnes Disturbed		> 1000 Tonnes Disturbed	
		Sulfur Content %	Acid Trail mol/tonne	Sulfur Content %	Acid Trail mol/tonne
Coarse (sands-gravels)	≤ 5	0.03	18	0.03	18
Medium (sandy loam-light clay)	5 – 40	0.06	36		
Fine (medium to heavy clays, silty clays)	≥ 40	0.10	62		

Source: Ahern et al. (1998)

4. Results

The soils encountered at the seven boreholes consisted of sand of various colours from the surface to the final depth of the borehole. The exception was at BH1, where more indurated sand was encountered at about 14m bgl and sandstone at about 15m bgl.

The pH_F of all soil samples collected and tested ranged between 4.3 and 7.8. After oxidation, samples reported pH_{FOX} between 2.2 and 5.3. All field pH testing results have been presented in Table 3 and the laboratory certificates are provided in Appendix B.

Table 3 Field pH Analysis Results

Sample ID	Depth (m)	pH(F)	pH(Fox)	Reaction Rate
BH1 5.1M	5.1	5.6	<u>2.3*</u>	2
BH1 8.2M	8.2	6.4	<u>2.2*</u>	2
BH1 9.85M	9.85	5.8	<u>2.8*</u>	2
BH1 12.85M	12.85	5.5	<u>2.0*</u>	2
BH1 14.30M	14.30	6.0	<u>2.1*</u>	4
BH2 2.7M	2.7	6.0	<u>3.8</u>	1
BH2 5.9M	5.9	5.6	<u>2.0*</u>	2
BH2 7.4M	7.4	5.0	<u>2.2*</u>	4
BH2 8.9M	8.9	5.5	<u>2.4*</u>	4
BH2 13.4M	13.4	6.0	<u>2.1*</u>	2
BH3 2.85M	2.85	5.1	<u>2.1*</u>	4
BH3 4.3M	4.3	5.3	<u>2.1*</u>	4
BH3 8.85M	8.85	5.1	<u>2.1*</u>	4

Sample ID	Depth (m)	pH(F)	pH(Fox)	Reaction Rate
BH3 10.6M	10.6	5.9	<u>2.2*</u>	4
BH3 16.3M	16.3	6.9	<u>2.2*</u>	2
BH4 2.9M	2.9	5.7	<u>2.5*</u>	2
BH4 7.4M	7.4	5.6	<u>2.2*</u>	2
BH4 10.4M	10.4	5.5	<u>2.0*</u>	4
BH4 13.4M	13.4	5.9	<u>2.2*</u>	2
BH4 16.2M	16.2	5.3	<u>2.2*</u>	2
BH5 1.3M	1.3	4.9	4.4	1
BH5 2.9M	2.9	5.4	<u>2.4*</u>	4
BH5 7.4M	7.4	5.7	<u>2.2*</u>	2
BH5 13.2M	13.2	5.7	<u>2.3*</u>	4
BH5 14.7M	14.7	5.3	<u>2.2*</u>	4
BH6 2.7M	2.7	5.2	4.3	1
BH6 4.1M	4.1	5.6	<u>2.1*</u>	2
BH6 7.4M	7.4	6.1	<u>2.1*</u>	2
BH6 11.8M	11.8	4.8	<u>2.4*</u>	2
BH6 16.4M	16.4	5.5	<u>2.4*</u>	4
BH7 2.9M	2.9	5.4	<u>2.2*</u>	4
BH7 7.4M	7.4	5.7	<u>2.4*</u>	2
BH7 11.9M	11.9	6.0	<u>2.3*</u>	2
BH7 14.9M	14.9	5.3	<u>2.2*</u>	2
BH7 16.4M	16.4	5.2	<u>2.2*</u>	2

Underline indicates pH(Fox) is at least one unit less than pH(F).

* indicates pH(Fox) is less than 3.

Bold indicates samples selected for sPOCAS analysis.

Nine samples were selected for sPOCAS analysis. These were BH1 8.2M, BH2 13.4M, BH3 10.6M, BH4 2.9M, BH4 13.4M, BH5 7.4M, BH6 7.4M, BH7 2.9M and BH7 11.9M According to the sPOCAS analysis results:

- Eight of the nine soil samples (all except BH5 7.4M) had net acidities greater than the action criteria of 18 mol H⁺ / tonne.
- All samples contain slightly to moderately elevated concentrations of Peroxide Oxidisable Sulfur (POS) and can be considered to contain PASS.
- All soils have low concentrations of actual acidity, as indicated by the Titratable Actual Acidity (TAA) results.

A summary of the sPOCAS laboratory results have been presented in Table 4 and the laboratory certificates are provided in Appendix B.

Table 4 sPOCAS Analysis Results

Analysis	Unit	BH1 8.2M	BH2 13.4M	BH3 10.6M	BH4 2.9M	BH4 13.4M	BH5 7.4M	BH6 7.4M	BH7 2.9M	BH7 11.9M
pH KCl	pH	5.1	5.6	6.9	5.4	5.9	5.9	5.7	5.3	5.7
pH OX	pH	3.2	3.1	2.8	3.0	3.1	3.1	3.0	2.6	3.0
POS	%S	0.07	0.06	0.04	0.06	0.04	0.03	0.06	0.22	0.06
TAA	mole H ⁺ /t	9	<2	<2	3	<2	<2	<2	5	<2
TPA	mole H ⁺ /t	62	34	28	37	20	11	31	126	33
Net Acidity	mole H ⁺ /t	54	40	27	41	28	17	37	146	40

Bold indicates meeting the action criteria

All of the samples are considered to be PASS, except BH5 7.4M for which TPA was less than the action criteria and Peroxide Oxidisable Sulfur (POS) was equal to the action criteria. Exposure of these soils to the atmosphere is likely to create acidic conditions that may have a detrimental impact on the local environment.

4.1 Recommendations

Since the results of the soil samples exceeded the assessment criterion, it is recommended that an Acid Sulfate Management Plan (ASSMP) be prepared for the soils excavated at the site. In applying the precautionary principal as recommended by ASSMAC (1998), it is recommended that the ASSMP and the liming rate should be based on the highest result ie BH7 2.9M. Acidity can be generated very quickly in sandy soil and there is usually little or no buffering capacity.

Additional sampling could be carried out to determine whether this highest net acidity result is an anomaly or representative of a localised ASS source, and this may provide an opportunity to revise the required liming rate.

5. References

Ahern, C.R., Stone, Y. and Blunden, B. (1998) *Acid Sulfate Soils Assessment Guidelines*, Acid Sulfate Soil Management Advisory Committee, Wollongbar, NSW, Australia.

Ahern, C.R., McElnea, A.E. & Sullivan, L.A. (2004) *Acid Sulfate Soils Laboratory Methods Guidelines*. Queensland Department of Natural Resources, Mine and Energy, Indooroopilly, Queensland, Australia.

Appendices

Appendix A – Borehole Logs

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH1**SHEET 1 OF 3**

Position : 538051.0 E 6782581.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 25/2/2014 **Date Completed :** 25/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations			
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index		
1	TC-bit auger	HW casing	▽	SPT 6 20/70mm N=ref	0.20		SP	SAND; dark grey, fine grained, poorly graded, trace organics (TOPSOIL)	SM	MD	0.65m: PASS sub-sample		
				0.50		SP	SAND; pale grey, fine grained (ALLUVIUM)	SM	MD				
2	Rotary Wash Boring		▽	ASS	1.20		SP	SAND; dark brown, fine grained, poorly graded, moderate induration/cementation	SM	VD	1.2m: PASS sample		
3				SPT 27 25/60mm N=ref				1.8m: Grey lense 2.0m: Slight odour	VM		2.2m: PASS sub-sample		
4				SPT 25/90mm N=ref							3.55m: PASS sub-sample		
5				SPT 30/100mm N=ref							5.1m: PASS sub-sample		
6													
7				SPT 30 25/80mm N=ref				From 6.5m: Brown to dark brown			6.7m: PASS sub-sample		
8					8.00								

See standard sheets for
 details of abbreviations
 & basis of descriptions

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Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH1**SHEET 2 OF 3**

Position : 538051.0 E 6782581.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 25/2/2014 **Date Completed :** 25/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	
9 <										

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 & basis of descriptions

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BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH1**SHEET 3 OF 3**

Position : 538051.0 E 6782581.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 25/2/2014 **Date Completed :** 25/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL				Comments/ Observations		
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength		Moisture Condition	Consistency / Density Index
17				N=44				End of BH1: 15.95m (Target depth) Monitoring well installed to 4m depth.			
18											
19											
20											
21											
22											
23											
24											

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Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH2**SHEET 1 OF 3**

Position : 537779.0 E 6782947.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 26/2/2014 **Date Completed :** 26/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations
SCALE (m)	Drilling Method	Hole Support Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition Consistency / Density Index	
1	TC-bit auger	HW casing		ASS	0.20	▲▲▲▲▲	SM	SILTY SAND; dark grey, fine grained, poorly graded, trace rootlets/organics (TOPSOIL)	D MD	0.2m: PASS sample
							SP	SAND; grey, fine grained, poorly graded, trace rootlets (ALLUVIUM)	D MD	
2				ASS	0.65		SP	SAND; orange, fine to medium grained poorly graded, minor iron oxide staining	D D	0.8m: PASS sample
				SPT 4 6 7 N=13						
3					2.00		SP	SAND; dark red-brown, fine to medium grained, poorly graded, iron induration, weakly cemented	M VD	2.3m: PASS sub-sample
				SPT 28 15/70mm N=ref						
4										4.2m: PASS sub-sample
				SPT 28 25/80mm N=ref						
5										5.9m: PASS sub-sample
				SPT 7 15 20 N=35						
6					6.80		SP	SAND; grey, fine grained, poorly graded, with coarse silt, non-cohesive, slight odour	VM MD	7.4m: PASS sub-sample
				SPT 4 7 6 N=13						
7					8.00					
8										

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BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH2**SHEET 2 OF 3**

Position : 537779.0 E 6782947.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 26/2/2014 **Date Completed :** 26/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations		
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index	
9	Rotary Wash Boring			SPT 6 18 18 N=36			SP	SAND AS PREVIOUS	VM	VD	8.9m: PASS sub-sample	
10				SPT 5 5 7 N=12				From 9.5m: Becoming pale grey-brown		MD	10.4m: PASS sub-sample	
11					11.00		SP	SAND; pale yellow-brown, fine grained, poorly graded, with coarse silt, slight odour	VM	VD		
12				SPT 9 20 24 N=44							D	11.9m: PASS sub-sample
13				SPT 9 13 19 N=32								13.4m: PASS sub-sample
14												
15				SPT 10 16 24 N=40				14.9m: Moderate odour			14.8m: PASS sub-sample	
16					16.00							

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 & basis of descriptions

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BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH2**SHEET 3 OF 3**

Position : 537779.0 E 6782947.0 N MGA94 56 **Surface RL:** 10.0m **AHD** **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 26/2/2014 **Date Completed :** 26/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index
				SPT 8 16 23 N=39	16.45		SP	SAND AS PREVIOUS	VM	VD	16.4m: PASS sub-sample
17								End of BH2: 16.45m (Target depth) Monitoring well installed to 3.9m depth.			
18											
19											
20											
21											
22											
23											
24											

See standard sheets for
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 & basis of descriptions

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BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH3**SHEET 1 OF 3**

Position : 537446.0 E 6782771.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 25/2/2014 **Date Completed :** 26/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL						Comments/ Observations				
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index					
1	TC-bit auger	HW casing	▽	SPT 5 8 10 N=18	0.20		SM	SILTY SAND; dark grey, fine grained, poorly graded, trace rootlets/organinc (TOPSOIL)	D	MD	1.4m: PASS sub-sample				
					SP		SAND; grey fine grained, poorly graded (ALLUVIUM)	D	MD						
	0.60	SP			SAND; pale grey, fine grained, poorly graded, trace silt, possible moderate coarse silt component, non-cohesive		M	VD							
2	Rotary Wash Boring		SPT 5 9 12 N=21	SPT 8 9 8 N=17	From 3.5m: Fine to medium grained, fine dominant. Grades to slightly paler shade (white-grey)				VM	D	2.85m: PASS sub-sample				
4												5	6	7	8.00
3			SPT 12 17 18 N=35								4.3m: PASS sub-sample				
4			SPT 11 19 23 N=42							5.9m: PASS sub-sample					
5												7.4m: PASS sub-sample			
6															
7															
8															

See standard sheets for
 details of abbreviations
 & basis of descriptions

**GHD GEOTECHNICS**

230 Harbour Drive, Coffs Harbour NSW 2450 Australia
 T: 61 2 6550 5600 F: 61 2 6652 5601 E: cfsmail@ghd.com

CONSULTING GEOTECHNICAL ENGINEERS AND GEOLOGISTS

Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH3**SHEET 2 OF 3**

Position : 537446.0 E 6782771.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 25/2/2014 **Date Completed :** 26/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index
9	Rotary Wash Boring			SPT 10 16 17 N=33			SP	SAND AS PREVIOUS; pale grey, fine to medium grained, poorly graded, trace silt	VM	VD	8.85m: PASS sub-sample
10				SPT 15 26 29 N=55				9.2m - 9.7m: Inferred possible coarse sand/fine to medium gravel layer			10.6m: PASS sub-sample
11				SPT 11 19 21 N=40							11.9m: PASS sub-sample
12				SPT 14 20 23 N=43							13.35m: PASS sub-sample
13				SPT 12 20 22 N=42							14.9m: PASS sub-sample
14											
15											
16					16.00						

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BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH3**SHEET 3 OF 3**

Position : 537446.0 E 6782771.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 25/2/2014 **Date Completed :** 26/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index
				SPT 12 21 29 N=50	16.45		SP	SAND AS PREVIOUS, possible organic trace	VM	VD	16.3m: PASS sub-sample
17								End of BH3: 16.45m (Target depth) Monitoring well installed to 4.0m depth.			
18											
19											
20											
21											
22											
23											
24											

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Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH4**SHEET 1 OF 3**

Position : 537695.0 E 6782866.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 26/2/2014 **Date Completed :** 27/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL						Comments/ Observations
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	
1	TC-bit auger	HW casing		ASS	0.20		CH	SANDY CLAY; dark grey, high plasticity, sand is fine grained, trace rootlets (DISTURBED TOPSOIL/FILL)	SM	St	0.1m: PASS sample
	Rotary Wash Boring				0.50		SM	SILTY SAND; grey, fine grained, poorly graded (ALLUVIUM)	M	MD	
							SP	SAND; orange, fine grained, poorly graded, trace silt	M	VD	
2	Rotary Wash Boring			SPT 5 8 12 N=20					VM		1.4m: PASS sub-sample
3				SPT 7 12 17 N=29							2.9m: PASS sub-sample
4				SPT 6 10 15 N=25							4.4m: PASS sub-sample
5											
6				SPT 4 6 17 N=23							5.7m: PASS sub-sample
7				SPT 9 11 14 N=25			7.2m: Trace coarse sub-rounded gravel				7.4m: PASS sub-sample
8					8.00						

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Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH4**SHEET 2 OF 3**

Position : 537695.0 E 6782866.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 26/2/2014 **Date Completed :** 27/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL						Comments/ Observations
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	
9	Rotary Wash Boring			SPT 7 13 17 N=30			SP	SAND; pale grey-brown, fine grained, poorly graded, trace silt, slight to moderate odour	VM	VD	8.9m: PASS sub-sample
9.50							SM	SILTY SAND; grey, fine grained, silt is low plasticity, moderate odour, possible organics	W	VL	10.4m: PASS sub-sample
10				SPT 2 1 1 N=2							
11					11.00		SP	SAND; grey to pale grey, fine grained, trace silt, slight odour	VM	VD	11.9m: PASS sub-sample
12				SPT 8 17 25 N=42							
13				SPT 13 23 30 N=53				From 12.5m: Pale grey			
14											
15				SPT 11 20 23 N=43				From 15.5m: fine to coarse grained			14.9m: PASS sub-sample
16					16.00						

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BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH4**SHEET 3 OF 3**

Position : 537695.0 E 6782866.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 26/2/2014 **Date Completed :** 27/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index
				SPT 17 25/120mm N=ref	16.27		SP	SAND AS PREVIOUS; pale grey, fine to coarse, poorly graded, trace silt, slight odour End of BH4: 16.27m (Target depth)	VM	VD	16.2m: PASS sub-sample
17											
18											
19											
20											
21											
22											
23											
24											

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Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH5**SHEET 1 OF 3**

Position : 537518.0 E 6782897.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 27/2/2014 **Date Completed :** 27/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL						Comments/ Observations				
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index					
1	TC-bit auger	HW casing	▽	ASS	0.40		SM	SILTY SAND; dark grey, fine grained, trace rootlets and organics (TOPSOIL)	D	MD	0.3m: PASS sample				
	Rotary Wash Boring				SPT 6 10 13 N=23	2.00		SP	From 1.1m: White mottled orange	M		VD			
2											SM		SILTY SAND; brown, fine grained, prroly graded	W	L- MD
4											SM		SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD
6											SM		SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD
8	SM	SAND; pale grey, fine grained, poorly graded, trace silt		VM	VD										
						9	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD					
10	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					11	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
12	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					13	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
14	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					15	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
16	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					17	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
18	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					19	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
20	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					21	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
22	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					23	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
24	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					25	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
26	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					27	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
28	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					29	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
30	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					31	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
32	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					33	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
34	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					35	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
36	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					37	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
38	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					39	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
40	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					41	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
42	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					43	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
44	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					45	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
46	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					47	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
48	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					49	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
50	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					51	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
52	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					53	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
54	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					55	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
56	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					57	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
58	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					59	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
60	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					61	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
62	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					63	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
64	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					65	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
66	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					67	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
68	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					69	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
70	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					71	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
72	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					73	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
74	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					75	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
76	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					77	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
78	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					79	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
80	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					81	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
82	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					83	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
84	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					85	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
86	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					87	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
88	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					89	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
90	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					91	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
92	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					93	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
94	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					95	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
96	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					97	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
98	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					99	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
100	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					101	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
102	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					103	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
104	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					105	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
106	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					107	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
108	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					109	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
110	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					111	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
112	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					113	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
114	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					115	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
116	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					117	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
118	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					119	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
120	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					121	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
122	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					123	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
124	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					125	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
126	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					127	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
128	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					129	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
130	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					131	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
132	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					133	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
134	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					135	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
136	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					137	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
138	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					139	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
140	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					141	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
142	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					143	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
144	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					145	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
146	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					147	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
148	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					149	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
150	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					151	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
152	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					153	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
154	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					155	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
156	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					157	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
158	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					159	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
160	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					161	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
162	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					163	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
164	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					165	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
166	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					167	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
168	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					169	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
170	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					171	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
172	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					173	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
174	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					175	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
176	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					177	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
178	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					179	SP	SAND; pale yellow-orange, fine grained, poorly graded (ALLUVIUM)	D	MD						
180	SM	SAND; pale grey, fine grained, poorly graded, trace silt	VM	VD											
					181										

See standard sheets for
 details of abbreviations
 & basis of descriptions

**GHD GEOTECHNICS**

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 CONSULTING GEOTECHNICAL ENGINEERS AND GEOLOGISTS

Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH5**SHEET 2 OF 3**

Position : 537518.0 E 6782897.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 27/2/2014 **Date Completed :** 27/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations		
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index	
9	Rotary Wash Boring			SPT 13 15 14 N=29			SP	SAND AS PREVIOUS 8.0m - 8.7m: Paler colouration. Distinct change to pale grey at 8.7m	VM	VD	8.9m: PASS sub-sample	
10				SPT 10 19 22 N=41							10.4m: PASS sub-sample	
11												
12					SPT 20 25/100mm N=ref							11.7m: PASS sub-sample
13					SPT 17 25/120mm N=ref							13.2m: PASS sub-sample
14												
15				SPT 13 30/150mm N=ref								14.7m: PASS sub-sample
16					16.00							

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Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH5**SHEET 3 OF 3**

Position : 537518.0 E 6782897.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 27/2/2014 **Date Completed :** 27/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations
SCALE (m)	Drilling Method	Hole Support \\ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition Consistency / Density Index	
				SPT 0 0 0 N=0	16.45			SAND/SILT - inferred very loose/soft zone, no sample recovery	W VL/VS	16.0m: SPT fell under sod weight, no recovery. Not enough water in mud tank to efficiently clean hole and retest.
								End of BH5: 16.45m (Target depth)		
17										
18										
19										
20										
21										
22										
23										
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 & basis of descriptions

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Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH6**SHEET 1 OF 3**

Position : 537766.0 E 6782769.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 24/2/2014 **Date Completed :** 25/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL						Comments/ Observations													
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index														
1	TC-bit auger	HW casing			0.20		SP	SAND; yellow, fine grained, uniformly graded (FILL)	SM	MD	1.4m: PASS sub-sample													
					0.50		GP	GRAVEL; dark grey, medium grained, angular, with clay (FILL)	SM	D														
	2	Rotary Wash Boring			NW casing		1.00		SP	SAND; grey-brown, fine to medium grained, poorly graded, trace clay (ALLUVIUM)		SM	D-VD											
							1.00		SP	0.9m: Grey band SAND; yellow mottled pale brown, fine grained, poorly graded		SM	VD											
							2.00		SP	1.8m - 2.0m: Indurated, low to medium resistance SAND; pale yellow-brown, fine to medium grained, poorly graded, trace sub-angular gravel, trace clay, minor indurated lenses		VM	VD											
							3			4			5		From 5.5m: Trace gravel is sub-rounded	W	VM	4.1m: PASS sub-sample						
																			6	7		8.00		
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Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH6**SHEET 2 OF 3**

Position : 537766.0 E 6782769.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 24/2/2014 **Date Completed :** 25/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations		
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition			Consistency / Density Index
9	Rotary Wash Boring	NW casing		SPT 13 17 23 N=40	8.20		SP	SAND AS PREVIOUS	VM	VD	8.5m: PASS sub-sample 8.9m: PASS sub-sample	
						CI	SANDY CLAY; grey, medium plasticity, sand is fine grained	VM	St			
					8.55		SP	SAND; grey to pale grey, fine grained, poorly graded, with clay/silt	VM	VD		
					From 9.0m: trace clay/silt, pale grey colour dominant							
				SPT 10 12 17 N=29						10.0m: SPT no recovery. Inferred clae fine sand, pale grey sand cuttings		
					SPT 13 17 26 N=43						11.8m: PASS sub-sample	
						12.5m: Minor dark grey/black organics returned in cutting; not visible in adjacent samples at 11.5m and 13m					D	
						SPT 13 16 18 N=34						13.3m: PASS sub-sample
												VD
15				SPT 15 23 30 N=53						14.8m: PASS sub-sample		
16					16.00							

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BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH6**SHEET 3 OF 3**

Position : 537766.0 E 6782769.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 24/2/2014 **Date Completed :** 25/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index
				SPT 15 23 25/120mm N=ref	16.42		SP	SAND AS PREVIOUS	VM	VD	16.4m: PASS sub-sample
17								End of BH6: 16.42m (Target depth)			
18											
19											
20											
21											
22											
23											
24											

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GEO_BOREHOLE_221720005_BOREHOLE_LOGS.GPJ GHD GEO_TEMPLATE.GDT 1/8/14

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH7**SHEET 1 OF 3**

Position : 537567.0 E 6782654.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 27/2/2014 **Date Completed :** 28/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL						Comments/ Observations
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	
1 <											

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BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH7**SHEET 2 OF 3**

Position : 537567.0 E 6782654.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 27/2/2014 **Date Completed :** 28/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL						Comments/ Observations
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	
9	Rotary Wash Boring			SPT 8 11 16 N=27			SP	SAND AS PREVIOUS; grey, fine to medium grained, poorly graded, trace silt	VM	D	8.9m: PASS sub-sample
10				SPT 10 16 23 N=39						VD	10.4m: PASS sub-sample
11								11.5m: Slight odour			
12				SPT 10 16 22 N=38							11.9m: PASS sub-sample
13				SPT 8 16 23 N=39				13.1m: Minor orange-brown iron oxide stained mottles			13.4m: PASS sub-sample
14								From 14m: Slightly paler colouration, pale grey to grey			
15				SPT 12 21 30 N=51							14.9m: PASS sub-sample
16					16.00						

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 & basis of descriptions

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Job No.**221720005**

BOREHOLE LOG SHEET

Client : RIXA
Project : Doonbah Sand Quarry
Location : Evan's Head, NSW

HOLE No. BH7**SHEET 3 OF 3**

Position : 537567.0 E 6782654.0 N MGA94 56 **Surface RL:** 10.0m AHD **Angle from Horiz. :** 90° **Processed :** DK
Rig Type : GOT-2008 **Mounting:** Truck **Contractor :** DE Drilling **Driller :** Dave Frappell **Checked :**
Date Started : 27/2/2014 **Date Completed :** 28/2/2014 **Logged by :** DK **Date:**

DRILLING					MATERIAL					Comments/ Observations	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition		Consistency / Density Index
				SPT 13 20 29 N=49	16.45		SP	SAND AS PREVIOUS; pale grey, fine to medium grained, poorly graded, trace silt	VM	VM	16.4m: PASS sub-sample
17								End of BH7: 16.45m (Target depth)			
18											
19											
20											
21											
22											
23											
24											

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Job No.**221720005**

Appendix B – Laboratory Certificates



Environmental

CERTIFICATE OF ANALYSIS

Work Order	: EB1406058	Page	: 1 of 4
Client	: GHD PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MR BEN LUFFMAN	Contact	: Vanessa Turnbull
Address	: 230 HARBOUR DRIVE PO Box 1340 COFFS HARBOUR NSW, AUSTRALIA 2450	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: ben_luffman@ghd.com	E-mail	: vanessa.turnbull@alsenviro.com
Telephone	: +61 02 6650 5600	Telephone	: 61-7-3552 8660
Facsimile	: +61 02 6652 6021	Facsimile	: 61-7-3352 3662
Project	: 2217200	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: -----		
C-O-C number	: -----	Date Samples Received	: 12-MAR-2014
Sampler	: -----	Issue Date	: 19-MAR-2014
Site	: -----		
Quote number	: EN/005/13	No. of samples received	: 9
		No. of samples analysed	: 9

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results



WORLD RECOGNISED
ACCREDITATION

NATA Accredited Laboratory 825

Accredited for compliance with
ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils



Page : 2 of 4
Work Order : EB1406058
Client : GHD PTY LTD
Project : 2217200

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

- ASS: EA029 (SPOCAS): Excess ANC not required because pH OX less than 6.5.

- ASS: EA029 (SPOCAS): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from kg/t dry weight to kg/m3 in-situ soil, multiply reported results x wet bulk density of soil in t/m3.

- ASS: EA029 (SPOCAS): Retained Acidity not required because pH KCl greater than or equal to 4.5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOL)

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID					
			Client sampling date / time					
Compound	CAS Number	LOR	Unit	BH1 8.2M	BH2 13.4M	BH3 10.6M	BH4 2.9M	BH4 13.4M
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	5.1	5.6	6.9	5.4	5.9
pH OX (23B)	----	0.1	pH Unit	3.2	3.1	2.8	3.0	3.1
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	9	<2	<2	3	<2
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	62	34	28	37	20
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	52	34	28	34	20
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	0.10	0.05	0.04	0.06	0.03
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	0.08	0.05	0.04	0.05	0.03
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.02	<0.02	0.02	<0.02	<0.02
Peroxide Sulfur (23De)	----	0.02	% S	0.07	0.06	0.07	0.06	0.04
Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	0.07	0.06	0.04	0.06	0.04
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	45	40	26	38	28
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.02	% Ca	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Calcium (23Wh)	----	0.02	% Ca	<0.02	<0.02	<0.02	<0.02	<0.02
Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Magnesium (23Tm)	----	0.02	% Mg	<0.02	<0.02	<0.02	<0.02	<0.02
Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.02	<0.02	<0.02	<0.02	<0.02
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	0.09	0.06	0.04	0.06	0.04
Net Acidity (acidity units)	----	10	mole H+ / t	54	40	27	41	28
Liming Rate	----	1	kg CaCO3/t	4	3	2	3	2



Analytical Results

Sub-Matrix: SOIL (Matrix: SOL)

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID					
		Client sampling date / time					
Compound	CAS Number	LOR	Unit	BH5 7.4M	BH6 7.4M	BH7 2.9M	BH7 11.9M
EA029-A: pH Measurements							
pH KCl (23A)		0.1	pH Unit	5.9	5.7	5.3	5.7
pH OX (23B)		0.1	pH Unit	3.1	3.0	2.6	3.0
EA029-B: Acidity Trail							
Titratable Actual Acidity (23F)		2	mole H+ / t	<2	<2	5	<2
Titratable Peroxide Acidity (23G)		2	mole H+ / t	11	31	126	33
Titratable Sulfidic Acidity (23H)		2	mole H+ / t	11	31	121	33
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02
sulfidic - Titratable Peroxide Acidity (s-23G)		0.02	% pyrite S	<0.02	0.05	0.20	0.05
sulfidic - Titratable Sulfidic Acidity (s-23H)		0.02	% pyrite S	<0.02	0.05	0.19	0.05
EA029-C: Sulfur Trail							
KCl Extractable Sulfur (23Ce)		0.02	% S	<0.02	<0.02	<0.02	<0.02
Peroxide Sulfur (23De)		0.02	% S	0.03	0.06	0.22	0.06
Peroxide Oxidisable Sulfur (23E)		0.02	% S	0.03	0.06	0.22	0.06
acidity - Peroxide Oxidisable Sulfur (a-23E)		10	mole H+ / t	17	37	141	40
EA029-D: Calcium Values							
KCl Extractable Calcium (23Vh)		0.02	% Ca	<0.02	<0.02	<0.02	<0.02
Peroxide Calcium (23Wh)		0.02	% Ca	<0.02	<0.02	<0.02	<0.02
Acid Reacted Calcium (23X)		0.02	% Ca	<0.02	<0.02	<0.02	<0.02
acidity - Acid Reacted Calcium (a-23X)		10	mole H+ / t	<10	<10	<10	<10
sulfidic - Acid Reacted Calcium (s-23X)		0.02	% S	<0.02	<0.02	<0.02	<0.02
EA029-E: Magnesium Values							
KCl Extractable Magnesium (23Sm)		0.02	% Mg	<0.02	<0.02	<0.02	<0.02
Peroxide Magnesium (23Tm)		0.02	% Mg	<0.02	<0.02	<0.02	<0.02
Acid Reacted Magnesium (23U)		0.02	% Mg	<0.02	<0.02	<0.02	<0.02
Acidity - Acid Reacted Magnesium (a-23U)		10	mole H+ / t	<10	<10	<10	<10
sulfidic - Acid Reacted Magnesium (s-23U)		0.02	% S	<0.02	<0.02	<0.02	<0.02
EA029-H: Acid Base Accounting							
ANC Fineness Factor		0.5	-	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02	% S	0.03	0.06	0.23	0.06
Net Acidity (acidity units)		10	mole H+ / t	17	37	146	40
Liming Rate		1	kg CaCO3/t	1	3	11	3



Environmental

CERTIFICATE OF ANALYSIS

Work Order	: ES1404609	Page	: 1 of 9
Client	: GHD PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR BEN LUFFMAN	Contact	: Client Services
Address	: 230 HARBOUR DRIVE PO Box 1340 COFFS HARBOUR NSW, AUSTRALIA 2450	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: ben_luffman@ghd.com	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 6650 5600	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 6652 6021	Facsimile	: +61-2-8784 8500
Project	: 2217200	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: 158451-3	Date Samples Received	: 04-MAR-2014
C-O-C number	: 158451-3	Issue Date	: 11-MAR-2014
Sampler	:	No. of samples received	: 35
Site	:	No. of samples analysed	: 35
Quote number	: EN/005/13		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils



Page : 2 of 9
Work Order : ES1404609
Client : GHD PTY LTD
Project : 2217200

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **ASS: EA037 (Rapid Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme**
- **EA037 ASS Field Screening: NATA accreditation does not cover performance of this service.**



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Compound	CAS Number	LOR	Client sample ID			
			Client sampling date / time			
			BH1 5.1M	BH1 8.2M	BH1 9.85M	BH1 12.85M
			25-FEB-2014 15:00	25-FEB-2014 15:00	25-FEB-2014 15:00	25-FEB-2014 15:00
			ES1404609-001	ES1404609-002	ES1404609-003	ES1404609-004
						ES1404609-005
pH (F)	0.1	pH Unit	5.6	6.4	5.8	5.5
pH (Fox)	0.1	pH Unit	2.3	2.2	2.8	2.0
Reaction Rate	1	-	2	2	2	2
						6.0
						2.1
						4



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Compound	CAS Number		LOR		Client sampling date / time		Client sample ID	
pH (F)			0.1		5.1		BH3 2.85M	BH3 16.3M
pH (Fox)			0.1		2.1		BH3 4.3M	BH3 10.6M
Reaction Rate			1		4		BH3 8.85M	BH3 16.3M

Sub-Matrix: SOIL (Matrix: SOIL)

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID						
Compound	CAS Number	Client sampling date / time		BH4 2.9M	BH4 7.4M	BH4 10.4M	BH4 13.4M	BH4 16.2M
		LOR	Unit					
EA037: Ass Field Screening Analysis								
pH (F)	---	0.1	pH Unit	5.7	5.6	5.5	5.9	5.3
pH (Fox)	---	0.1	pH Unit	2.5	2.2	2.0	2.2	2.2
Reaction Rate	---	1	-	2	2	4	2	2



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Compound	CAS Number		LOR		Client sampling date / time		Client sample ID	
pH (F)			0.1		5.2	24-FEB-2014 15:00	BH6 2.7M	BH6 16.4M
pH (Fox)			0.1		4.3	24-FEB-2014 15:00	BH6 4.1M	BH6 11.8M
Reaction Rate			1		1	24-FEB-2014 15:00	BH6 7.4M	BH6 16.4M
						24-FEB-2014 15:00	ES1404609-026	ES1404609-029
						24-FEB-2014 15:00	ES1404609-027	ES1404609-030
						24-FEB-2014 15:00	ES1404609-028	ES1404609-030
						24-FEB-2014 15:00	ES1404609-029	ES1404609-030
						24-FEB-2014 15:00	ES1404609-030	ES1404609-030



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID											
Compound	CAS Number	LOR		Client sampling date / time						Unit			
EA037: Ass Field Screening Analysis	pH (F)		0.1		5.4		5.7		6.0		5.3		5.2
	pH (Fox)		0.1		2.2		2.4		2.3		2.2		2.2
	Reaction Rate		1		4		2		2		2		2

GHD

230 Harbour Drive

Coffs Harbour NSW 2450

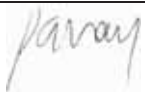
T: (02) 6650 5600 F: (02) 6650 5601 E: cfsmail@ghd.com

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	B Luffman	S Gray		S Lawer		November 14

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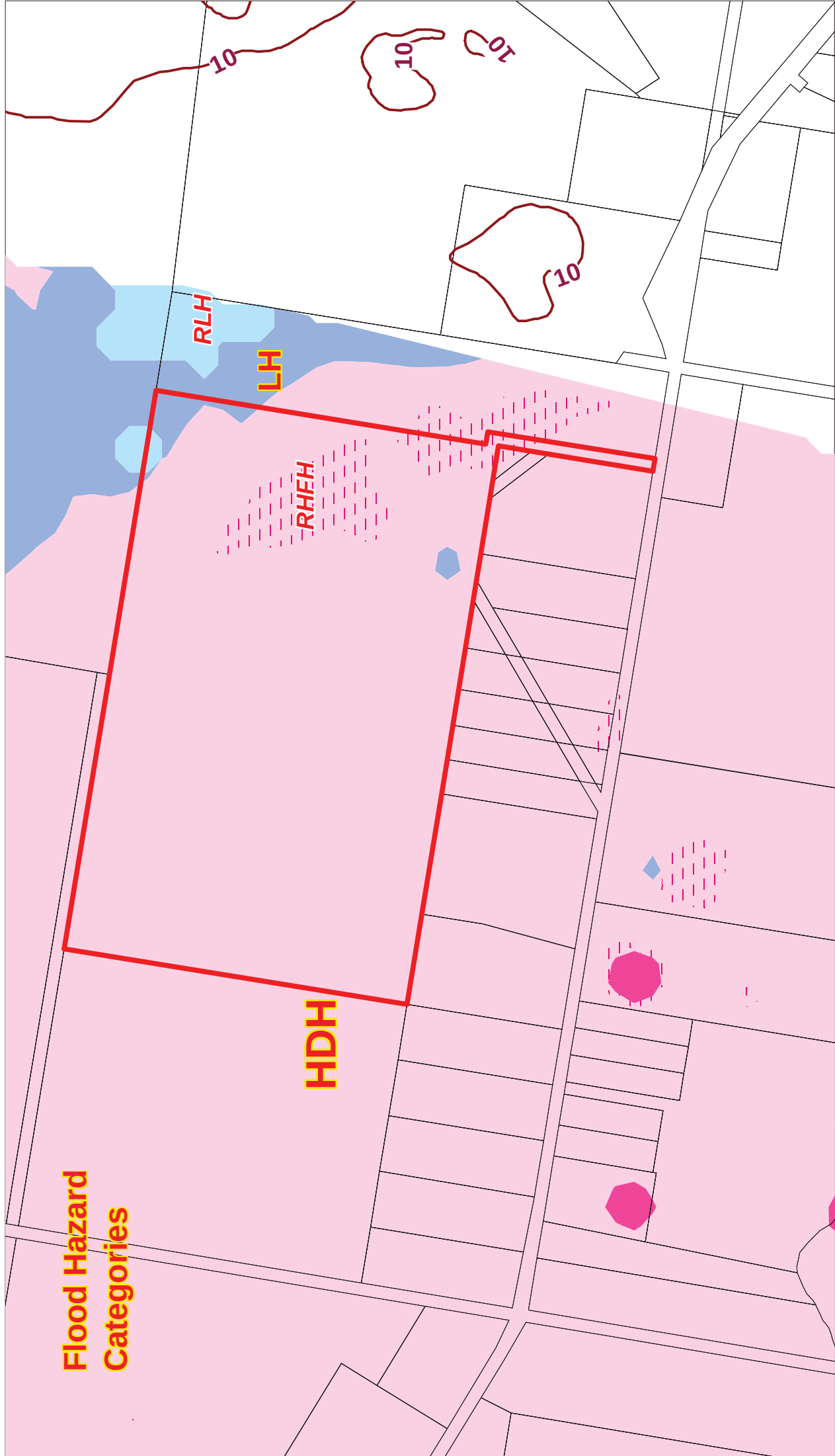


Appendix D – Groundwater Database Search Results

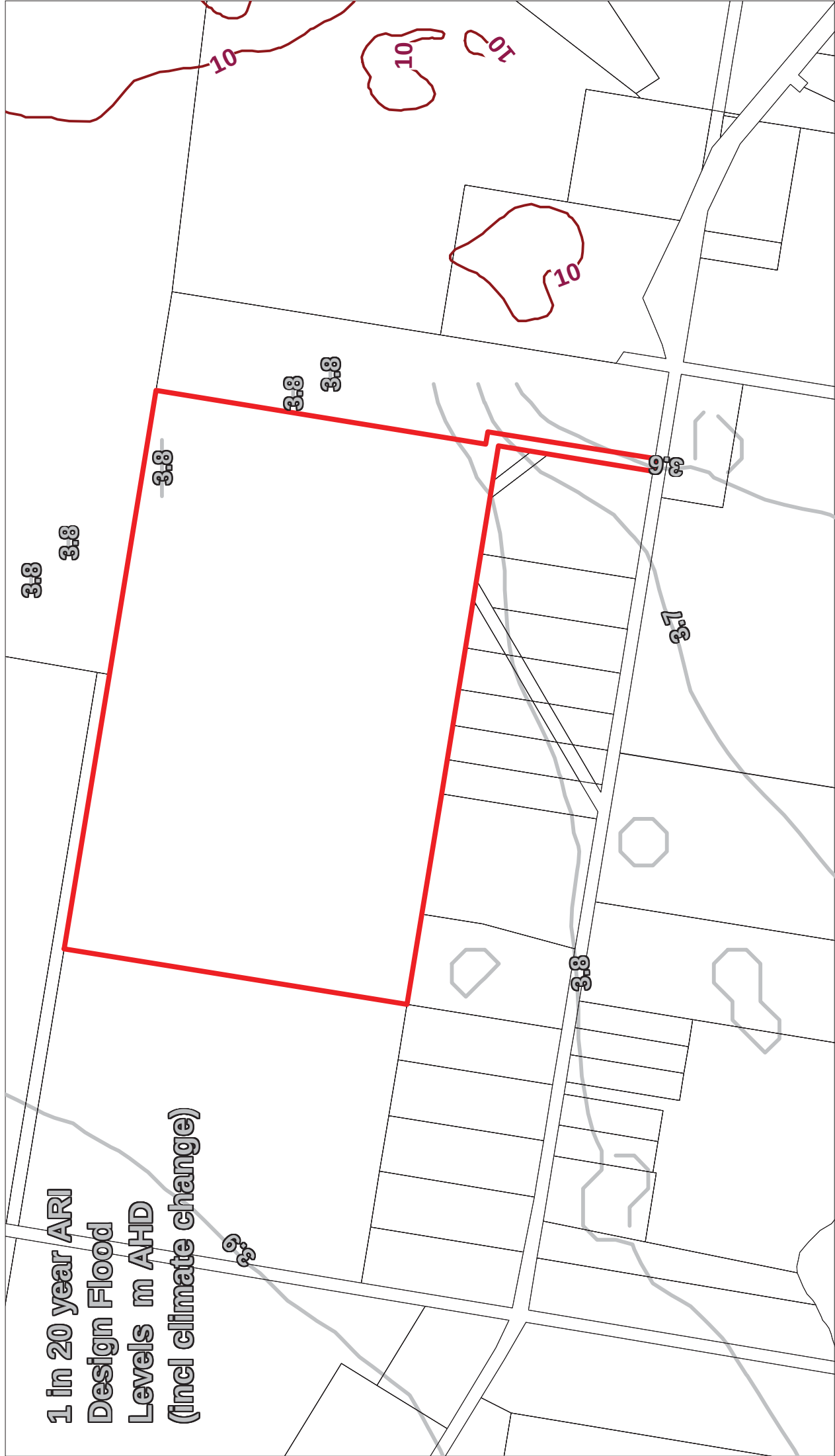
Name	License No.	Latitude	Longitude	Use	WBZ	SWL	Salinity	Yield (L/s)	Aquifer
GW032023	30BL182974	-29.0804	153.3647	Monitoring Bore	2.7-14.8	1.8	(Unknown)	6.32	Sand
GW032024		-29.0812	153.3658	Town Water Supply	-	-	(Unknown)	-	-
GW032302		-29.0806	153.3655	Monitoring Bore	-	-	(Unknown)	-	-
GW032303		-29.0806	153.365	Monitoring Bore	-	-	(Unknown)	-	-
GW032304		-29.0804	153.3652	Monitoring Bore	-	-	(Unknown)	-	-
GW032305		-29.0801	153.3655	Monitoring Bore	-	-	(Unknown)	-	-
GW032306	30BL024771	-29.0801	153.3638	Monitoring Bore	-	-	-	-	-
GW034578	30BL025888	-29.0884	153.3825	Domestic Stock	4.2-4.8	4.2	Potable	1.89	Sand
GW039150		-29.0842	153.3711	Monitoring Bore	41821	1.6	0-500 ppm	18.18	Sand, Clay
GW039151		-29.0873	153.379	Monitoring Bore	4.6-28	1.5	0-500 ppm	10.35	-
GW039152		-29.093	153.3999	Monitoring Bore	4.2-35 17-23 27-35.3 39-45 43.5-48	0	0-500 ppm	20.66 26.25 15.15	Sand, Sandstone
GW040869	30BL180631	-29.0806	153.3643	Town Water Supply	2.5-14.9	1.99	(Unknown)	6	Sand
GW044873	30BL104925	-29.0648	153.3833	Stock	5.9-6.1	-	Good	0	Sand
GW046447	30BL104924	-29.0623	153.3816	Stock	5.8-6.1	-	Good	0.63	Sand
GW046619		-29.0909	153.3927	Irrigation	0-1.8	-	(Unknown)	-	Sand
GW046620		-29.0884	153.3913	Unknown	2.7-4.2	0.6	Potable	0	Coarse Sand
GW046621		-29.0954	153.3913	Unknown	2.6-3.4	0.6	Potable	0	Coarse Sand
GW046641		-29.0962	153.3938	Irrigation	0-1.8	-	(Unknown)	-	Sand
GW047664	30BL114539	-29.087	153.3725	Recreation (Groundwater)	2-8.6	2	(Unknown)	1.26	-
GW047694		-29.0817	153.3688	Town Water Supply	4.8-13.3	1.1	(Unknown)	5	-
GW053237	30BL119125	-29.0829	153.3711	Town Water Supply	4.3-17.4	0.8	(Unknown)	19	Sand
GW103407	30BL177055	-29.0855	153.3762	Domestic	4.5-6	2	0	2.6	Sand
GW302688	30BL179288	-29.083	153.364	-	-	-	-	-	-
GW302689	30BL179289	-29.0845	153.3644	Domestic Stock	-	-	-	-	-
GW304076	30BL181948	-29.0845	153.3739	Domestic		-	-	-	-
GW304522	30BL182285	-29.0947	153.3966	Monitoring Bore		-	(Unknown)	-	-

Name	License No.	Latitude	Longitude	Use	WBZ	SWL	Salinity	Yield (L/s)	Aquifer
GW305118	30BL183581	-29.0962	153.399	Domestic	7.4-8	5.6	(Unknown)	0.3	coffee rock brown mg soft, sand
GW305291	30BL182720	-29.0944	153.3992	Domestic		5.2	(Unknown)	1	coarse black sand, soft black rock, coarse sand (brown)
GW305301	30BL183001	-29.0953	153.3991	Domestic		5.7	(Unknown)	1	indurated black sand, soft rock, coarse sand (brown)
GW305746	30BL184149	-29.0913	153.3998	Domestic		9	-	2	-
GW305770	30BL184028	-29.0764	153.3672	Monitoring Bore		1.25		-	Silty sand Sand Clay Sandstone
GW305855	30BL184031	-29.0711	153.376	Monitoring Bore		1	(Unknown)	-	Sand
GW305933	30BL184094	-29.0658	153.3839	Monitoring Bore		-	-	-	-
GW305934	30BL184094	-29.0664	153.384	Monitoring Bore		-	-	-	-
GW305935	30BL184094	-29.0668	153.3838	Monitoring Bore		-	-	-	-
GW305999	30BL184327	-29.0794	153.3636	Monitoring Bore		1.8	-	-	Sandy Clay, Sand
GW306000	30BL184327	-29.0784	153.3639	Monitoring Bore		1.8	-	-	Sand
GW306001	30BL184327	-29.0782	153.3648	Monitoring Bore		1.5	-	-	Clay Sand
GW306200	30BL184794	-29.0908	153.3953	Domestic		4.5	(Unknown)	1	Sand

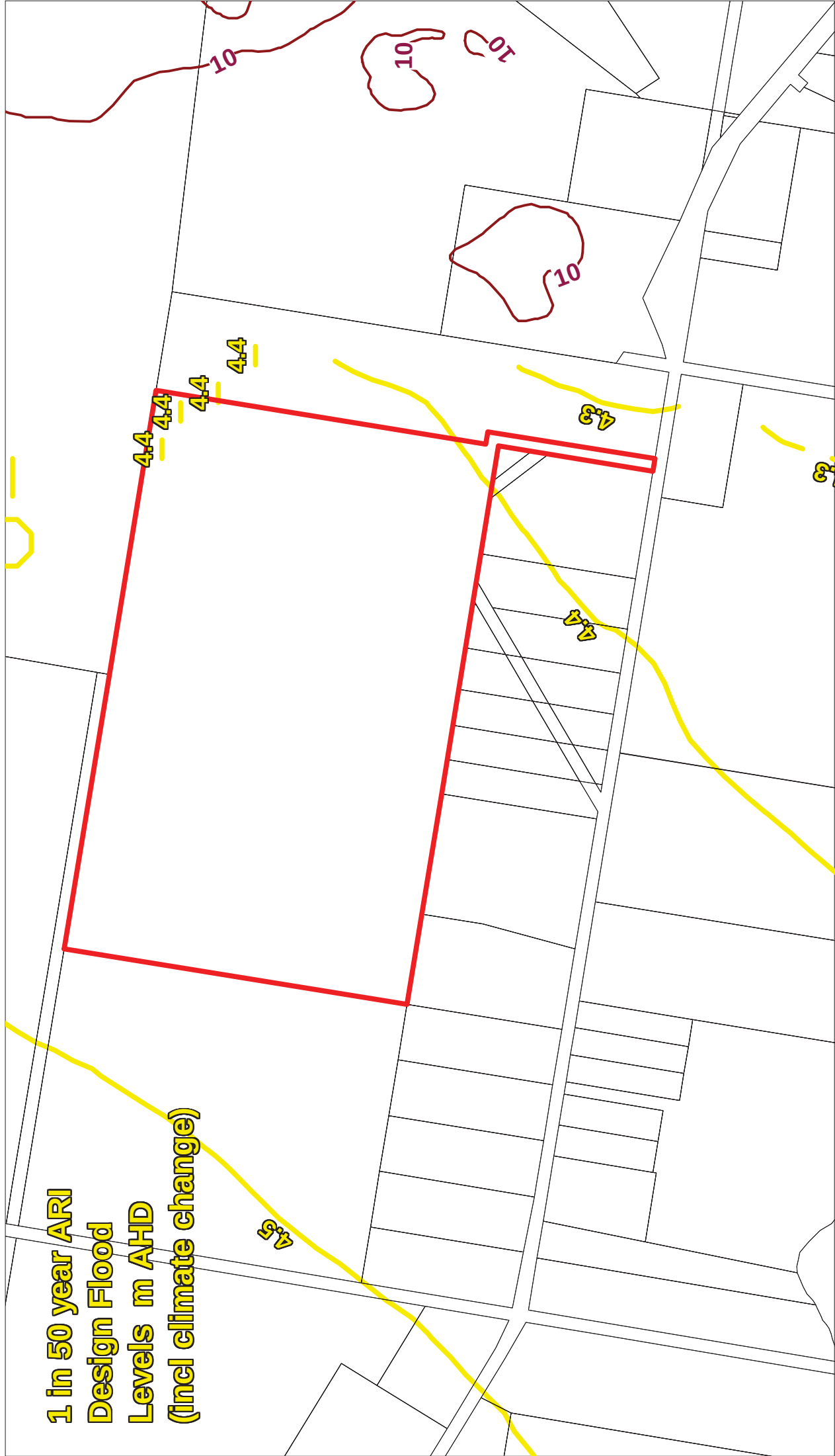
Appendix E – Flooding



**1 in 20 year ARI
Design Flood
Levels m AHD
(incl climate change)**



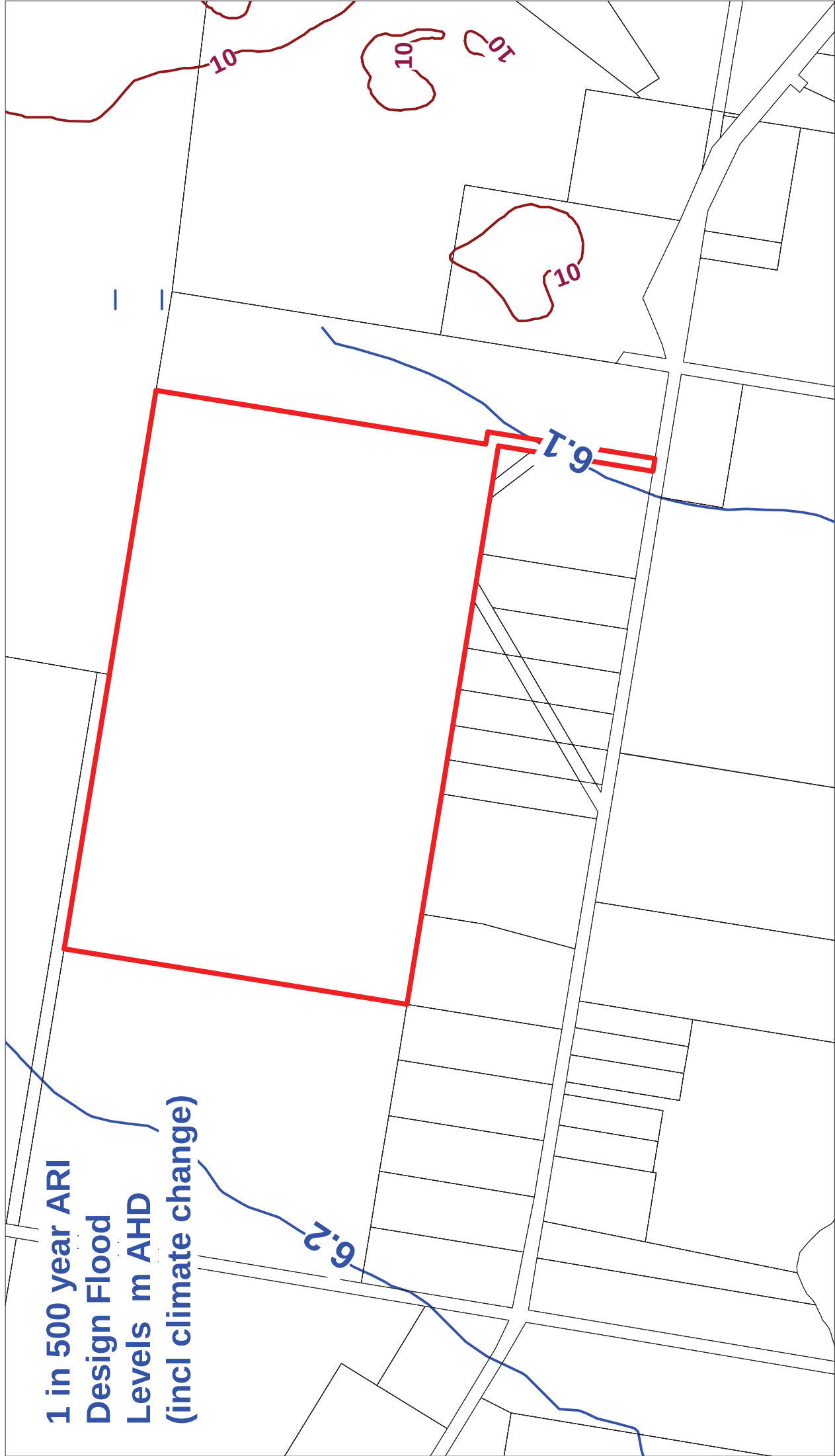
**1 in 50 year ARI
Design Flood
Levels m AHD
(incl climate change)**



**1 in 100 year ARI
Design Flood
Levels m AHD
(incl climate change)**



**1 in 500 year ARI
Design Flood
Levels m AHD
(incl climate change)**



0.128	0.133	0.122	0.129	0.136	0.139	0.145	0.149	0.159	0.18	0.173	0.163	0.155	0.144	0.134	0.128	0.14	0.162	0.168	0.162	0.144	0.132	0.125	0.126	0.133	0.132	0.116	0.075
0.128	0.132	0.127	0.135	0.14	0.144	0.147	0.153	0.163	0.193	0.206	0.2	0.191	0.176	0.156	0.143	0.147	0.158	0.156	0.18	0.17	0.158	0.152	0.155	0.166	0.161	0.147	
0.129	0.131	0.132	0.139	0.145	0.149	0.151	0.156	0.166	0.189	0.216	0.22	0.217	0.207	0.195	0.182	0.173	0.173	0.161	0.19	0.189	0.172	0.16	0.154	0.16	0.159	0.175	0.005
0.133	0.132	0.132	0.138	0.145	0.15	0.153	0.156	0.162	0.178	0.206	0.221	0.223	0.222	0.215	0.203	0.199	0.188	0.185	0.206	0.207	0.182	0.161	0.141	0.137	0.134	0.119	
0.139	0.131	0.132	0.137	0.144	0.149	0.152	0.152	0.155	0.161	0.191	0.212	0.222	0.222	0.215	0.212	0.216	0.217	0.211	0.229	0.251	0.237	0.215	0.203	0.178	0.152	0.123	
0.15	0.143	0.141	0.136	0.142	0.143	0.143	0.144	0.152	0.156	0.188	0.206	0.215	0.214	0.205	0.211	0.216	0.232	0.23	0.24	0.268	0.283	0.248	0.21	0.206	0.21	0.194	
0.151	0.171	0.158	0.142	0.142	0.128	0.131	0.135	0.148	0.166	0.203	0.215	0.216	0.213	0.193	0.191	0.206	0.215	0.226	0.236	0.25	0.298	0.289	0.257	0.255	0.297	0.245	
0.148	0.175	0.174	0.158	0.149	0.143	0.131	0.129	0.135	0.156	0.196	0.213	0.223	0.22	0.193	0.161	0.184	0.198	0.218	0.234	0.238	0.299	0.297	0.324	0.305	0.347		
0.137	0.163	0.177	0.164	0.146	0.148	0.133	0.126	0.127	0.144	0.188	0.212	0.226	0.215	0.2	0.182	0.192	0.198	0.213	0.228	0.248	0.292	0.316	0.355	0.328	0.314		
0.161	0.159	0.172	0.173	0.145	0.131	0.131	0.137	0.145	0.158	0.18	0.201	0.213	0.212	0.213	0.208	0.199	0.206	0.216	0.236	0.296	0.356	0.367	0.347	0.249			
0.193	0.161	0.166	0.194	0.172	0.145	0.136	0.136	0.158	0.151	0.154	0.153	0.168	0.221	0.235	0.21	0.195	0.195	0.201	0.209	0.22	0.258	0.331	0.364	0.345	0.174		
0.222	0.201	0.198	0.219	0.203	0.17	0.154	0.143	0.176	0.16	0.152	0.153	0.155	0.209	0.223	0.196	0.175	0.181	0.191	0.197	0.217	0.25	0.327	0.373	0.348			
0.211	0.229	0.244	0.265	0.274	0.258	0.238	0.213	0.212	0.22	0.194	0.171	0.172	0.204	0.243	0.203	0.193	0.187	0.187	0.189	0.211	0.235	0.294	0.366	0.377			
0.165	0.185	0.213	0.237	0.257	0.264	0.268	0.272	0.28	0.284	0.26	0.238	0.23	0.239	0.279	0.26	0.244	0.218	0.218	0.205	0.216	0.245	0.276	0.341	0.369			
0.147	0.147	0.158	0.155	0.151	0.162	0.186	0.214	0.25	0.284	0.268	0.245	0.245	0.261	0.295	0.324	0.31	0.279	0.263	0.25	0.239	0.256	0.263	0.311	0.274			
0.154	0.145	0.149	0.129	0.123	0.129	0.143	0.149	0.166	0.201	0.231	0.219	0.204	0.22	0.252	0.284	0.302	0.285	0.263	0.254	0.255	0.267	0.276	0.307				
0.155	0.151	0.146	0.129	0.124	0.13	0.148	0.148	0.154	0.19	0.204	0.195	0.193	0.19	0.191	0.204	0.229	0.246	0.233	0.225	0.236	0.273	0.31	0.332				

10

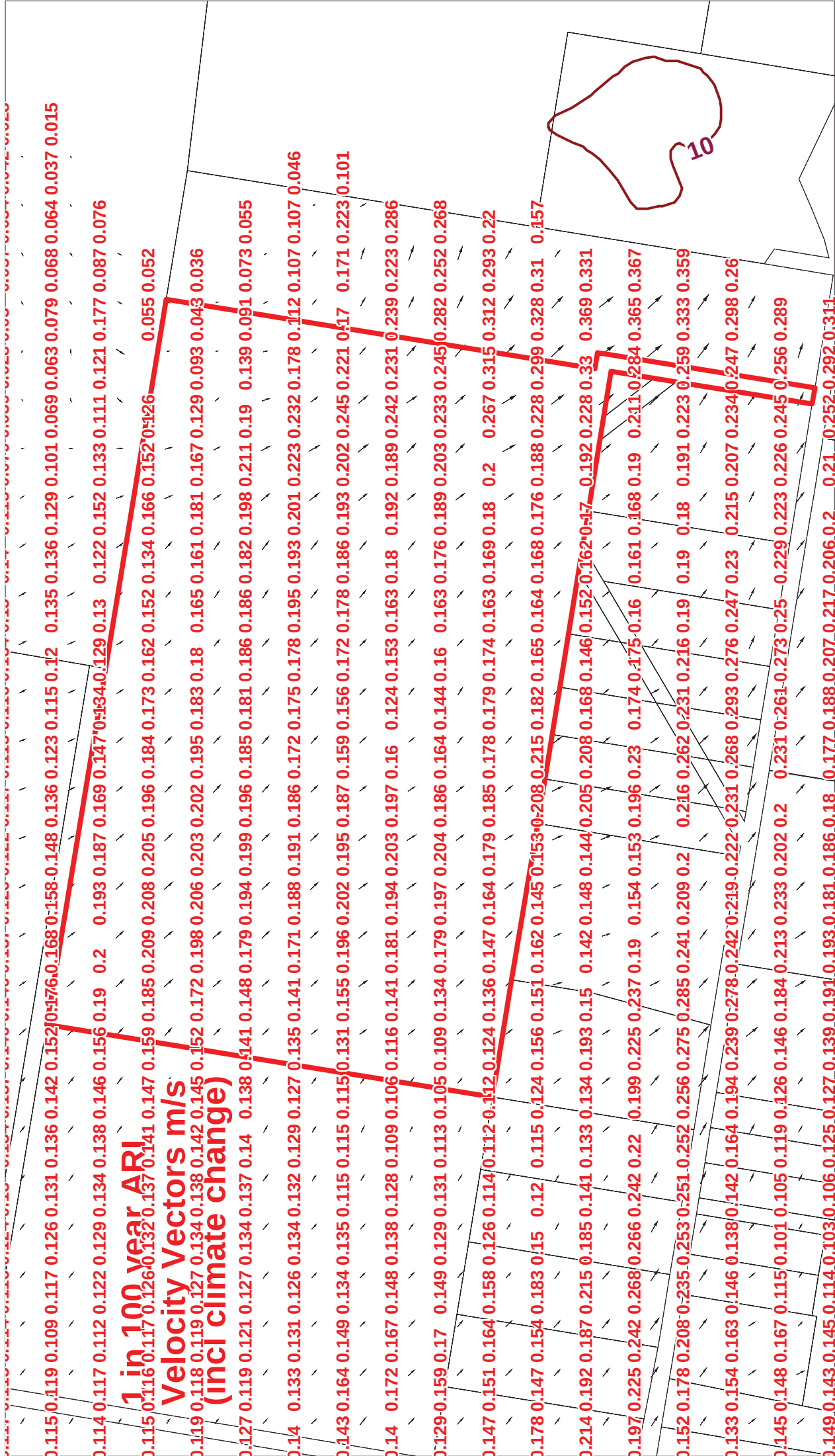
1 in 500 year API

Velocity Vectors m/s
(incl climate change)

1 in 500 year ARI

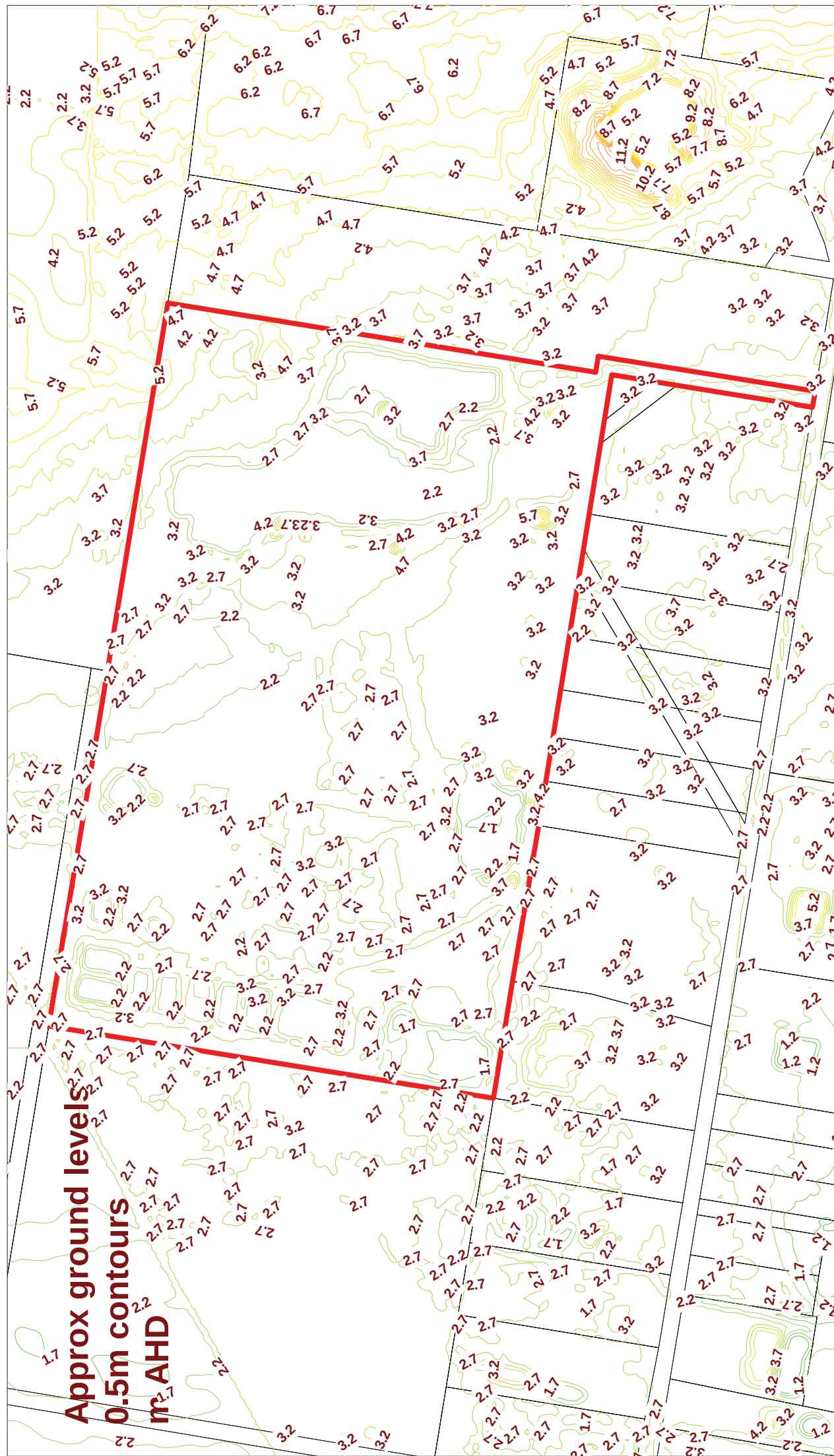
Velocity Vectors m/s
(incl climate change)

10



Velocity Vectors m/s
0.100.100.110.120.130.130.1
(incl climate change)

0.085	0.09	0.078	0.083	0.092	0.101	0.105	0.112	0.135	0.126	0.118	0.11	0.098	0.084	0.077	0.076	0.078	0.069	0.065	0.036	0.008					
0.085	0.088	0.08	0.089	0.095	0.103	0.109	0.117	0.146	0.151	0.141	0.139	0.122	0.1	0.091	0.083	0.073	0.059	0.081	0.055	0.03					
0.085	1.08	0.22	0.06	0.11	0.121	0.143	0.158	0.15	0.146	0.136	0.125	0.118	0.107	0.088	0.065	0.09	0.965	0.047							
0.088	0.088	0.088	0.094	0.101	0.105	0.107	0.1	0.11	0.13	0.132	0.131	0.124	0.109	0.102	0.104	0.099	0.093	0.097	0.092	0.071	0.039	0.016			
0.11	0.103	0.1	0.096	0.106	0.104	0.096	0.087	0.096	0.111	0.118	0.128	0.127	0.12	0.101	0.099	0.099	0.106	0.097	0.089	0.094	0.087	0.049	0.015		
0.117	0.134	0.12	0.109	0.11	0.087	0.078	0.074	0.099	0.141	0.165	0.155	0.143	0.136	0.107	0.094	0.099	0.095	0.09	0.081	0.082	0.093	0.071	0.029	0.011	
0.116	0.147	0.137	0.12	0.107	0.091	0.066	0.068	0.089	0.112	0.131	0.141	0.155	0.154	0.116	0.075	0.079	0.081	0.085	0.081	0.076	0.087	0.079	0.071	0.017	0.003
0.108	0.132	0.134	0.112	0.095	0.091	0.07	0.069	0.095	0.115	0.142	0.146	0.147	0.132	0.11	0.075	0.083	0.09	0.093	0.096	0.099	0.092	0.078	0.077	0.015	
0.114	0.122	0.126	0.124	0.1	0.089	0.081	0.104	0.141	0.129	0.113	0.129	0.141	0.146	0.127	0.109	0.104	0.098	0.098	0.111	0.135	0.185	0.175	0.125	0.058	
0.139	0.109	0.113	0.14	0.105	0.081	0.087	0.145	0.215	0.169	0.141	0.145	0.205	0.207	0.157	0.137	0.125	0.111	0.119	0.128	0.141	0.163	0.167	0.117		
0.181	0.149	0.143	0.175	0.14	0.098	0.12	0.153	0.305	0.194	0.157	0.17	0.153	0.223	0.22	0.147	0.121	0.11	0.11	0.135	0.153	0.161	0.491	0.515	0.411	
0.148	0.176	0.196	0.246	0.258	0.223	0.217	0.204	0.27	0.277	0.213	0.16	0.157	0.235	0.237	0.161	0.188	0.163	0.125	0.141	0.153	0.143	0.274	0.442	0.819	
0.133	0.138	0.168	0.246	0.291	0.259	0.251	0.25	0.312	0.318	0.215	0.192	0.17	0.192	0.231	0.199	0.191	0.148	0.133	0.138	0.13	0.136	0.182	0.377	0.592	
0.16	0.129			0.212	0.153	0.139	0.168	0.268	0.357	0.335	0.256	0.186	0.192	0.204	0.215	0.2	0.162	0.143	0.135	0.123	0.165	0.222	0.429	0.432	
0.168	0.176	0.135	0.084	0.082	0.079	0.067	0.074	0.107	0.162	0.212	0.22	0.19	0.203	0.234	0.224	0.186	0.18	0.174	0.198	0.234	0.282	0.539			
0.188	0.196	0.114	0.095	0.099	0.088	0.071	0.07	0.093	0.218	0.193	0.142	0.175	0.163	0.152	0.17	0.179	0.173	0.181	0.174	0.183	0.179	0.474	0.637		





Appendix F – Impacts of Groundwater

Impact Assessment Methodology

Potential impacts to groundwater levels from the proposed quarry extension have been predicted by analytical calculations. It is noted that the excavation currently occupies an area of approximately 6.28 hectares and it is proposed to expand the excavation to approximately 16.4 hectares. The average depth of extraction would increase from approximately 4 m (-1m AHD) to 15 m (-12m AHD).

Impact Prediction – Groundwater Levels

Analytical calculations were utilised to predict the potential groundwater level impacts. Impacts have been predicted for a range of potential scenarios.

Methodology

Preliminary groundwater inflow estimates have been undertaken using the analytical equations and approach outlined in Marinelli and Niccoli (2000). The equations presented in this paper provide a simple means of estimating steady state or long term average inflows to a mine pit that may contain a pit lake of infinite depth.

The solutions presented consider:

- The effect of decreased saturated thickness near the pit walls;
- Distributed recharge to the water table; and
- Upward flow through the pit bottom.

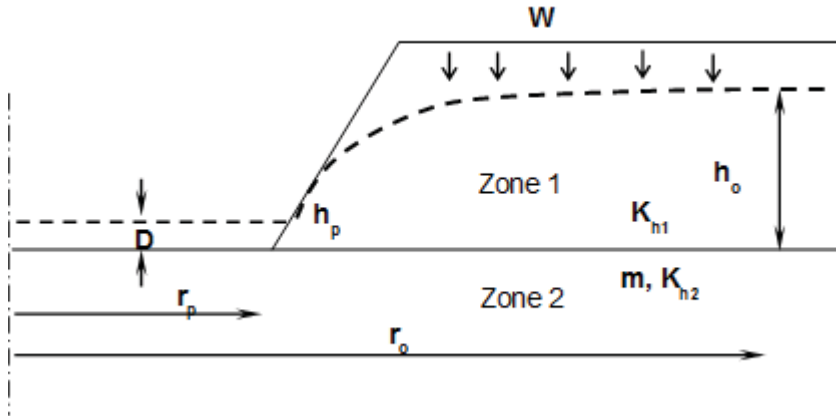
Separate flow calculations are undertaken for inflow into the pit walls (Q_1 , Zone 1) and pit base (Q_2 Zone 2), see Figure F1. Assumptions inherent in the flow calculations for Zone 1 include:

- Pit walls are approximated as a circular cylinder;
- Groundwater flow is horizontal (Dupuit - Forchheimer approximation is valid);
- The static (pre mining) water table is horizontal;
- Groundwater flow toward the pit is axially symmetric;
- Uniform distributed recharge occurs across the site as a result of surface infiltration; and
- All recharge in the radius of influence is captured by the pit.

Assumptions relevant to Zone 2 include:

- Hydraulic head is initially uniform throughout the zone. Initial head is equal to the elevation of the initial water table in Zone 1;
- The disk sink has constant hydraulic head equal to the elevation of the pit lake water surface. If the pit is completely dewatered the disk sink is equal to the elevation of the pit bottom;
- Flow to the disk sink is three dimensional and axially symmetric; and
- Materials within Zone 2 are anisotropic, and the principal co-ordinate directions for hydraulic conductivity are horizontal and vertical.

Figure F1 Pit Inflow Hydraulic Model



Relevant equations presented in Marinelli and Niccoli (2000) are as follows:

$$h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left(r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \left(\frac{r_o^2 - r_p^2}{2} \right) \right)}$$

$$Q_1 = W\pi(r_o^2 - r_p^2)$$

$$Q_2 = 4r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

Where:

- h_o = Initial (pre-mining) saturated thickness (m, above base of pit);
- h_p = Saturated thickness at pit wall (m, above base of pit);
- W = Distributed recharge flux (m/d);
- K_{h1} = Horizontal hydraulic conductivity Zone 1 (m/d);
- K_{h2} = Horizontal hydraulic conductivity Zone 2 (m/d);
- K_{v2} = Vertical hydraulic conductivity Zone 2 (m/d);
- r_p = Effective pit radius (m);
- r_o = Radius of influence (m);
- d = Depth of the pit lake (m).

Since dewatering of the pit is not proposed, the volume of groundwater flow into the pit has been assumed to be equal to evaporation from the pit. This has allowed the level of water in the pit to be calculated. Knowing the water level in the pit has allowed estimates of the water level at any sensitive receptors to be approximated.

Input Data

Data sources and assumptions used to derive input values for each of the parameters required in the equations developed by Marinelli and Niccoli (2000) are outlined below:

Initial (pre-mining) saturated thickness (h_0)

The initial (pre-mining) saturated thickness was assumed to be equal to the groundwater level indicated by the groundwater bores. The depth of the pit was 15 m bgl as indicated by the preliminary mine plan and the depth of the water table was taken as 2.5 m bgl which is approximately equal to the value indicated by the groundwater bores.

Distributed Recharge Flux (W)

Based on previous numerical modelling work undertaken in similar hydrogeological environments a recharge rate of 2% of long term average rainfall as recorded at the Bureau of Meteorology gauge at Woodburn (Cedar Street), Gauge Ref: 58061. Long term average rainfall as recorded at this gauge over the period 1886 to 2014 is 1368.4 mm/yr which gives an estimated long term average recharge rate of 27.4 mm/yr or 7.50×10^{-5} m/d.

Groundwater Inflow (Q)

The groundwater inflow into the pit has been assumed to be equal to evaporation. This is a suitable assumption as the pit will not be dewatered during mining. Evaporation data was adopted as recorded at the Bureau of Meteorology gauge at Alstonville Tropical Research Fruit Station Gauge Ref: 58131. Long term average evaporation as recorded at this gauge over the period 1970 to 2014 is 4.145 mm/d.

The evaporation volumes were assumed to be equal to groundwater inflow into the pit (Q). The assumption that groundwater inflow into the pit is equal to evaporation is a suitable assumption as the pit will not be dewatered during mining. This is also considered to be a worst case scenario that would apply during dry periods since direct rainfall recharge to the pit is not considered.

Hydraulic Conductivity Zones 1 and 2 (Kh_1 , Kh_2 and Kv_2)

Hydraulic Conductivity data has been assumed to be equal to generally accepted values of sand. Boreholes across the site indicated that the sandy stratum was generally fine grained with some medium grained sand some traces of silt. Based on the hydraulic conductivity values adopted by Kruseman and de Riddler (2000) for fine sand of 1 to 5 m/d and for medium sand 5 to 20 m/d; a horizontal hydraulic conductivity of approximately 5 m/d has been adopted. It was assumed that the horizontal hydraulic conductivity is 10 times greater than vertical hydraulic conductivity.

Effective Pit Radius (r_p)

The current preliminary mine plan indicates that the total mined area will equal 16.4 hectares. The methodology outlined by Marinelli and Niccoli (2000) requires the mine pit to be approximated by a circular pit. The effective circular radius of the pit was calculated from the total mined area indicated from preliminary mine plans and applying the formulae for the area of a circle i.e. $A = \pi r_p^2$.

Radius of Influence (r_0)

The radius of influence (r_0) of any groundwater abstraction represents a balance between the hydraulic conductivity of the strata and the rate of recharge incident at the water table. The radius of influence is therefore significantly affected by the presence or absence of hydrogeological recharge (such as perennial rivers) and/or no flow boundaries (such as geological boundaries) and therefore cannot be accurately predicted in advance.

Substituting the evaporated volume for Q_1 and Q_2 has allowed the radius of influence to be calculated. Once the radius of influence is known the saturated thickness at the pit wall (h_p) and the depth of pit lake (d) can be calculated.

Impact Assessment Criteria

The NSW Aquifer Interference Policy requires that potential impacts on groundwater sources, including their users and GDEs, be assessed against minimal impact considerations, outlined in Table 1 of the Policy. If the predicted impacts are less than the Level 1 minimal impact considerations, then these impacts will be considered as acceptable. The Level 1 minimal impact considerations for Highly Productive Coastal Sands Water Sources have been adopted for this groundwater impact assessment and are as follows:

- Water table: less than or equal to 10% cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, at a distance of 40 m from any high priority groundwater dependent ecosystem or high priority culturally significant site listed in the schedule of the relevant WSP. A maximum of a 2 m water table decline cumulatively at any water supply work.
- If more than 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any high priority groundwater dependent ecosystem; or high priority culturally significant site; listed in the schedule of the relevant water sharing plan then appropriate studies (including the hydrogeology, ecological condition and cultural function) will need to demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than 2 m decline cumulatively at any water supply work then make good provisions should apply.
- Water pressure: a cumulative pressure head decline of not more than a 2 m decline at any water supply work.
- If the predicted pressure head decline is greater than the requirement above, then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline will not prevent the long-term viability of the affected water supply works unless make good provisions apply.
- Groundwater quality: any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity
- If the change in groundwater quality is greater than the condition above, then appropriate studies will need to demonstrate to the Minister's satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works.

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Appendix E – Noise Impact Assessment



Rixa Quarries Pty Ltd
Doonbah Quarry - EPL Application
Noise Impact Assessment

November 2014

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Appendix B – Unattended noise monitoring charts
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Appendix D – Third octave tonality analysis
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Appendix F – Predicted operational noise levels - mitigated

1. Introduction

1.1 Purpose of this report

GHD has been engaged by Rixa Quarries Pty Ltd (Rixa Quarries) to conduct a Noise Impact Assessment for the existing sand quarry located at 405 Woodburn-Evans Head Road, Doonbah, NSW.

The site currently has development consent to extract up to 35,715 m³ (approximately 57,000 tonnes) per annum (DA 128/95). However the quarry has now exhausted the resources available under this approval.

This report has been prepared as part of an application for the proposed expansion of Doonbah Quarry to an extraction rate of up to 490,000 tonnes per annum (tpa).

1.2 Scope

The scope of work to conduct the Noise Impact Assessment involved:

- A review of the surrounding study area to gain an understanding of local site features and the location and nature of potential sensitive receivers.
- A review of existing environmental studies, as applicable.
- Establishing project specific noise goals for the project, based on previous long term noise monitoring data at the site, with consideration to the following guidelines and standards:
 - NSW Industrial Noise Policy (EPA, 2000) (INP)
 - NSW Road Noise Policy (DECCW, 2011)
- A review of site operations to identify principal noise sources during operation and their corresponding sound power levels.
- Undertaking one noise modelling scenario for the operation using Computer Aided Noise Abatement (CadnaA) software to predict sound pressure levels emanating from the site based on operations at the production rate of 490,000 tpa.
- Undertaking one noise modelling scenario with the inclusion of noise mitigation measures with the aim of demonstrating compliance at the nearest sensitive receivers.
- Undertaking a desktop assessment of road traffic noise impacts from heavy vehicles entering/exiting the site on public roads.
- Providing a summary of the predicted results and outlining recommendations for in-principle noise mitigation measures, where exceedances are predicted.

1.3 Limitations

This report: has been prepared by GHD for Rixa Quarries Pty Ltd and may only be used and relied on by Rixa Quarries Pty Ltd for the purpose agreed between GHD and the Rixa Quarries Pty Ltd as set out in Section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Rixa Quarries Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer to Section 1.4 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Rixa Quarries Pty Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The findings of this report represent the findings apparent at the date and time of the assessment. It is the nature of environmental assessments that all variations in environmental conditions cannot be accessed and all uncertainty concerning the conditions of the ambient noise environment cannot be eliminated. Professional judgement must be exercised in the investigation and interpretation of observations.

Site conditions (including the presence of insect noise or other noise sources) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

1.4 Assumptions

The following assumptions were made in this assessment:

- Quarry operating hours will be:
 - Weekdays: 7:00 am to 6:00 pm
 - Saturdays: 8:00 am to 1:00 pm
 - Public holidays: no work

Some minor work (e.g. maintenance) may occur outside these hours but these are considered to be inaudible.

- The equipment used on site will be limited to those assessed in this report.
- Processing equipment and haul routes will remain in similar locations to where they are currently situated.

2. Existing environment

2.1 Site location

The existing quarry is located at 405 Woodburn-Evans Head Road, Doonbah. The site is surrounded primarily by undeveloped bushland and National Park to the north and east and grazing land (farm land) immediately to the west. A number of residential properties are located along the southern boundary and on the southern side of Woodburn-Evans Head Road. The nearest residential dwelling is located within 100 metres of the quarry site boundary.

2.2 Noise sensitive receivers

Noise sensitive receivers in the vicinity of the site are detailed in Table 2-1. Figure 2-1 shows a site aerial image and the location of identified noise sensitive receivers. These receivers have been identified to represent those with the greatest potential for adverse noise impact.

Table 2-1 Identified noise sensitive receivers

Receiver	Receiver type	Single or double storey dwelling	Nearest quarry noise source	Approximate distance to nearest quarry noise source (m)
R1	Residential	Single	Access road	85
R2	Residential	Double	Access road	100
R3	Residential	Double	Access road	240
R4	Residential	Double	Dredge/loader	310
R5	Residential	Single	Dredge/loader	400
R6	Residential	Double	Dredge/loader	430
R7	Residential	Single	Cyclone/screen	460
R8	Residential	Double	Cyclone/screen	410
R9	Residential	Double (elevated single)	Cyclone/screen	580
R10	Residential	Double	Cyclone/screen	680
R11	Residential	Single	Cyclone/screen	640
R12	Residential	Single	Access road	90
R13	Residential	Single	Access road	470

The proposed site plan is shown in Appendix A.



Figure 2-1 Site location and noise sensitive receivers

2.3 Existing noise environment

The characteristics of the existing noise environment have been determined from the long term monitoring results outlined in the Rixa Quarries (No.2) Evans Head Quarry – EPL Application Noise Impact Assessment Report (GHD, 2013). The monitoring methodology and results from this previous report have been reproduced below.

Background noise monitoring was undertaken at two identified noise sensitive receivers between 9 and 21 October 2013. These locations were considered to represent the existing ambient noise environment in the area and were identified by GHD as being a safe and secure place for equipment, minimising the risk of theft or vandalism. Land access permission was also a factor that contributed to the final selection of the locations.

The noise loggers were programmed to accumulate L_{A90} , L_{A10} , L_{Aeq} and L_{Amax} noise descriptors continuously over sampling periods of 15 minutes for the entire monitoring period. Logger calibration was checked before and after measurements using a Bruel and Kjaer 4231 Sound Level Calibrator (serial number 2542101).

The data collected by the loggers was downloaded and analysed, and any invalid data removed. Invalid data generally refers to periods of time where average wind speeds were greater than 5 m/s^1 , or when rainfall occurred. Concurrent half hourly weather data were sourced from the Bureau of Meteorology's (BoM) Ballina automatic weather station, located approximately 40 km away. Given the similar coastal location and relatively flat intervening terrain, this location was considered acceptable to use for concurrent weather data. Details of the noise loggers and monitoring locations are provided in Table 2-2.

All sampling activities were undertaken with consideration of the specifications outlined in the AS 1055 (1997) 'Description and Measurement of Environmental Noise' and the NSW INP.

Table 2-2 Background noise monitoring details

Noise logger	Logger 1	Logger 2
Monitoring location	495 Woodburn – Evans Head Road, Doonbah (Receiver 2)	435 Woodburn – Evans Head Road, Doonbah (Receiver 8)
Logger type	Rion NL-42	SVAN 955
Logger serial no.	00131630	27624
Measurement started	09/10/2013 11:30	09/10/2013 15:30
Measurement ceased	21/10/2013 09:30	21/10/2013 10:00
Pre measurement calibration check	93.7	94.0
Post measurement calibration check	93.8	94.0
Frequency weighting	A	A
Time response	Fast	Fast

¹ Wind speed measurements are taken at 10 m height. Noise logger microphones are located at 1.5 m height. To account for the vertical wind profile from 10 m down to 1.5 m (microphone height), noise data was filtered based on 7 m/s wind speeds.

Noise logger	Logger 1	Logger 2
Photograph		

2.3.1 Summary of noise monitoring results

Unattended noise monitoring results

A summary of calculated background L_{A90} and ambient L_{Aeq} (day, evening and night) noise levels for the monitoring periods are provided in Table 2-3 and Table 2-4 for Logger 1 and Logger 2 respectively. Daily charts of the monitoring results are presented in Appendix B.

Site observations at the monitoring locations indicated that the primary noise sources in the area were as follows:

- Intermittent road traffic on Woodburn – Evans Head Road.
- Natural noise sources such as insect and bird noise and wind noise in foliage.

Based on information provided, some quarry operations were occurring during the noise monitoring period. These included dredge operations and excavator and loader movements. No haul truck movements occurred during the monitoring period. It was observed that quarry noise was faintly audible at the long term monitoring locations, however was not contributing to the measured ambient noise levels.

Table 2-3 Summary of noise monitoring results – Logger 1, dB(A)

Date	Background L_{A90} dB(A)			Ambient L_{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Wed-9-Oct-13	39	30	25	49	47	44
Thu-10-Oct-13	38	36	24	48	52	41
Fri-11-Oct-13	40	34	21	50	50	42
Sat-12-Oct-13	35	34	27	49	52	41
Sun-13-Oct-13	37	34	27	49	54	43
Mon-14-Oct-13	40	26	28	50	47	45
Tue-15-Oct-13	38	29	26	49	47	43
Wed-16-Oct-13	36	32	24	48	52	46
Thu-17-Oct-13	37	33	28	47	50	44
Fri-18-Oct-13	39	35	27	49	45	41
Sat-19-Oct-13	35	38	33	49	51	45
Sun-20-Oct-13	35	37	27	48	51	43
RBL and Leq Overall	37	34	27	49	51	43

Table 2-4 Summary of noise monitoring results – Logger 2 dB(A)

Date	Background L _{A90} dB(A)			Ambient L _{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Wed-9-Oct-13	38	32	25	46	46	43
Thu-10-Oct-13	38	34	26	49	48	40
Fri-11-Oct-13	39	30	21	48	50	42
Sat-12-Oct-13	35	33	25	46	45	43
Sun-13-Oct-13	34	35	26	46	46	44
Mon-14-Oct-13	38	28	28	48	44	42
Tue-15-Oct-13	37	29	26	46	46	43
Wed-16-Oct-13	35	35	25	45	46	43
Thu-17-Oct-13	35	34	27	46	47	42
Fri-18-Oct-13	38	31	28	46	45	43
Sat-19-Oct-13	34	33	27	46	48	44
Sun-20-Oct-13	32	36	25	45	48	44
RBL and Leq Overall	36	33	26	47	47	43

Attended noise monitoring results

A summary of the attended noise monitoring results are provided in Table 2-5. Charts of the monitoring results are presented in Appendix C.

Table 2-5 Summary of attended noise monitoring results dB(A)

Monitoring location	Date	Measurement time		Measured noise levels dB(A)				Observations (instantaneous dB(A))
		Start	Stop	L _{Aeq}	L _{A90}	L _{Amax}	L _{Amin}	
Logger 1	9/10/2013	11:31	11:46	47	38	69	34	- Intermittent traffic noise on Evans Head road (38 – 51) - Doonbah quarry faintly audible (estimated <30) - Wind in foliage (34 – 42) - Birds (34 – 46)
Logger 2	9/10/2013	15:18	15:33	54	39	72	35	- Doonbah quarry faintly audible (estimated <35) - Wind in foliage (39 – 43) - Intermittent traffic noise on Evans Head Road (36 – 49) - Insects (34 – 35)

2.4 Local meteorology

Noise propagation can be enhanced by local meteorological conditions. The INP states that when there is greater than a 30% occurrence of wind of up to 3 m/s, in any period (day, evening, night) in any season, from source to receiver, wind should be considered in noise prediction calculations.

Long term weather data was sourced from the Bureau of Meteorology's (BoM) Evans Head RAAF Bombing Range Automatic Weather Station (AWS) for the year 2011. This AWS is located approximately 10 km south of the site. Given the relatively flat land in the area, weather data collected at this location is considered to be representative of weather conditions at the site and has been utilised in preparing this report.

The operation will occur during the daytime period only. Figure 2-2 presents annual and seasonal wind roses during the daytime period for 2011 at Evans Head. Prevailing winds are shown to be from the north and south, with the strongest winds most often from the south and southeast. Winds from the northeast sector have the lowest frequency of occurrence.

Analysis of the seasonal wind rose data indicates that winds up to 3 m/s do not occur more than 30% of the time in the direction of sensitive receivers. Therefore, adverse wind conditions are not considered to be a feature of the area.

Although wind is not considered a feature of the area, the effects of adverse weather conditions have been included in the assessment, as discussed in Section 4.4.

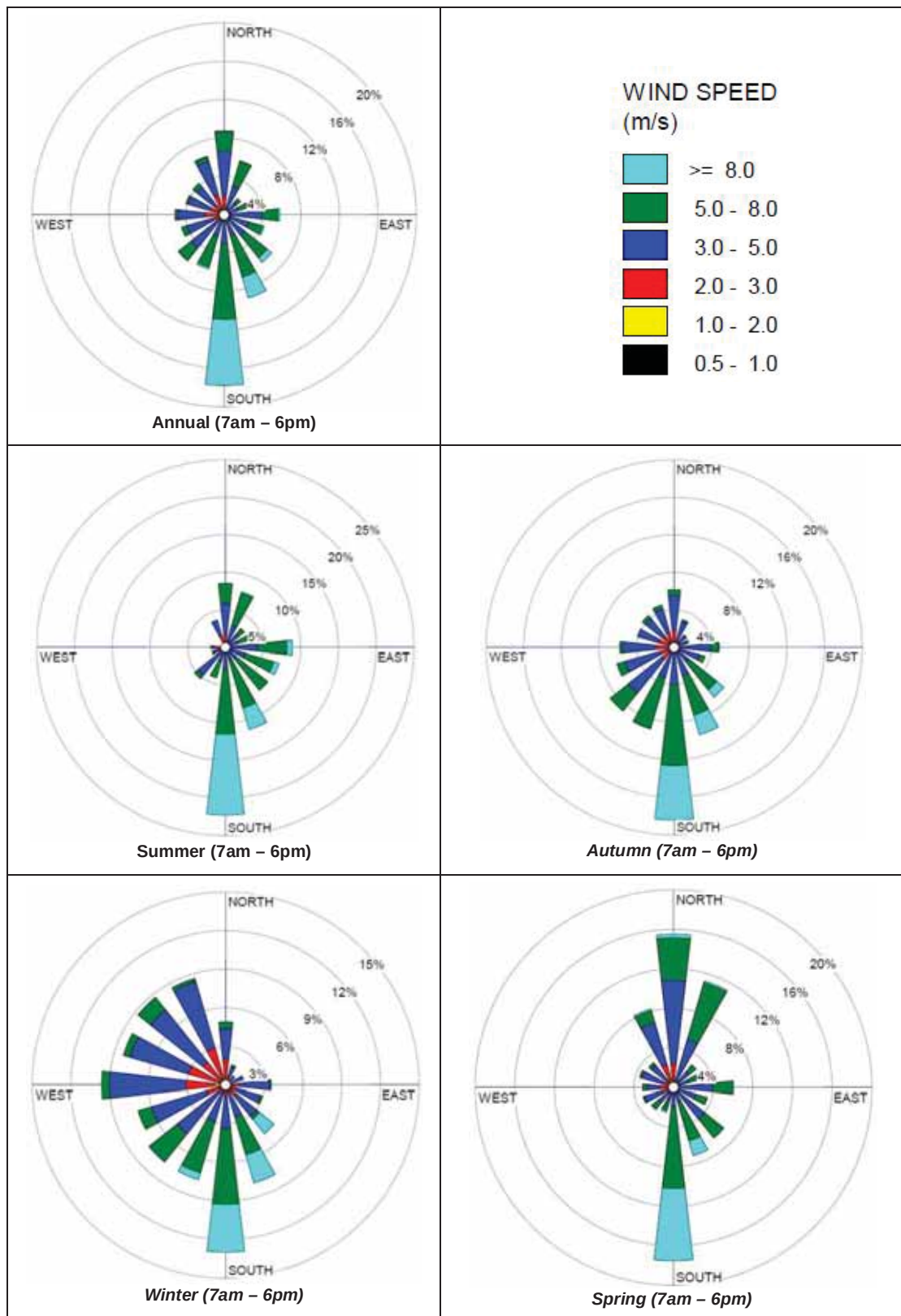


Figure 2-2 Annual and seasonal daytime wind rose charts, Evans Head 2011

3. Noise criteria

The noise criteria adopted for this assessment have been determined from the results outlined in the Rixa Quarries (No.2) Evans Head Quarry – EPL Application Noise Impact Assessment Report (GHD, 2013) and have been reproduced below.

Operational industrial noise criteria are derived from the NSW INP. The INP provides non mandatory industrial noise criteria to aid in the assessment of industrial noise sources scheduled under the *Protection of the Environment Operations Act 1997*. The policy sets two separate noise criteria to meet environmental noise objectives, one to account for intrusiveness and the other to protect the amenity of particular land uses.

Intrusiveness is assessed by determining the background noise level, where the equivalent continuous noise level from quarry operations should not be more than 5 decibels (dB) above the measured background level. The amenity criterion is based on noise criteria specific to the land use and associated activities. The project specific level is the more stringent of the intrusive and amenity criteria.

The intrusive, amenity and project specific levels are shown Table 3-1. The sensitive receivers in Table 2-1 are identified as being closest in proximity to the site and potentially the most impacted. The rural residential category was used to determine the amenity criteria for each sensitive receiver.

Table 3-1 Project specific operational noise criteria – daytime dB(A)

Criterion	Logger 1	Logger 2
Rating background level, LA90(Period)	37	36
Intrusiveness criteria, LAeq(15min)	42	41
Amenity criteria (rural), LAeq(period)	50	50
Estimated site contribution when operating, LAeq(period)	<35	<30
INP Table 2.2 modification 1	N/A	N/A
Project specific criterion, LAeq (15min)	42	41

1. Modification is based on existing industrial noise relative to the acceptable amenity noise level. Existing quarry noise (when operating) is less than acceptable noise level minus 6. Therefore no modification is made with consideration to Table 2.2 of the INP.

The NSW INP requires that the noise level at residences be assessed at the most affected point on or within the residential boundary or, if this is more than 30 m from the residence, at the most-affected point within 30 m of the residence.

As a conservative measure, the lowest project specific noise criterion of 41 dB(A) $L_{eq(15\text{ min})}$ has been adopted at all identified noise receivers.

3.1 Traffic on public roads

GHD understand that sand material would be hauled to and from the site via Woodburn – Evans Head Road and the existing quarry access road that runs to the quarry pit. Therefore, the quarry has the potential to create additional traffic noise on Woodburn – Evans Head Road.

Given the quarry access road is located on the site and is not a public road, noise from the access road is assessed under the INP.

The NSW *Road Noise Policy* (EPA, 2011) (RNP) provides non-mandatory road traffic noise target levels for land use developments with potential to create additional traffic on public roads.

Woodburn – Evans Head Road has been considered an arterial or sub-arterial road. The road traffic noise target levels are presented in Table 3-2.

Table 3-2 RNP traffic noise target levels at residential receivers – dB(A)

Type of Development	Day (7 am – 10 pm)	Night (10 pm – 7 am)
Existing residences affected by additional traffic on existing sub-arterial roads generated by land use developments.	LAeq(15 hour) 60 (external)	LAeq(9 hour) 55 (external)

4. Impact assessment

4.1 Methodology

The noise emissions from the operation have been assessed through noise modelling using Computer Aided Noise Abatement (CadnaA v4.4) to predict sound pressure levels at the nearest identified noise sensitive receivers.

CadnaA is a computer program for the calculation, assessment and prognosis of noise propagation. CadnaA calculates sound propagation according to ISO 9613-2, “*Acoustics – Attenuation of sound during propagation outdoors*”. The ISO 9613-2 algorithm also takes into account the presence of a well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm nights or ‘downwind’ conditions which are favourable to sound propagation.

Ground absorption, reflection, terrain and relevant shielding objects are taken into account in the calculations.

4.2 Description of site operations

Sand is primarily extracted through the use of a suction dredge positioned on one of the lakes within the site. Sand is then pumped onshore and stockpiled. As required, sand is screened and stockpiled or loaded by front end loader to haul trucks for removal from site.

The following items of plant and equipment are expected to operate on site:

- *Excavator* – for excavating topsoil, feeding the screens and stockpiling. Two are expected to operate on site.
- *Dredge* – for extracting the deeper resource sand once topsoil is removed.
- *Screening plant* – consisting of a screen used for separating the sand into different size fractions. A generator set is used to supply power to this system. The screen is fed by an excavator.
- *Front end loader* – to load sand onto the haul trucks and stockpiles.
- *Haul trucks* – for delivery of materials to customers.
- *Light vehicles* – used by staff to access the site.
- *Water cart* – to water haul roads and excavation.
- *Water pump* – to supply water cart.

Access to the site is off Woodburn – Evans Head Road in the south-eastern corner of the site.

4.3 Noise generating equipment

Table 4-1 displays a list of identified noise generating equipment expected to operate on site and their corresponding sound power levels.

For the purposes of noise level predictions, it has been assumed that all equipment listed in Table 4-1 will be operating simultaneously at maximum levels over the modelled duration, as outlined in Section 4.4.

In fact, during any given period, the machinery items to be used at the site will most likely operate at maximum sound power levels for only brief stages. At other times, the machinery may produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all equipment would be operating at maximum sound power levels at any one time. Therefore predictions are considered to be conservative estimates.

Table 4-1 Noise sources and sound power levels

Noise source	Octave centre frequency (Hz) dB(A)								Lw dB(A)	Source of data
	63	125	250	500	1k	2k	4k	8k		
Excavator (35 T)	58	60	58	61	62	60	54	42	96	A
Dredge (Generator)	85	92	95	93	91	90	83	69	100	B
Screening plant	75	85	87	96	100	99	94	90	104	B
Front-end loader	63	64	74	70	70	70	65	56	106	B/C
Haul truck/Water cart (at 20 km/hr)	85	94	96	98	100	97	91	83	105	D
Water pump	63	75	73	81	83	84	84	78	89	B
Light Vehicles (at 20 km/hr)	73	67	70	68	73	78	78	77	84	C
Cyclone – Generator (100 kW)	60	71	79	84	86	85	82	75	91	D
Cyclone – pump (75 kW)	59	71	80	85	92	90	86	78	95	D
Water pump	63	75	73	81	83	84	84	78	89	B

A. Previous noise measurement data undertaken by GHD of similar plant.

B. On site noise measurement.

C. BS 5228.1 – 2009.

D. Engineering Noise Control, Third Edition, A. Bies and H. Hanson, 1998.

4.4 Modifying factor corrections

Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content, it can cause greater levels of annoyance than other noise sources at the same noise level. The INP provides correction factors which are to be applied to the predicted noise levels for when such sources exist.

A review of site noise sources has been undertaken, based on the observations made on site as well as noise data provided in Table 4-1. The dredge, water pump and screening plant were assessed for tonality based on measured 1/3 octave noise data.

Appendix D provides the 1/3 octave band analysis for the dredge, water pump and screening plant. No tonal noise was identified. Other sources on site, such as excavators, loaders, generators and trucks do not typically contain tonal characteristics. Therefore, no correction factors have been applied for tonality.

Reverse beepers on mobile plant on site could be considered to be intermittent noise. The INP does provide a 5 dB adjustment for this type of noise; however, it is only applicable during the night-time period (10 pm – 7 am). As quarry operations will be during daytime hours only, this adjustment is not applicable.

Based on the above, no modifying factor corrections have been applied to quarry noise sources.

4.5 Model configuration

As the quarry progresses throughout its lifetime, the shape of the working area would change. In general, the extraction is proposed to move to the west of the existing extraction area and then south in four stages (Appendix A). Therefore four operational stages have been modelled and assessed.

- **Stage 1:** Proposed operations with dredge located at the southeast corner of the site
- **Stage 2:** Proposed operations with dredge located at the northeast corner of the site
- **Stage 3:** Proposed operations with dredge located at the northwest corner of the site
- **Stage 4:** Proposed operations with dredge located at the southwest corner of the site

For all stages, the noise impact of the quarry on surrounding receivers has been assessed at:

- **Average daily production**, approximately corresponding to 350,000 tonnes per year, which is expected to generate about 50 truck and dog loads (100 movements) per day.
- **Peak daily production**, approximately corresponding to 490,000 tonnes per year, which would require about 70 truck and dog loads (140 truck movements) per day.

The following assumptions were made with regard to the model configuration:

- Terrain was assumed to be flat. No sand stockpiles were included in the noise model.
- A general ground absorption coefficient of 1.0 was used throughout the model, representing grassland and low vegetation. A ground absorption coefficient of zero was used to represent water surfaces.
- Sound propagation is calculated according to the ISO 9613 algorithm.
- Modelling is based on atmospheric conditions of 10°C and 70% humidity.
- The locations of stationary and mobile equipment were modelled based on the site plans shown in Appendix A.

The noise modelling assumptions are as follows:

- One screening plant and loader were included in the noise model and were modelled as operating simultaneously for 90% and 80% of the time respectively over a 15-minute assessment period. The location of the screening plant and loader does not change between the four modelled operating scenarios.
- During the 15-minute assessment period, it was assumed that haul trucks would enter the site, travel up to the stockpile area, be loaded and then leave the site via the weighbridge. Haul trucks were modelled as moving point sources travelling at 20 km/hr. Haul trucks were modelled to the intersection of the access road and Woodburn – Evans Head Road.
- The excavator and dredge were modelled as operating 90% of the time.
- The water pump was modelled as operating for 50% of the time.
- The generator was modelled as operating for 90% of the time.
- There were assumed to be 10 light vehicle movements per day for staff (5 in / 5 out).
- Noise source heights above ground level were modelled as follows:
 - Excavator: 2 m
 - Screening plant: 3.5 m
 - Front End Loader: 2 m

- Haul truck: 2 m (A height of 2.0 m represents a combination of engine and exhaust noise)
- Light vehicles: 0.5 m
- Generator (Dredge) and pump: 1 m
- Single storey receivers were modelled at a height of 1.5 m above ground. Double storey receivers were modelled at height of 4.5 m above ground.

4.6 Model validation

Noise model predictions were validated by comparing the predicted noise levels with measured noise levels at monitoring locations on site and at the unattended monitoring locations. Where the predicted noise values are within 2 dB of the measured noise levels, the noise model is considered acceptable.

Noise sources for the validation scenario were modelled to represent activities on site during the time of each noise measurement. Generally, site operations included dredging towards the southern end of the Stage 1 lake and screening and loader movements towards the northern end of the lake.

A light breeze of 2 m/s in an east-south-easterly direction was observed while taking measurements on site. This has also been incorporated into the noise model for validation purposes.

To assist in the noise model validation process, sand stockpiles were included in the noise model based on their locations and estimated heights at the time of monitoring. Sand stockpiles were not included in future noise model predictions.

The results of the validation model scenario are presented in Table 4-2 and Figure 4-1. Measured and predicted noise levels compared well, which provides confidence in future noise model predictions.

Table 4-2 Noise model validation, dB(A)

Monitoring location	Measured Leq	Predicted Leq	Difference)
Screening plant 1	68.7	69.0	0.3
Dredge (western bank)	55.1	55.0	0.1
Dredge (southern bank)	51.6	51.2	0.4
Logger 1	Estimated ≤ 30	28.7	-
Logger 2	Estimated ≤ 35	35.7	-



Figure 4-1 Noise model validation

Note: this aerial image (source: Google 2013) does not accurately reflect the site layout. Site equipment has been located based on GPS coordinates rather than in relation to the aerial image.

4.7 Operational noise model results

Noise levels were predicted for future operation based on the operating conditions outlined in Section 4.5. The predicted noise levels for daytime site operations are shown in Table 4-3.

Noise model results indicate the operation is predicted to comply with the INP daytime noise criterion at most receivers, except for exceedances at receivers R1, R2, R3, R4, R5, R6, and R8 during some stages of operations. It is also noted that several receivers are very close, or equal to the adopted noise criterion.

An analysis of the model results leads to the following observations:

- Noise associated with the operation of haul trucks, the loader and the screening plant are the dominant noise source at most receivers.
- Noise from the movement of haul trucks is particularly dominant at receivers close to the haul road (R1, R2 and R3).
- Operation of the dredge impacts receivers during stages 1 and 4 of operations but has a lesser degree of impact in stages 2 and 3.

An assessment of noise mitigation measures has been provided in Section 5. It should be noted that the noise modelling is based on worst case operating conditions with conservative assumptions regarding site operations and weather conditions. This conservative approach is likely to result in predicted operational noise levels being slightly higher than actual noise levels.

Appendix E shows the predicted operational noise contour plots.

Table 4-3 Predicted operational noise levels

Receiver	Criterion	Predicted noise levels L _{Aeq} dB(A)							
		Stage 1		Stage 2		Stage 3		Stage 4	
		Peak daily production	Average daily production	Peak daily production	Average daily production	Peak daily production	Average daily production	Peak daily production	Average daily production
R1	41	45	44	45	44	45	44	45	44
R2	41	45	44	45	44	44	44	45	44
R3	41	43	43	43	42	43	42	43	43
R4	41	46	46	45	45	45	45	45	45
R5	41	42	42	41	41	41	41	42	41
R6	41	42	42	42	41	42	41	42	42
R7	41	40	40	40	40	40	40	41	41
R8	41	42	42	42	42	42	42	44	43
R9	41	39	39	39	39	39	39	40	40
R10	41	38	37	37	37	37	37	38	38
R11	41	37	37	36	36	37	36	37	37
R12	41	41	40	41	40	41	40	41	40
R13	41	36	35	35	35	35	35	35	35

4.8 Road traffic noise

Woodburn – Evans Head Road is the only public road leading directly to the site. The Annual Average Daily Traffic (AADT) count for Woodburn-Evans Head Road was sourced from the NSW Roads and Maritime Service (RMS) for the year 2004². An AADT of 2657 vehicles was provided, measured at a location approximately 1 km east of the Woodburn Township. A typical annual growth rate of 3% was used to estimate the AADT for the year 2013 to be 3467 vehicles.

No data was available for the percentage of heavy vehicles on Woodburn – Evans Head Road. Therefore it has been assumed that 5% of the AADT would comprise of heavy vehicles.

4.8.1 Traffic generation

During operation, it is likely that there would be a maximum of five employees or plant operators on the site at any one time. This would yield a daily workforce traffic generation in the order of 10 vehicle trips per day (vtpd). It is assumed the majority of the workforce would arrive between 6:30 am and 7:30 am and depart generally between 4:00 pm and 6:30 pm.

Truck and dog trailer combinations have a capacity of about 32 tonnes. At an average daily production, which would generate a win and haul rate of approximately 1,600 tonnes, the quarry is expected to generate about 50 truck and dog loads or 100 truck movements per day. At its peak, the quarry is expected to win and haul about 2,250 tonnes per day which would involve about 70 truck and dog loads or 140 truck movements per day.

4.8.2 Assessment approach

An assessment has been made of the existing and future levels of road traffic noise from Woodburn – Evans Head Road. Although noise monitoring was not specifically undertaken to measure road traffic noise, monitoring location 1 was located approximately 80 m from the roadway in the free-field and has been used to validate road traffic noise predictions.

Traffic noise modelling was conducted using The United Kingdom Department of Environment's *Calculation of Road Traffic Noise* (CoRTN).

Road traffic data input was as follows:

- Traffic speed: 80 km/hr (as signposted).
- 18-hour traffic volume was 94% of AADT.
- 5% split of heavy vehicles.
- $L_{A10(18\text{ hour})}$ to $L_{Aeq(15\text{ hour})}$ conversion of -1.4 dB, based on the average of measured weekday data at Logger 1.
- Increased traffic volume
- The maximum number of light and heavy vehicle movements was modelled
 - Heavy vehicle – 140 movements per day
 - Light vehicle – 10 movements per day

With consideration to RMS's *Environmental Noise Management Manual* (2000), the model is deemed to be verified if the average difference between the measured and calculated values of the descriptors is within +/-2.0 dB(A).

A comparison of measured and predicted noise levels was made and is presented in Table 4-4.

² Traffic Volume Data for Hunter and Northern Regions 2004, Roads and Traffic Authority, New South Wales, 2005.

Table 4-4 Comparison of measured and predicted road traffic dB(A)

Location	Measured	Predicted ¹	Difference
	L _{Aeq} (15 hour)	L _{Aeq} (15 hour)	
Logger 1	48.8	48.7	0.1

1. Validation predictions do not include 2.5 dB(A) façade correction factor as the logger was located in the free-field.

These results show a close correlation between the measured and predicted results at logging location 1, with variations of less than 2 dB(A). Therefore the CoRTN model is considered to be a valid approximation of the measured acoustic environment.

Road traffic noise levels were then predicted at 1 m from the nearest façade of identified receivers, with a correction factor for façade reflection (+2.5 dB) applied before comparison with the RNP L_{Aeq} (15 hour) criterion.

4.8.3 Predicted road traffic noise levels

The predicted existing L_{Aeq} (15 hour) noise levels and the predicted future L_{Aeq} (15 hour) noise levels (due to the increase in traffic volumes associated with the operation of the quarry) are summarised below in Table 4-5. The current predicted noise levels in Table 4-5 indicate that the daytime L_{Aeq} (15 hour) assessment criterion is currently exceeded at three receivers which are located in close proximity to the roadway (R2, R3 and R6). In these situations the RNP recommends that the proposed development does not increase road traffic noise levels by more than 2 dB.

Table 4-5 Predicted existing and future road traffic noise levels, dB(A)

Receiver	Traffic noise criterion L _{eq} (15 hour)	Current Predicted noise level L _{eq} (15 hour)	Future Predicted noise level L _{eq} (15 hour)	Complies (yes/no)
R1	60	51	52	Yes
R2	60	63	64	Yes
R3	60	61	62	Yes
R4	60	47	48	Yes
R5	60	57	58	Yes
R6	60	62	63	Yes
R7	60	55	56	Yes
R8	60	49	50	Yes
R9	60	56	57	Yes
R10	60	54	55	Yes
R11	60	52	53	Yes
R12	60	53	54	Yes
R13	60	48	49	Yes

The predicted growth in traffic due to quarry operations would increase the existing traffic noise by approximately 1 dB(A) all receivers. The RNP states that an increase of 2 dB(A) represents a level which is considered barely perceptible to the average person.

Despite road traffic noise predictions indicating compliance with the RNP criterion, heavy vehicle movements along the quarry access road and parts of Woodburn – Evans Head Road adjacent to sensitive receivers have the potential to generate annoyance. In particular bumps, pot holes or other irregularities in the roadway can cause short-term increased noise during vehicle passbys. Recommendations for noise mitigation measures are provided in Section 5.

5. Mitigation measures

5.1 Specific noise mitigation measures

Noise modelling predictions indicate the potential for an exceedance of the operational noise criteria by up to 5 dB(A) at receivers R1, R2, R3, R4, R5, R6 and R8. While all other receivers are predicted to comply with the criterion, there are a number of receivers where the predicted noise levels are very close or equal to the criterion. The following sections outline the mitigation measures that can be implemented to achieve compliance with the adopted noise criterion.

5.1.1 Access road noise mitigation

Model results indicate that the noise associated with the movement of haul trucks to and from the site is the dominant source at receivers R1, R2 and R3. Table 5-1 provides a breakdown of the individual contributions to the total noise level at R1, the most affected receiver.

Table 5-1 Partial noise levels at R1- Stage 1

Source	Individual noise contribution Leq dB(A)
Haul trucks	44
Loader	35
Screening plant	33
Dredge	33
Excavators	28
Cyclone/pumps	24
Total	45

The results of Table 5-1 have been used to identify where noise mitigation would be most efficient at reducing total noise levels from the site.

In order to mitigate the noise impacts associated with the movement of vehicles to and from the quarry along the access road at receivers located close to the access road it is recommended that staged acoustic barriers (fencing) be erected, thereby providing shielding effects at these receivers. These barriers should be located as close as practicable to the haul road and positioned to intersect the line-of-sight between the noise source and receivers. The predicted model results indicate that:

- During peak daily production noise walls provide effective shielding at a height of 2.8 m.
- During average daily production noise walls provide effective shielding at a height of 2.0 m.

The noise walls have been designed to achieve compliance with the adopted noise criterion at the most affected receivers under the modelled operating scenarios.

Figure 5-1 and Figure 5-2 below show the noise walls on site. Table 5-3 provides the predicted noise levels with the mitigation measures in place, which demonstrates compliance with the adopted noise criterion.

5.1.2 Onsite mitigation

Analysis of operational noise levels indicate that the operation of haul trucks onsite, the loader and the screening plant are the dominant noise source at most receivers, with noise from the dredge and excavator also contributing, but to a lesser degree. Table 5-2 provides a breakdown of the individual contributions to the total noise level at R4, the most affected receiver from site operations.

Table 5-2 Partial noise levels at R4- Stage 1

Source	Individual noise contribution L_{eq} dB(A)
Haul trucks	41
Loader	39
Screening plant	38
Dredge	38
Excavators	33
Cyclone/pumps	30
Total	46

The results of Table 5-2 can be used to identify where noise mitigation would be most efficient at reducing total noise levels from site operations.

Due to the availability of material within the quarry, one of the most effective and practical measures of mitigating noise levels from the screening plants and loader operations is to construct and maintain earth mounds around the processing areas, thus providing shielding to noise propagation off site. Earth mounds should be located to intersect the line-of-sight between the noise source and the receivers, i.e. to the south of the noise sources.

A noise model scenario has been run with the inclusion of three earth mounds, located to shield noise from the screening plant, the loader and the haul trucks on site.

During peak daily production (140 truck movements per day) the following measures are recommended, in addition to the access road noise walls discussed above:

- A mound is erected in front of the screening plant. The mound would need to be approximately 3.5 m high and approximately 20 m long.
- A mound is erected in front of the loader. The mound would need to be approximately 4.5 m high and approximately 20 m long.
- A mound is erected adjacent to the haul route, within the access road gates. The mound would need to be approximately 2.5 m high and 1 m short.

During average daily production (100 truck movements per day) the following measures are recommended:

- A mound is erected in front of the screening plant. The mound would need to be approximately 3.5 m high and approximately 20 m long.
- A mound is erected in front of the loader. The mound would need to be approximately 4.5 m high and approximately 20 m long.
- A mound is erected along the western and southern banks of the lake during stage 1 operations. The mound would need to be approximately 1.0 m high and 150 m long. The mound will provide shielding from the noise associated with the dredge. The mound will only be necessary during stage 1 of operations, however, as the dredge moves further away from receivers as operations progress through stages 2, 3 and 4.

The noise mounds have been designed to achieve compliance with the adopted noise criterion at the most affected receivers under worst case conditions.

Figure 5-1 , Figure 5-2 and Figure 5-3 show the locations of the three noise mounds. Where mounds are already partially constructed on site, these should be developed further in order to meet the height and length requirements detailed in Figure 5-1 , Figure 5-2 and Figure 5-3.

Table 5-3 provides the predicted noise levels with the mitigation measures in place, which demonstrates compliance with the adopted noise criterion.

Appendix F shows the predicted operational noise contour plots after mitigation.



Figure 5-1 Noise mitigation scenario- peak daily production



Figure 5-2 Noise mitigation – average daily production – stage 1



Figure 5-3 Noise mitigation – average daily production – stages 2, 3 and 4

Table 5-3 Predicted operational noise levels - Mitigated

Receiver	Criterion	Predicted noise levels L _{Aeq} dB(A)							
		Stage 1		Stage 2		Stage 3		Stage 4	
		Peak daily production	Average daily production	Peak daily production	Average daily production	Peak daily production	Average daily production	Peak daily production	Average daily production
R1	41	41	40	41	40	41	40	41	40
R2	41	41	41	41	40	41	40	41	40
R3	41	39	39	39	39	39	39	39	39
R4	41	41	41	41	41	41	41	41	41
R5	41	38	38	37	37	37	37	38	38
R6	41	38	38	38	37	38	37	38	39
R7	41	37	37	37	37	37	37	38	39
R8	41	40	40	39	39	39	39	41	41
R9	41	37	37	36	36	36	36	37	38
R10	41	37	37	37	37	37	37	37	37
R11	41	34	34	33	33	33	33	34	35
R12	41	39	38	39	38	39	38	39	38
R13	41	35	34	35	35	35	34	35	34

The following measures are also recommended to assist in reducing potential impacts:

- Ensure operations do not begin before 7 am or continue after 6 pm, including vehicles arriving on site and leaving the site.
- As far as possible, materials dropping heights into or out of trucks should be minimised.
- All equipment would be selected to minimise noise emissions. Equipment would be fitted with appropriate silencers and be in good working order. Machines found to produce excessive noise compared to normal industry expectations would be removed from the site or stood down until repairs or modifications can be made.
- Machines found to produce excessive noise compared to industry best practice should be removed from the site or stood down until repairs or modifications can be made.
- To reduce the annoyance associated with reversing alarms, broadband reversing alarms (audible movement alarms) should be considered for all site equipment. Satisfactory compliance with occupational health and safety requirements would need to be achieved and a safety risk assessment may need to be undertaken to determine that safety is not compromised. Refer to Appendix C of the NSW *Interim Construction Noise Guideline* (OEH, 2009) for more information.
- Surfacing the haul road from the weighbridge to Woodburn – Evans Head Road would assist in reducing noise during haul truck movements. Although it is out of the control of Rixa Quarries, it would also be recommended to resurface or smooth Woodburn – Evans Head Road in areas adjacent to noise receivers. This would assist in minimising banging/bumping noise from haul trucks as they travel to and from the quarry, particularly when they are unloaded.

5.2 Work ethics

All site workers would be sensitised to the potential for noise impacts on local residents and encouraged to take practical and reasonable measures to minimise the impact during the course of their activities. This would include:

- Avoid the use of loud radios.
- Avoid shouting and slamming doors.
- Where practical, machines would be operated at low speed or power and switched off when not being used rather than left idling for prolonged periods.
- Keep truck drivers informed of designated vehicle routes, parking locations and delivery hours.
- Avoid dropping materials from height and avoid metal to metal contact on material.
- All engine covers would be kept closed while equipment is operating.

5.3 Community relations

Consultation and cooperation with the neighbours to the site will assist in minimising uncertainty, misconceptions and adverse reactions to noise. It is recommended the following community relation measures be implemented:

- The quarry manager would provide a community liaison phone number and permanent site contact so that noise complaints can be received and addressed in a timely manner.
- Upon receipt of a noise complaint, noise monitoring would be undertaken and reported as soon as possible. If exceedances are detected, the situation would be reviewed in order to identify means to attempt to reduce the impact to acceptable levels.

5.4 Compliance noise monitoring

Sound power data for noise sources such as screening plant and haul trucks have been referenced from other data, as detailed in Table 4-1. This creates a level of uncertainty in noise model predictions, which is common in most predictive assessments. Due to the marginal level of compliance at many receivers, it is recommended that compliance noise monitoring be undertaken during initial quarry operations to verify noise model predictions and confirm compliance with the adopted noise criterion.

6. Conclusion

An assessment of the potential noise impacts from the existing quarry operations at Doonbah has been undertaken. This assessment has led to the following conclusions, which are subject to the limitations outlined in Section 1.3:

- Existing noise levels in the area surrounding the site are low and typical of a rural environment.
- An operational noise criterion of 41 dB(A) L_{eq} (15 min) has been adopted for all sensitive receivers.
- The operational noise assessment has been undertaken based on a worst-case operating scenario, with all equipment operating at maximum sound power levels over the modelling period.
- The noise assessment indicates that the noise levels due to operation of the quarry are expected to meet the adopted noise criterion at all identified sensitive receivers, except for R1, R2, R3, R4, R5, R6 and R8 where an exceedance of up to 5 dB(A) is predicted.
- An analysis of noise mitigation requirements to achieve compliance at all identified receivers has been undertaken. It is recommended that
 - During peak production two 2.8 m high acoustic barriers be erected on either side of the access road in order to mitigate the noise impacts associated with the movement of vehicles to and from the quarry along the access road. During average daily production it is recommended that the acoustic barriers be 2.0 m high.
 - During peak production three earth mounds be erected (using quarry material) in front of the screener, loader and internal haul roads at heights of 3.5 m, 4.5 m and 2.5 m respectively.
 - During average daily production three earth mounds be erected for stage 1 in front of the screener, loader and internal haul roads at heights of 3.5 m, 4.5 m and 1.0 m respectively.
 - For stages 2, 3 and 4, during average daily production, two earth mounds be erected in front of the screener and loader at heights of 3.5 m and 4.5 m respectively.

These recommendations are outlined in detail in Section 5.1.

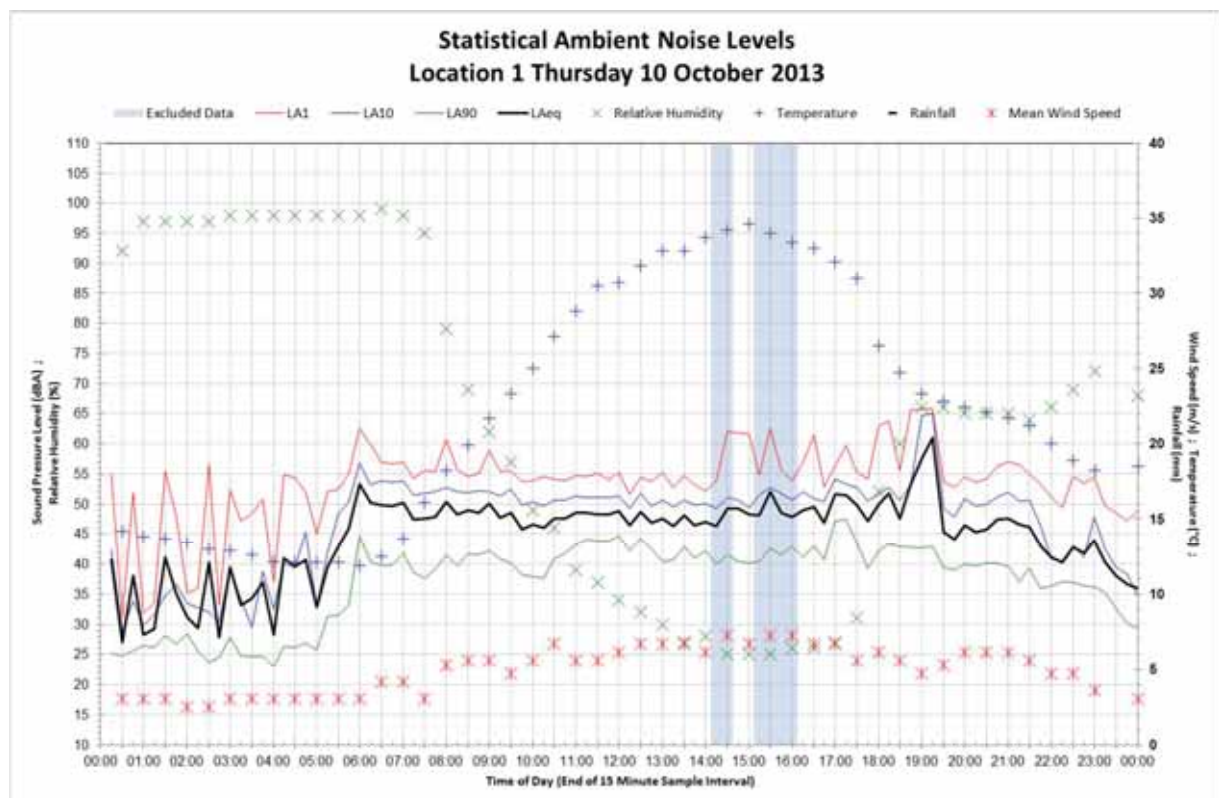
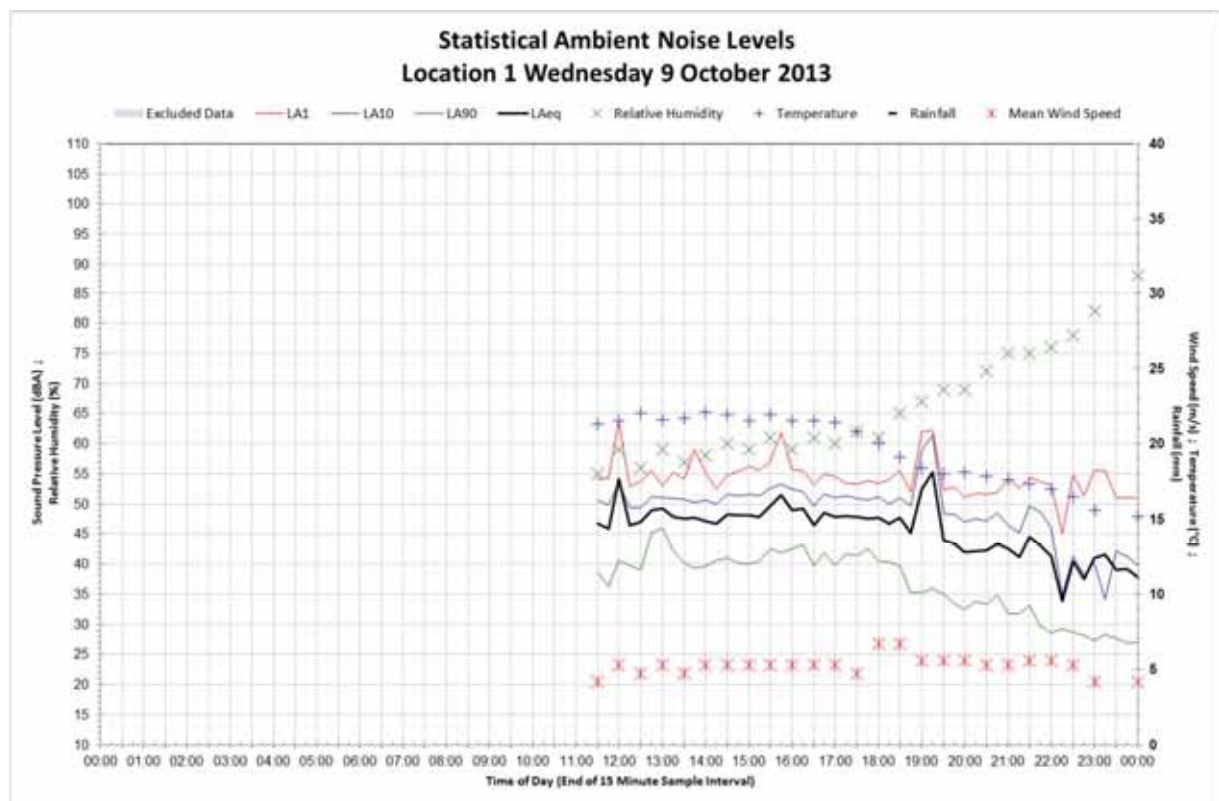
- The predicted growth in traffic due to quarry operations is expected to increase the existing traffic noise by approximately 1 dB(A). The RNP states that an increase of 2 dB(A) represents a level which is considered barely perceptible to the average person.
- Further recommendations have been provided in Section 5 to assist in minimising potential noise impacts.

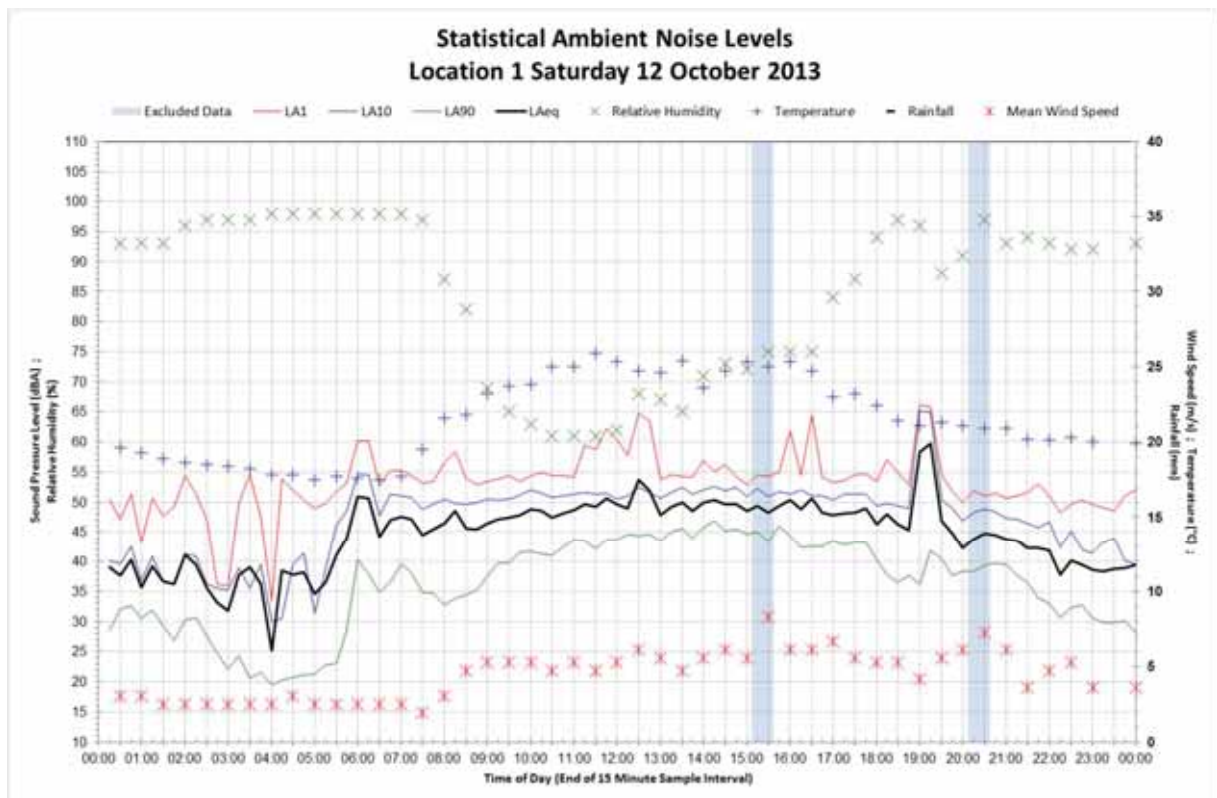
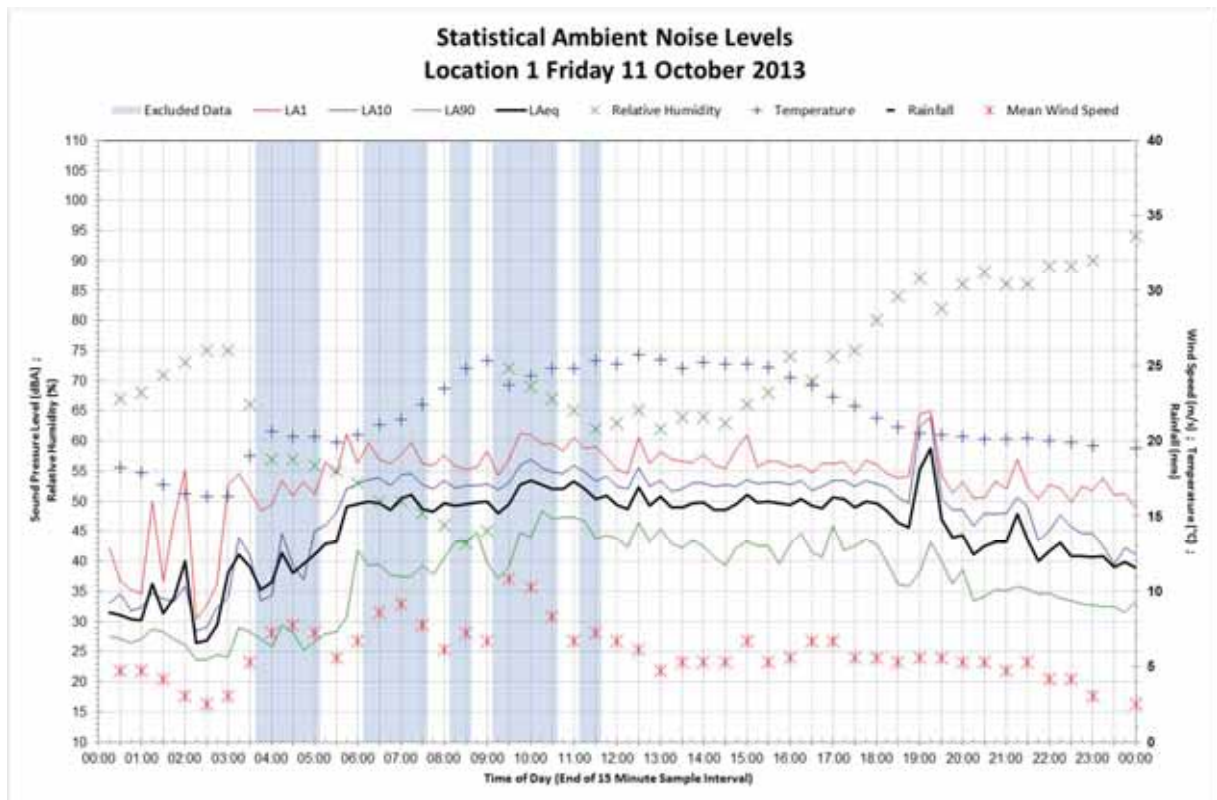
Appendices

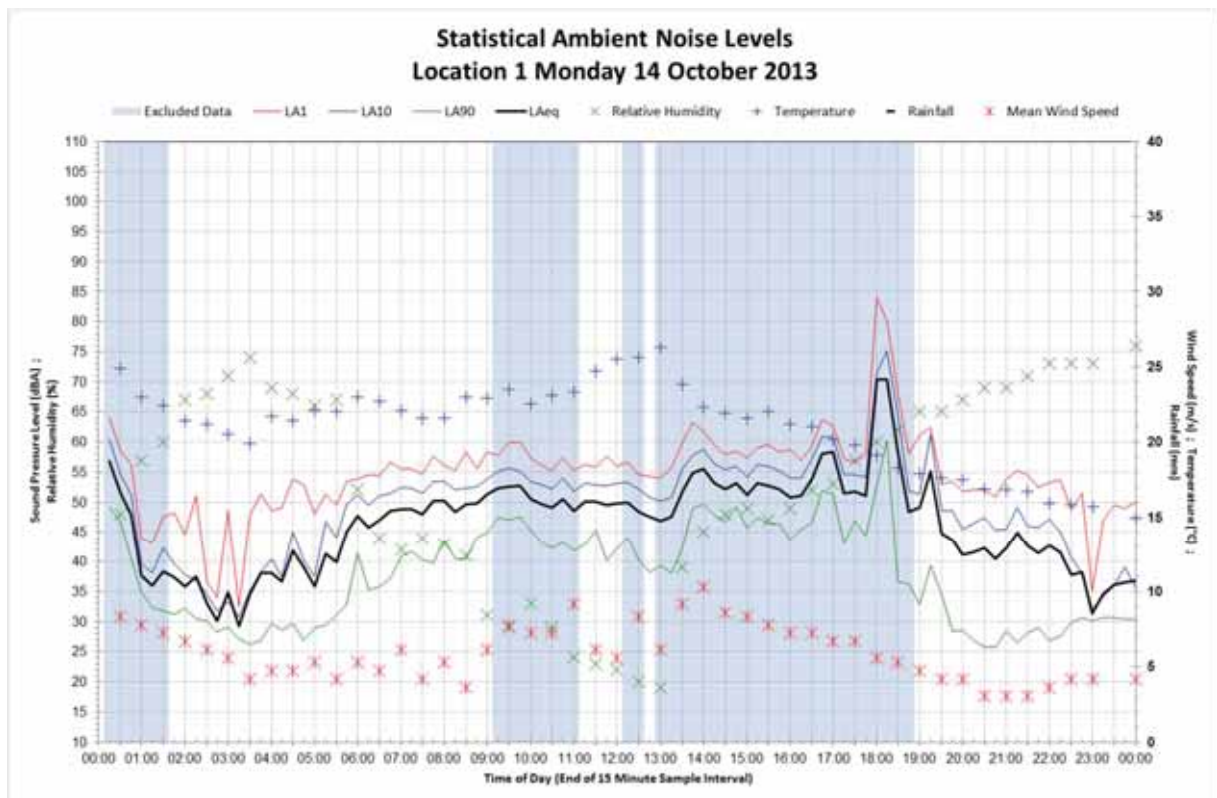
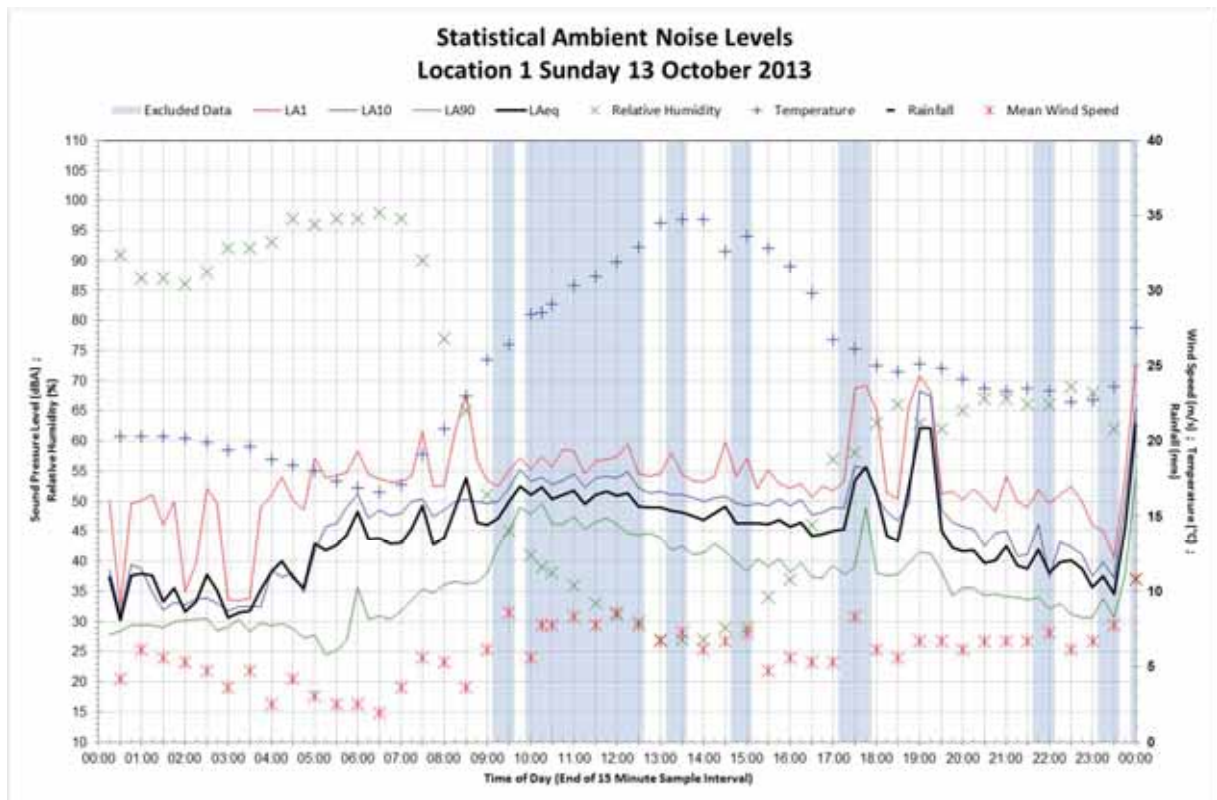
Appendix A – Site plan

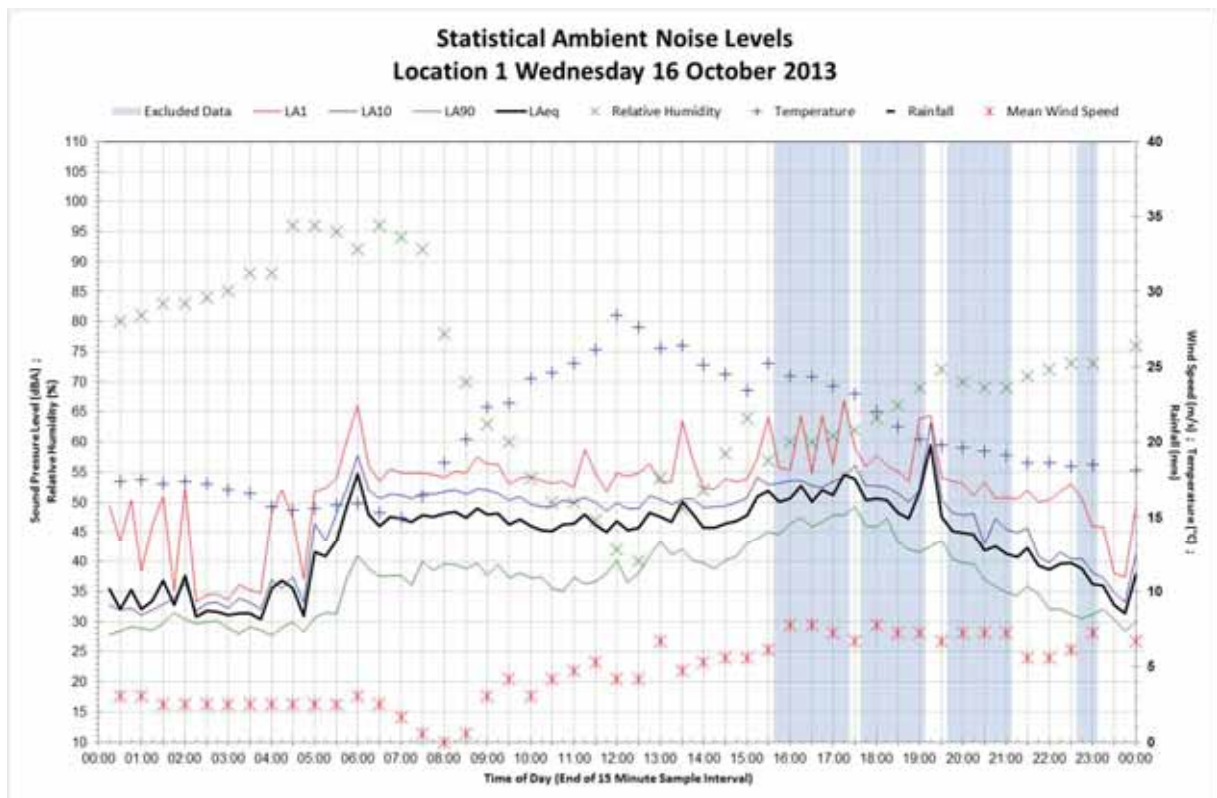
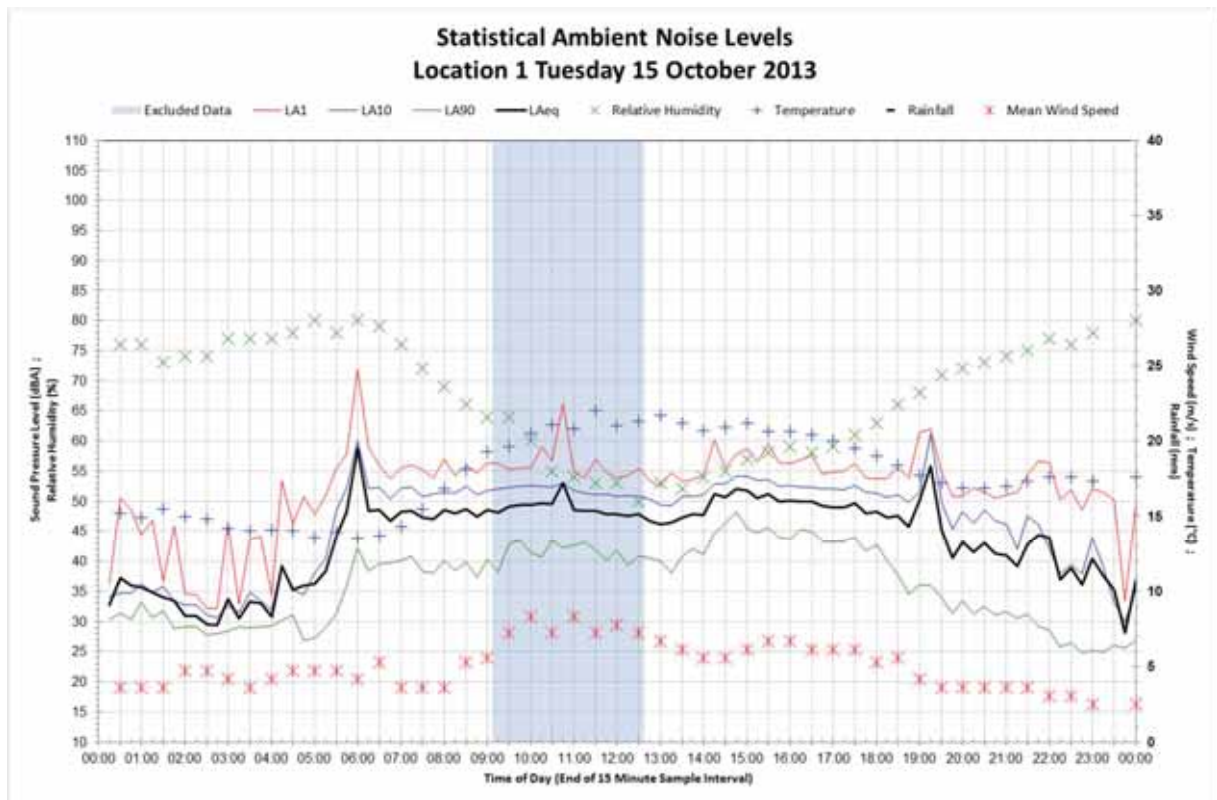


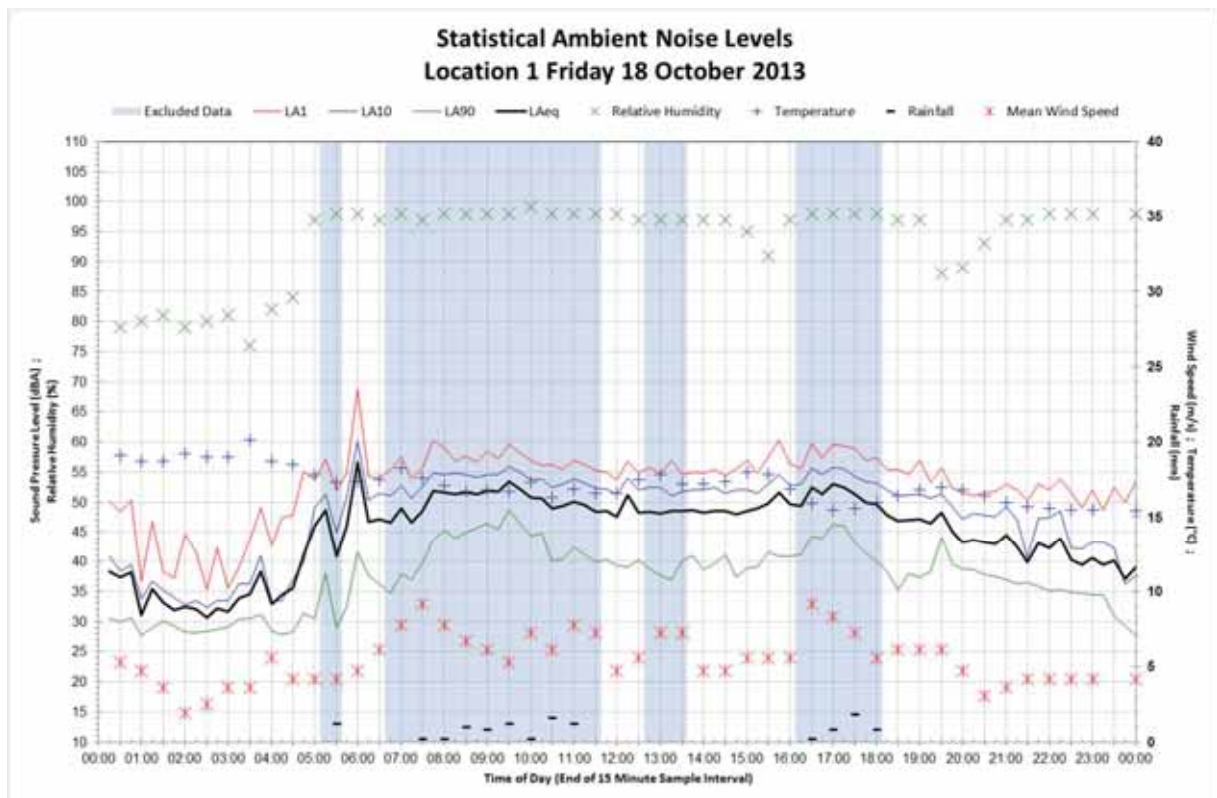
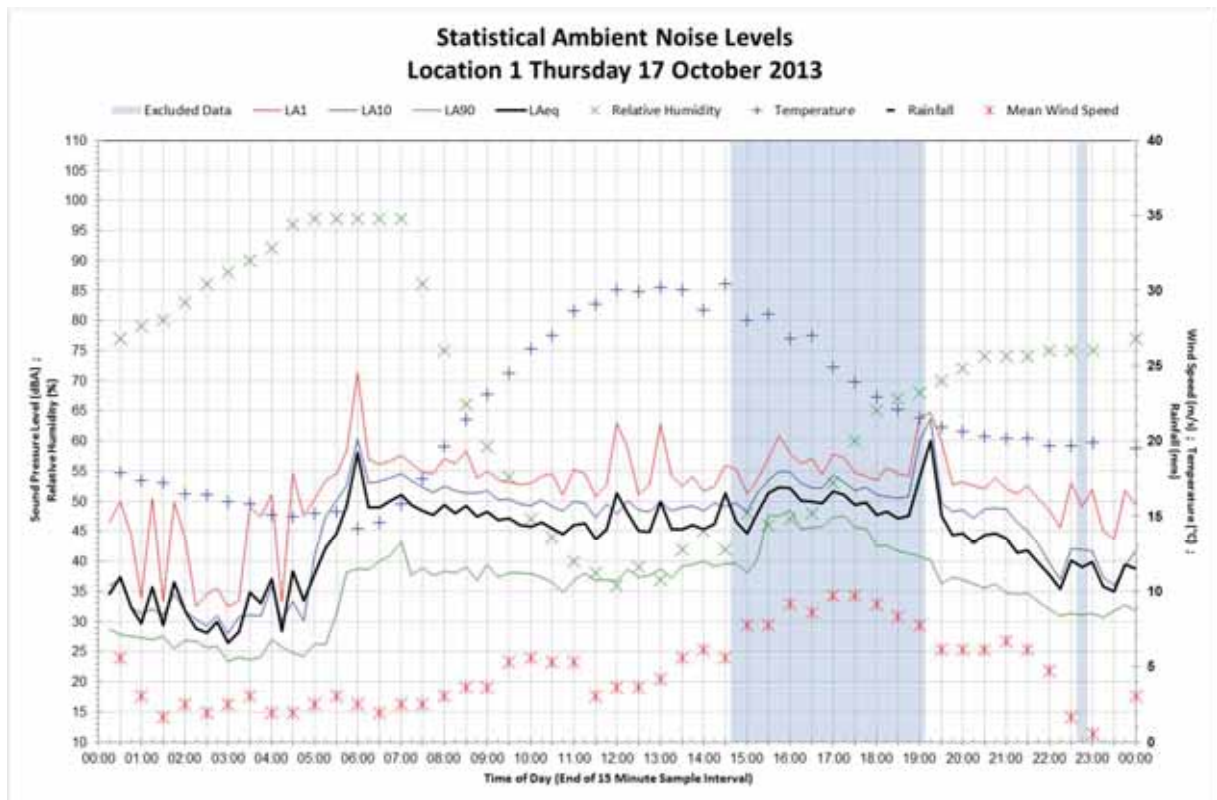
Appendix B – Unattended noise monitoring charts

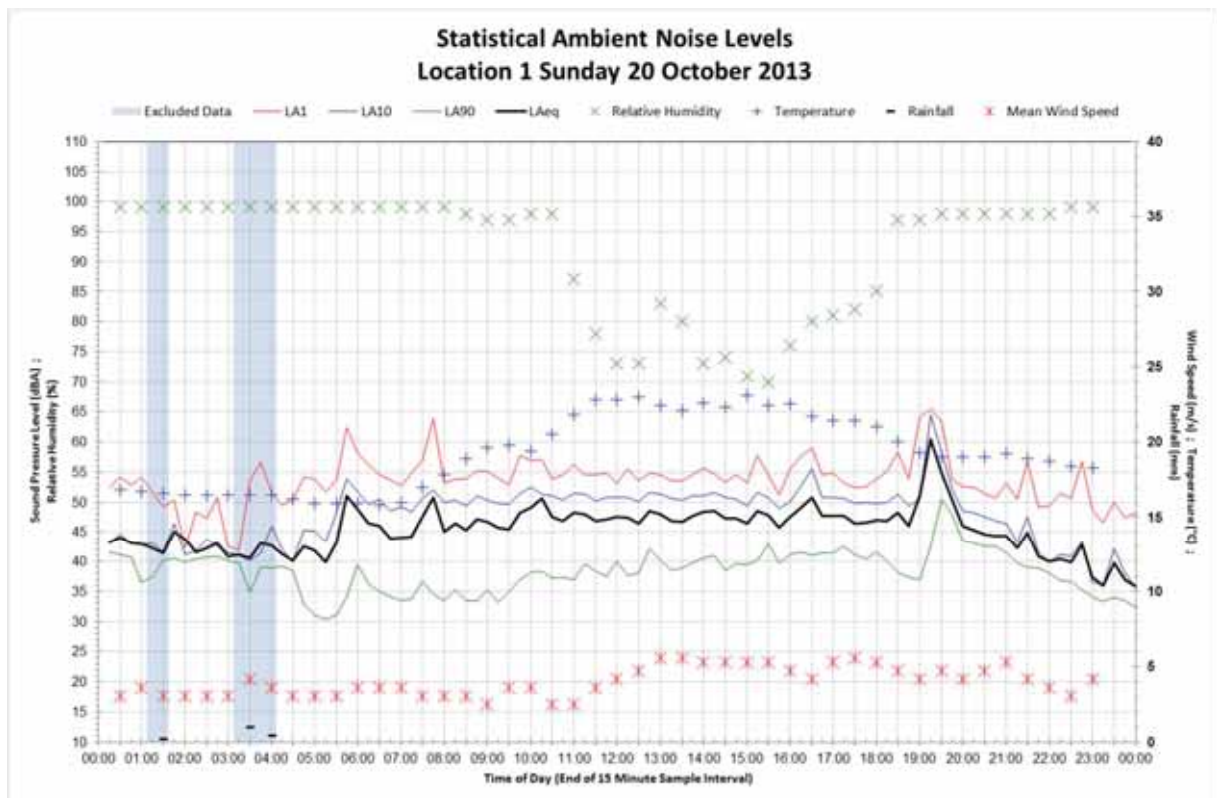
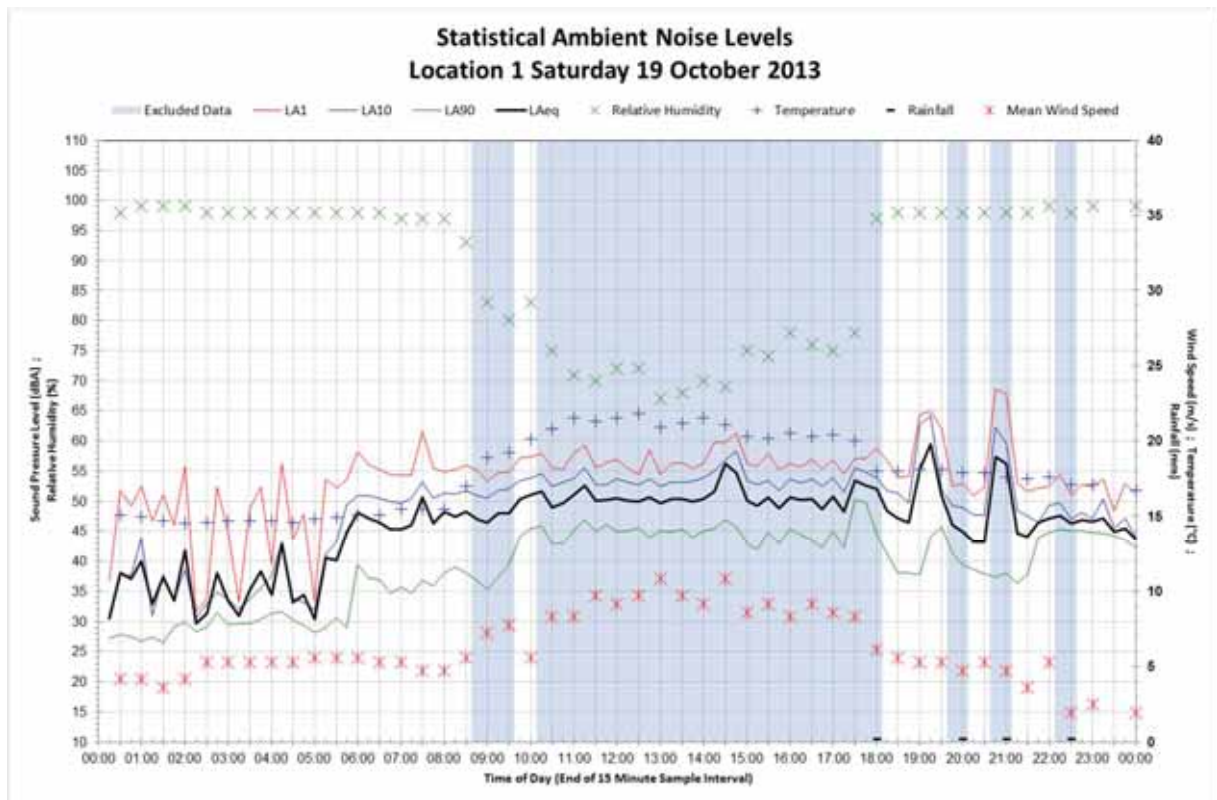


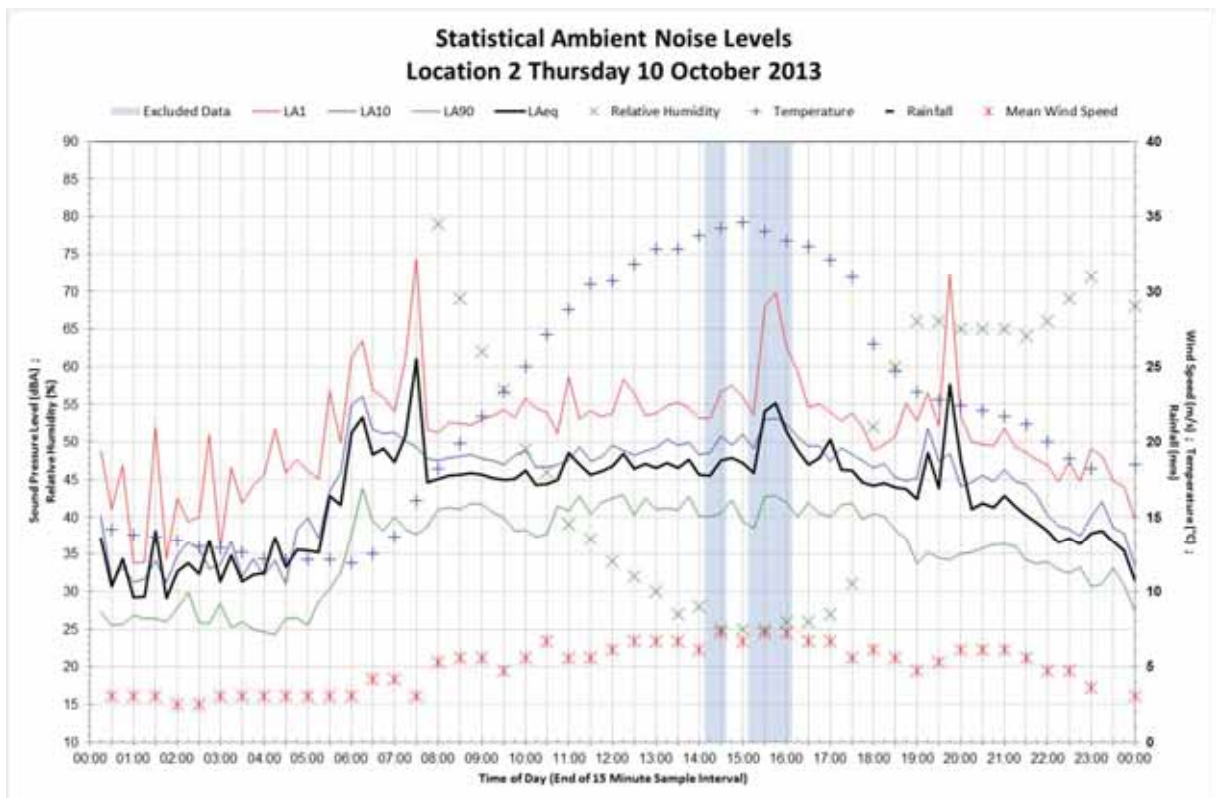
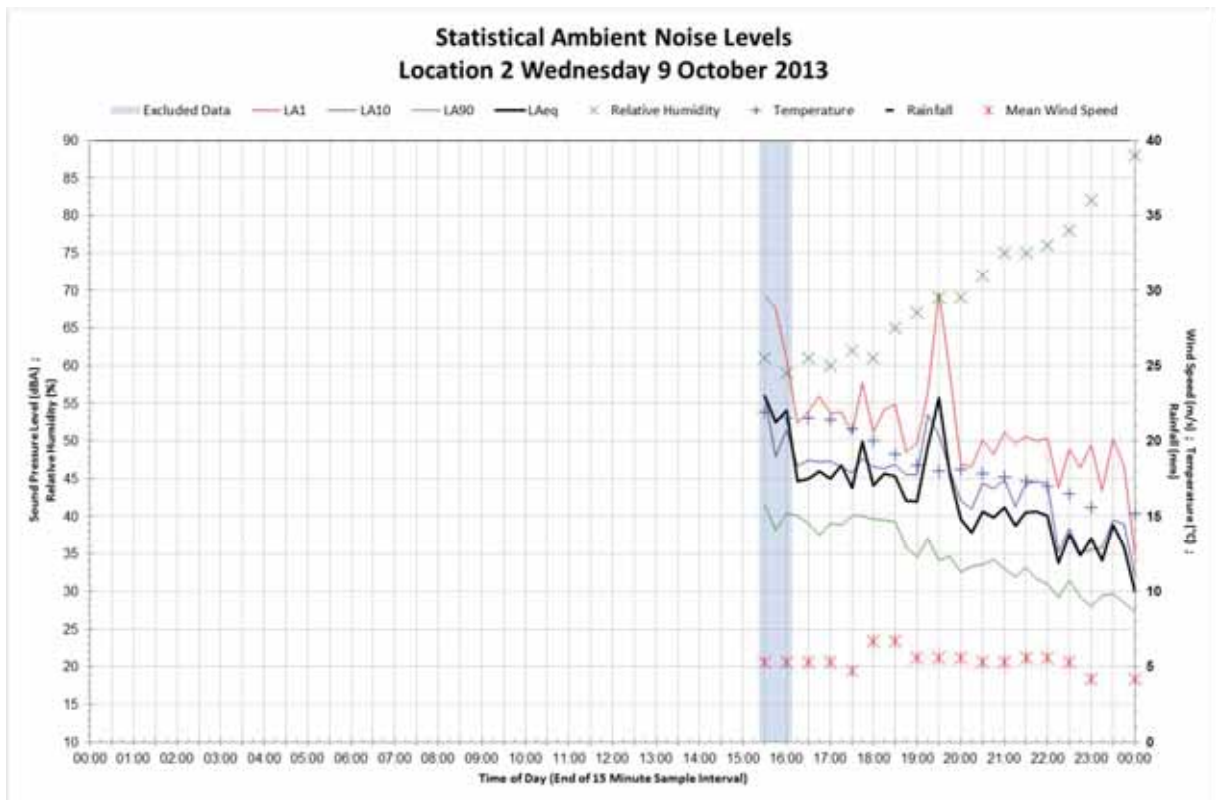


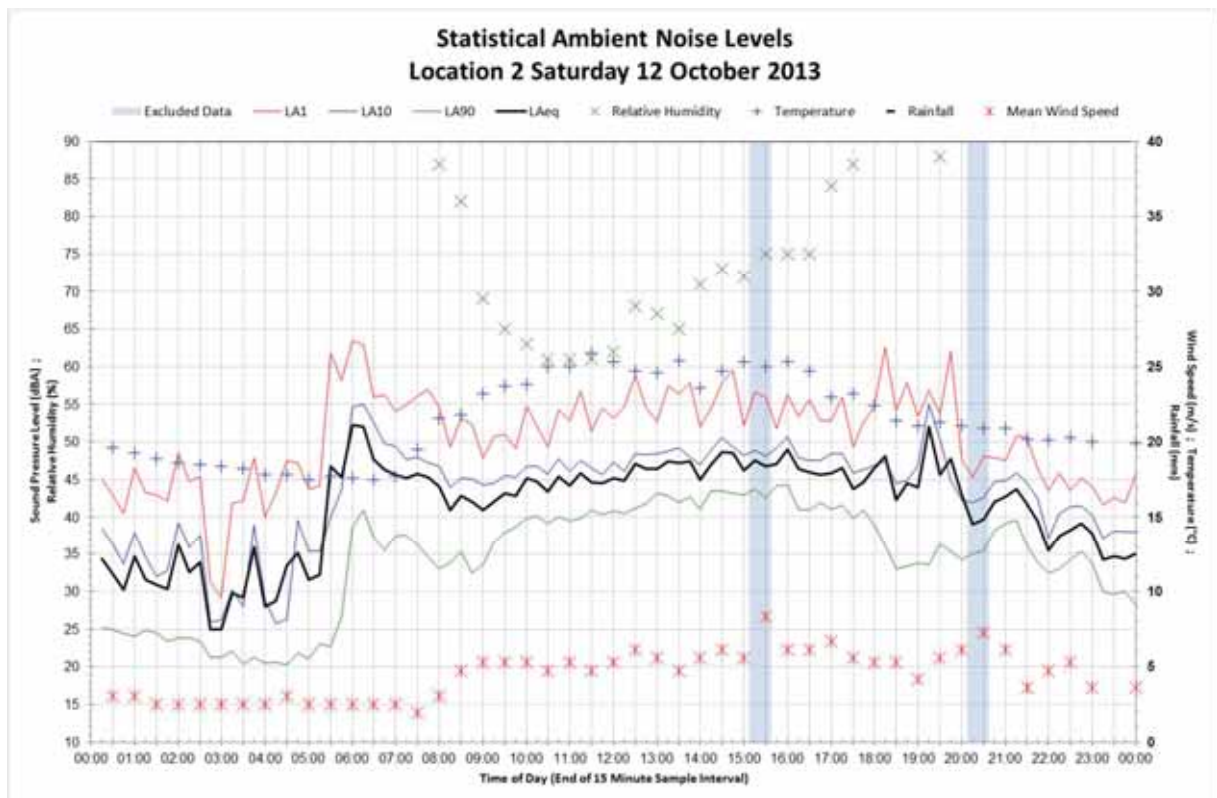
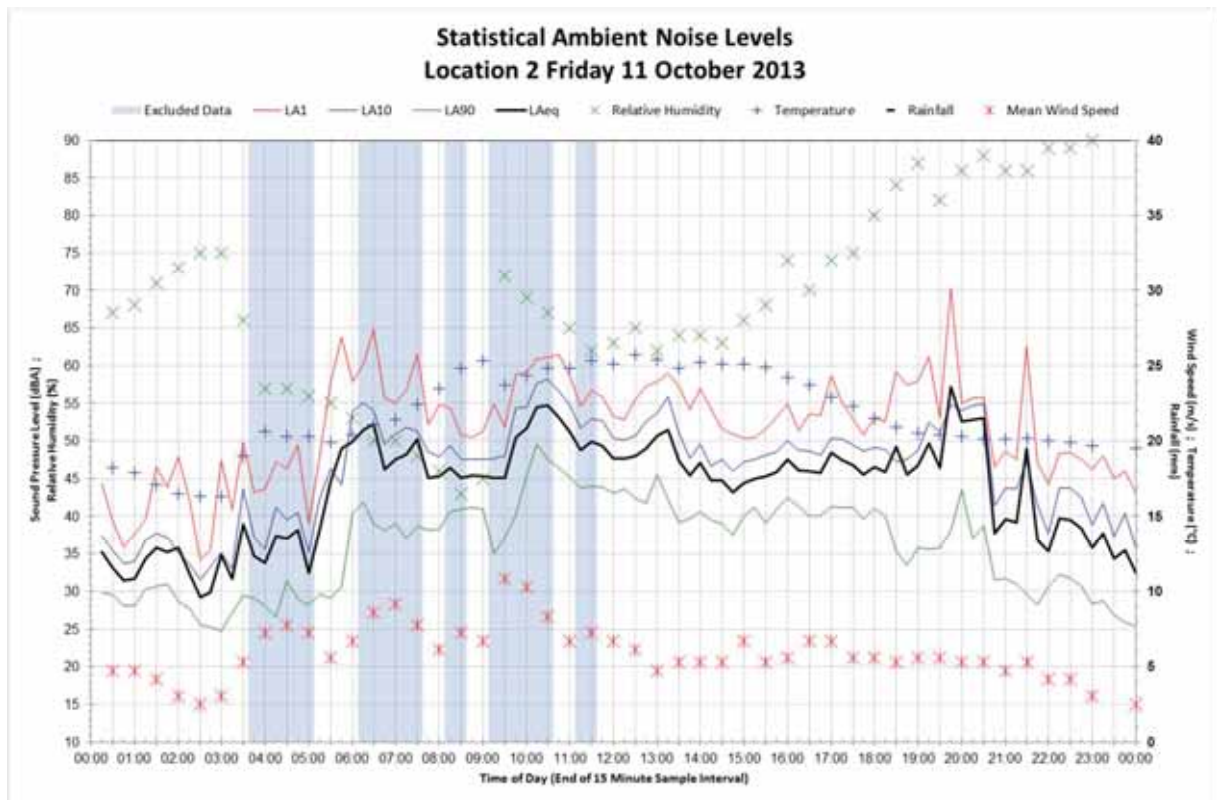


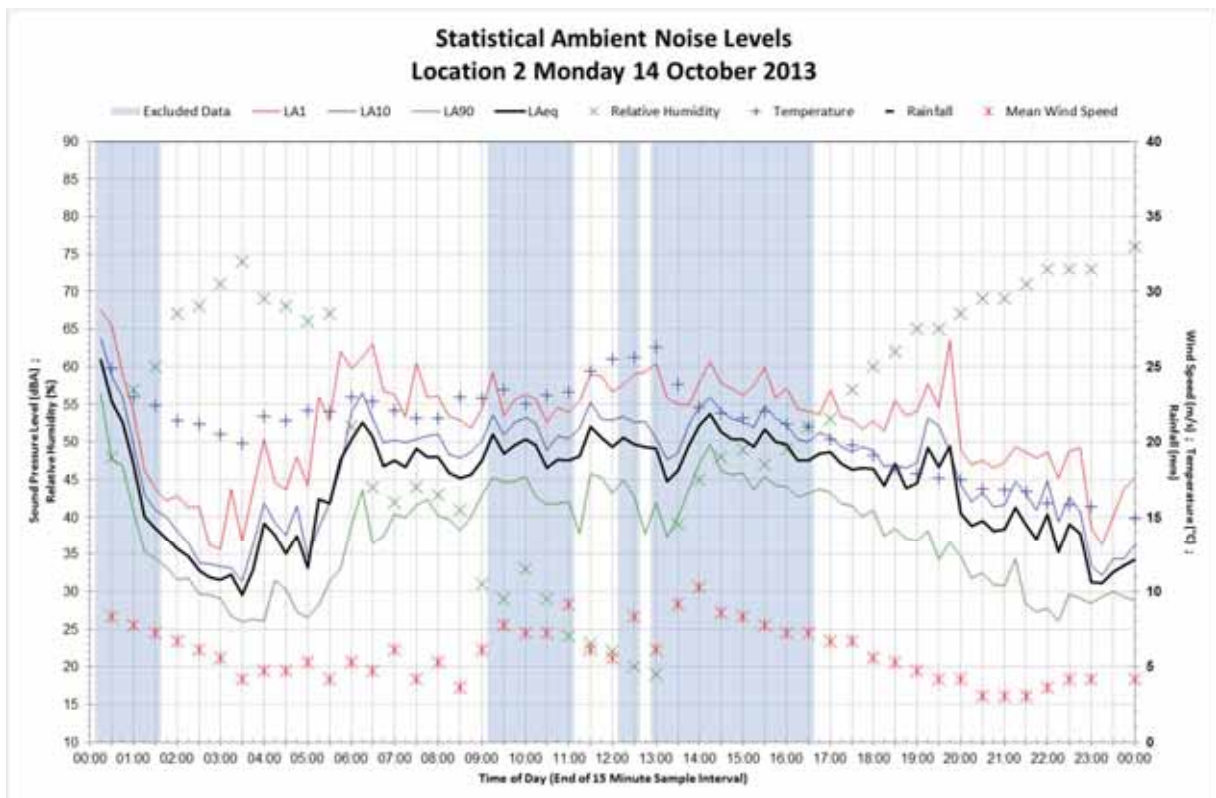
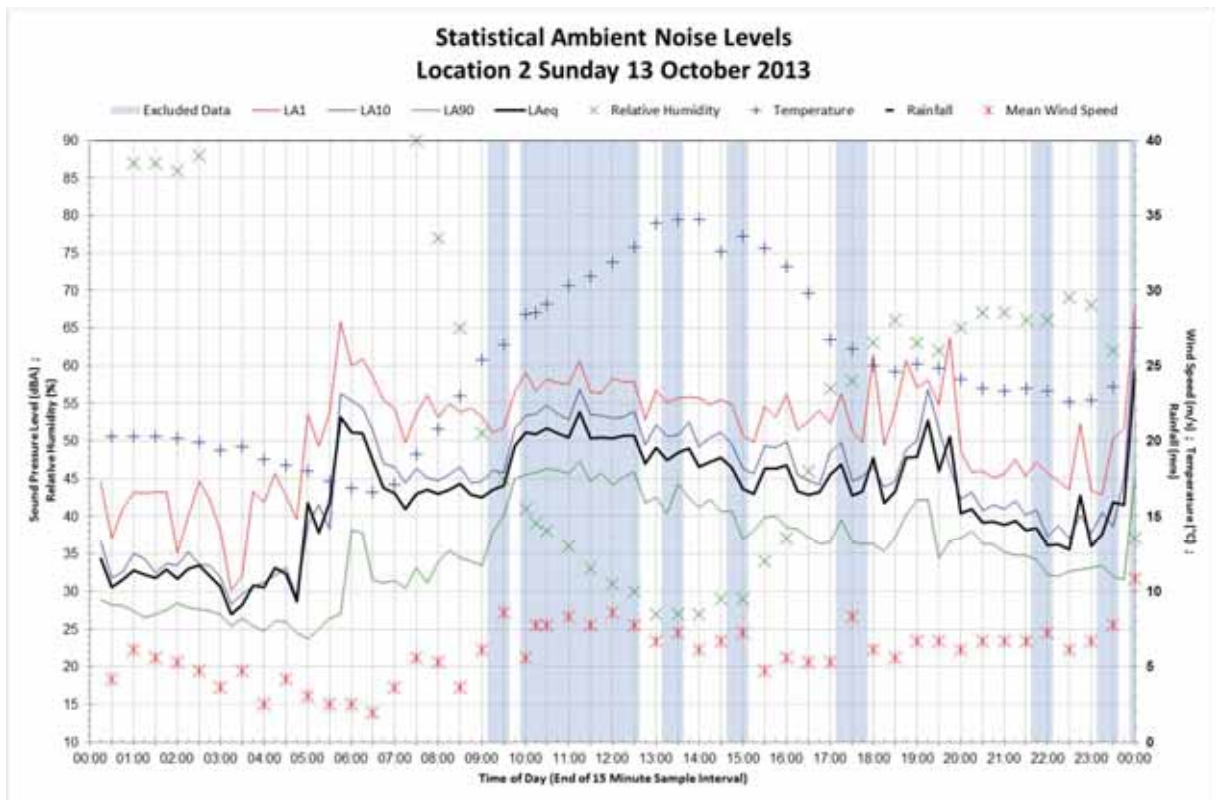


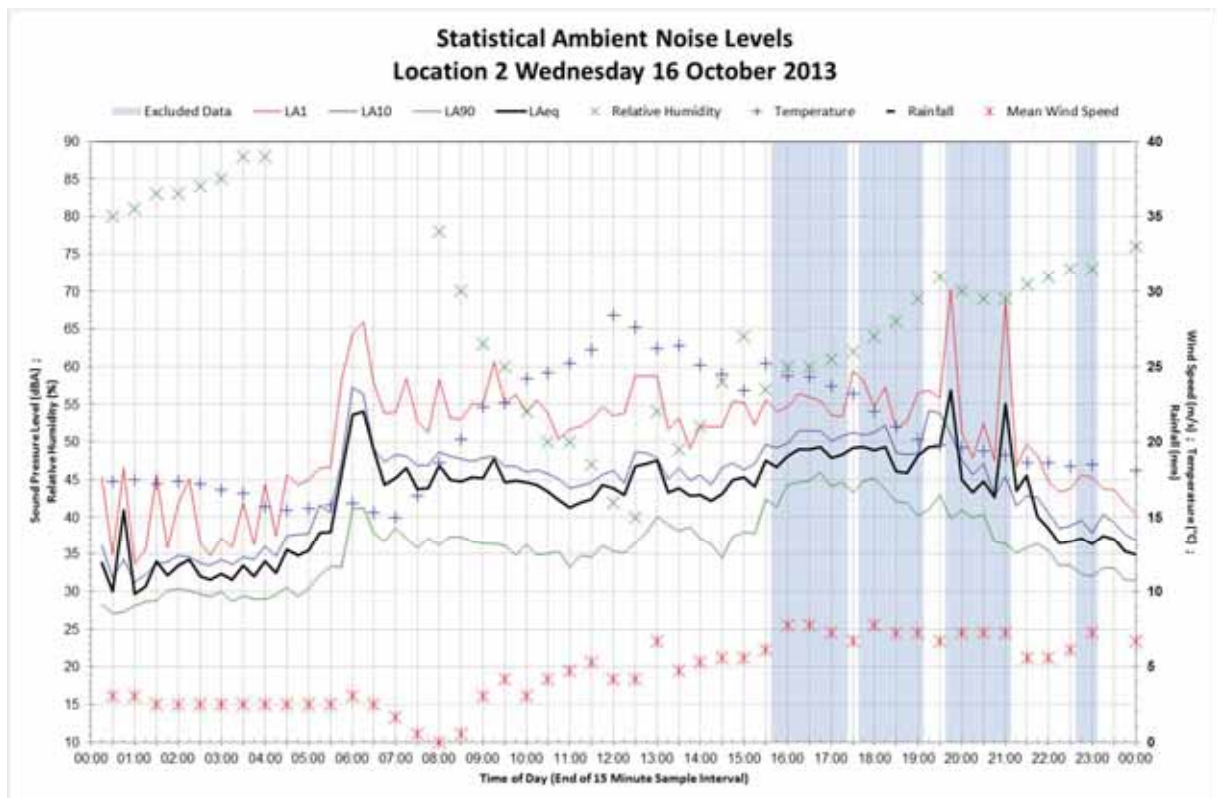
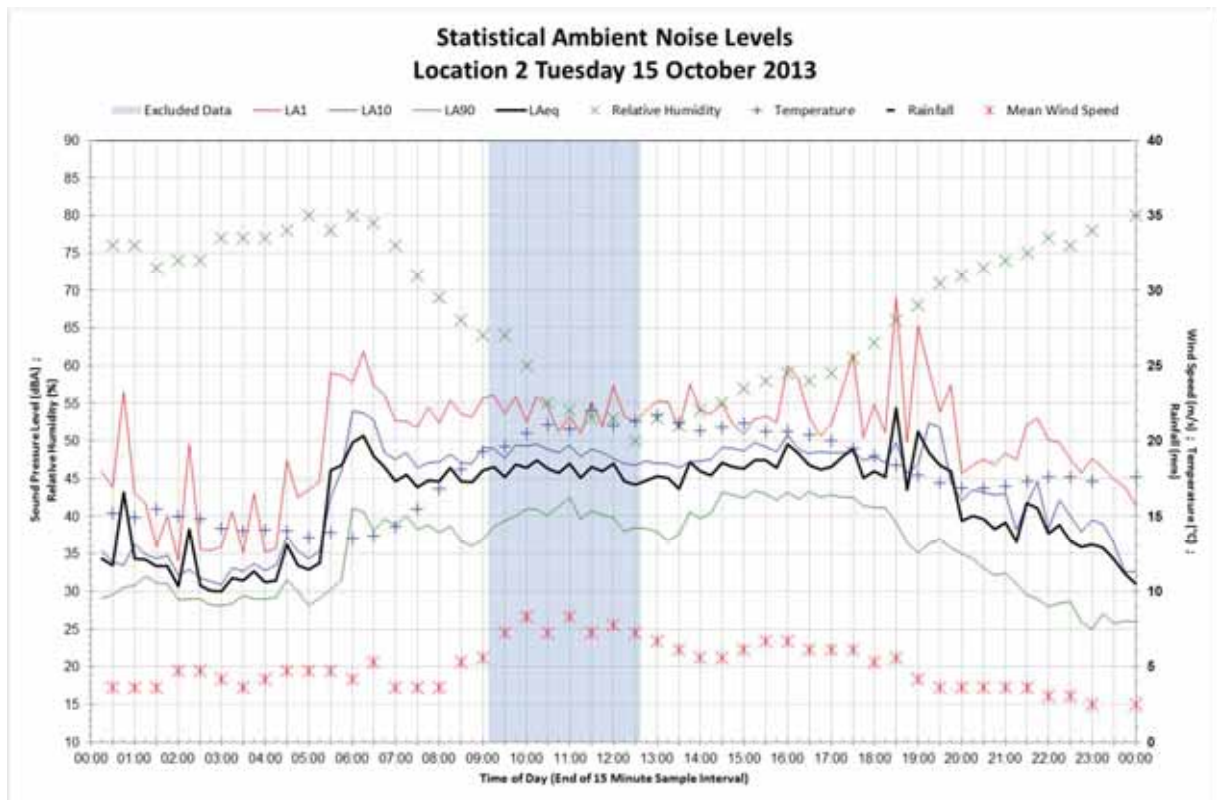


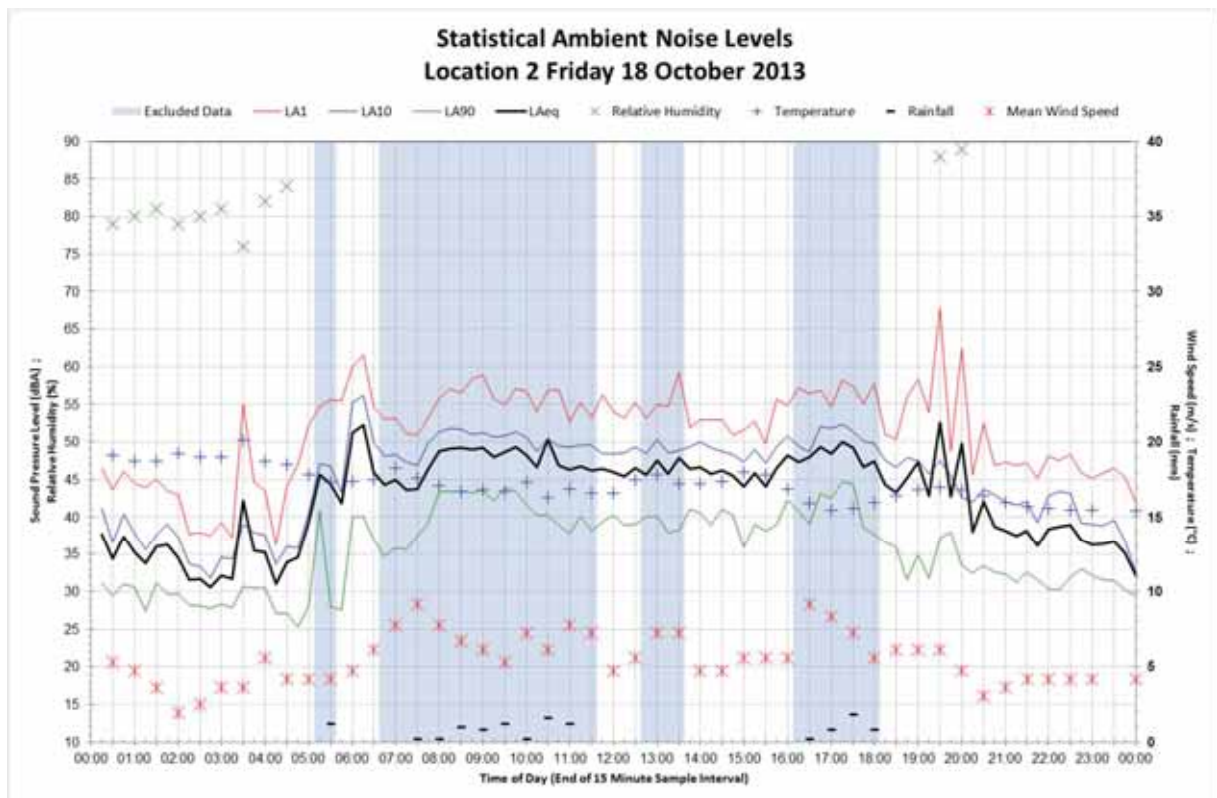
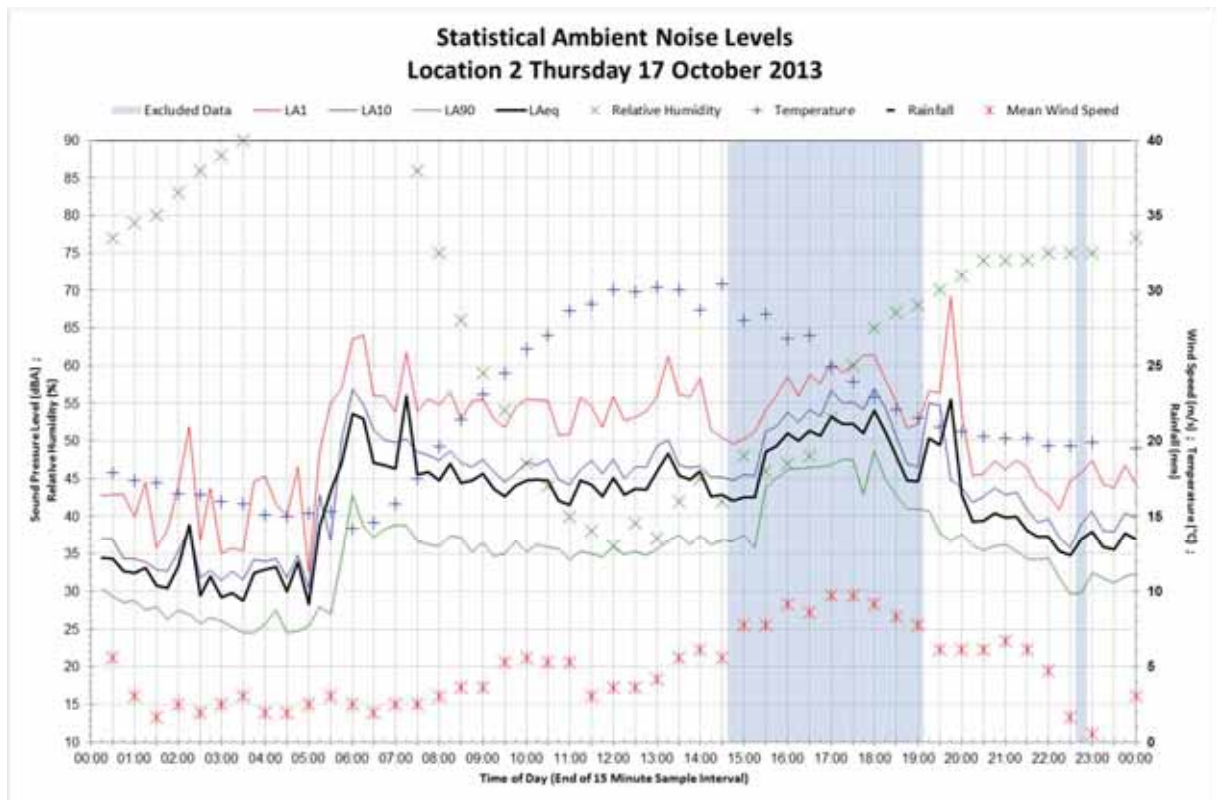


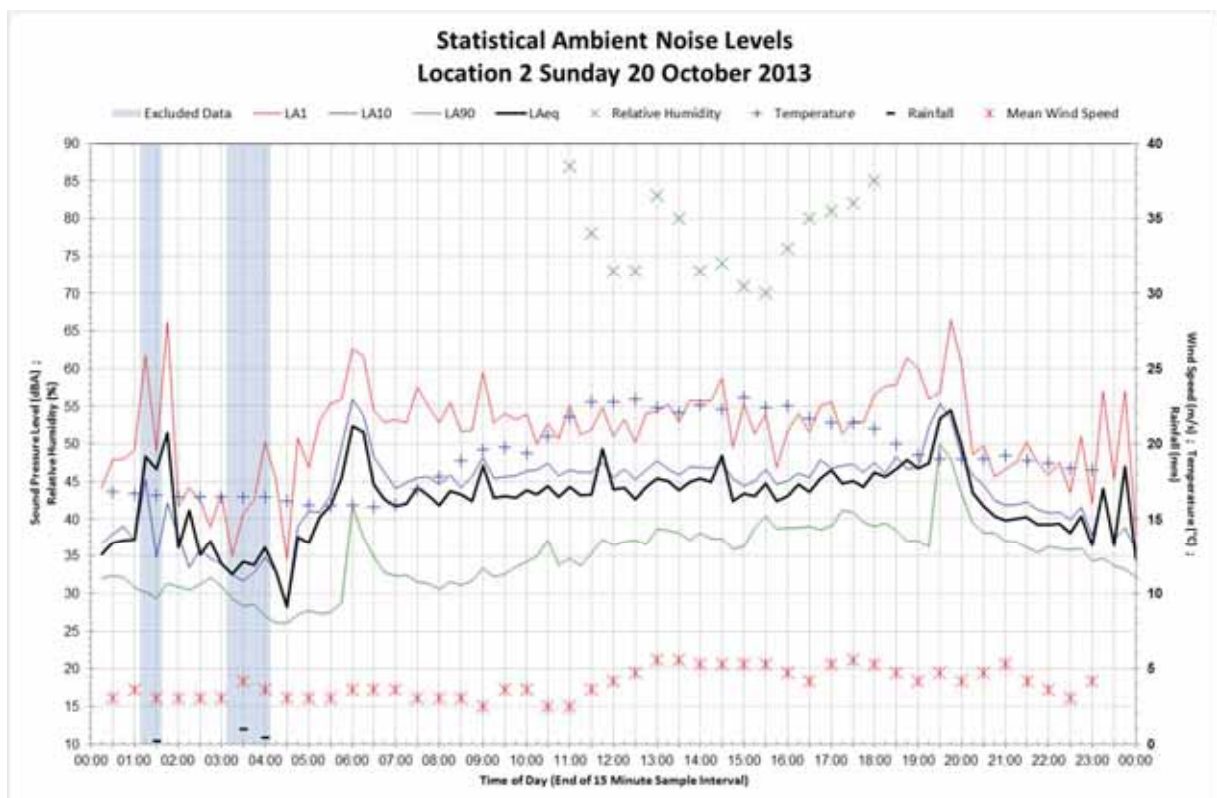
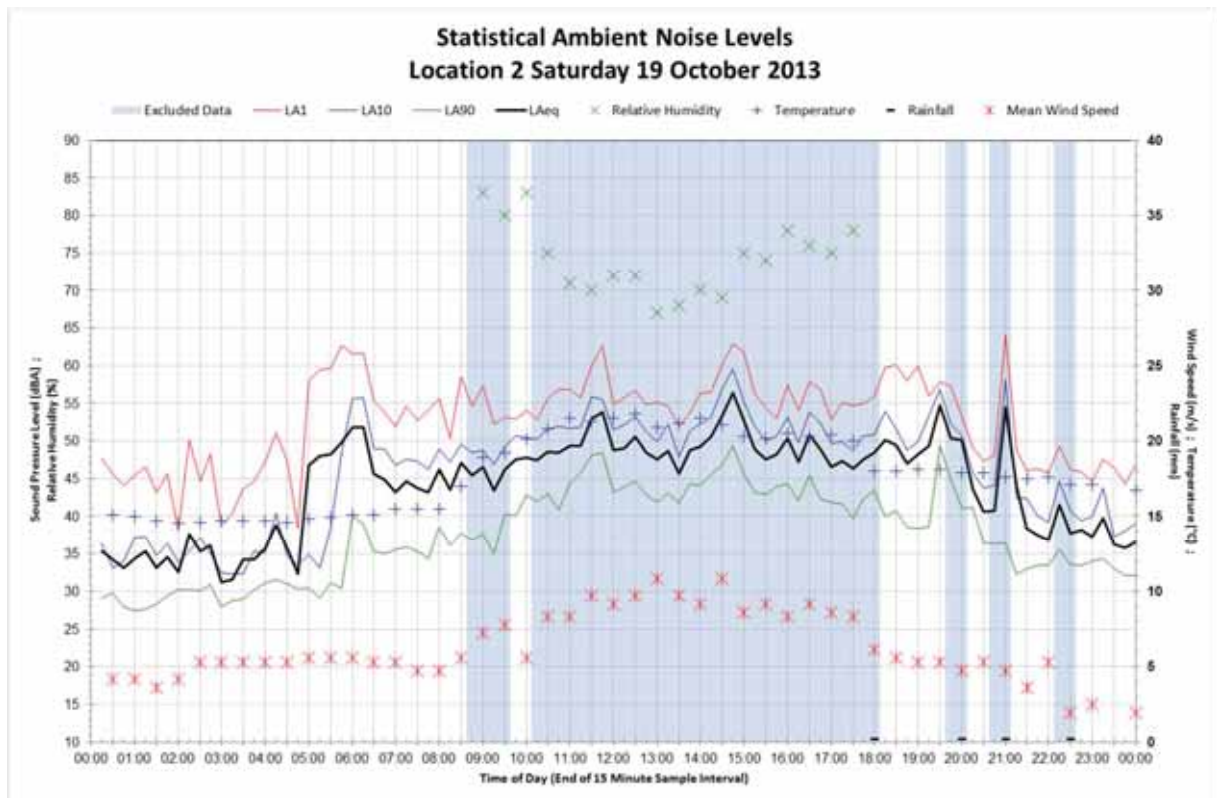






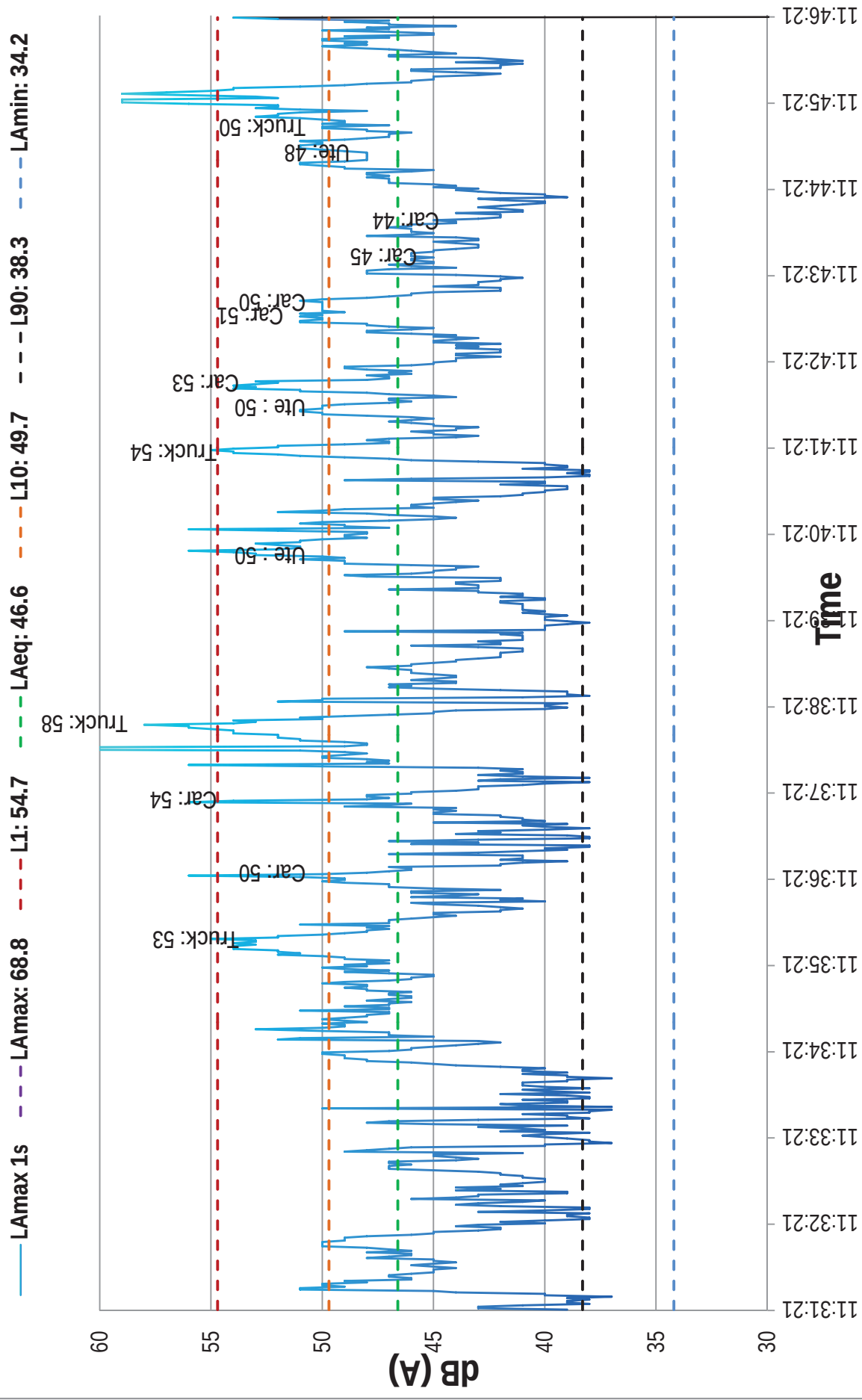




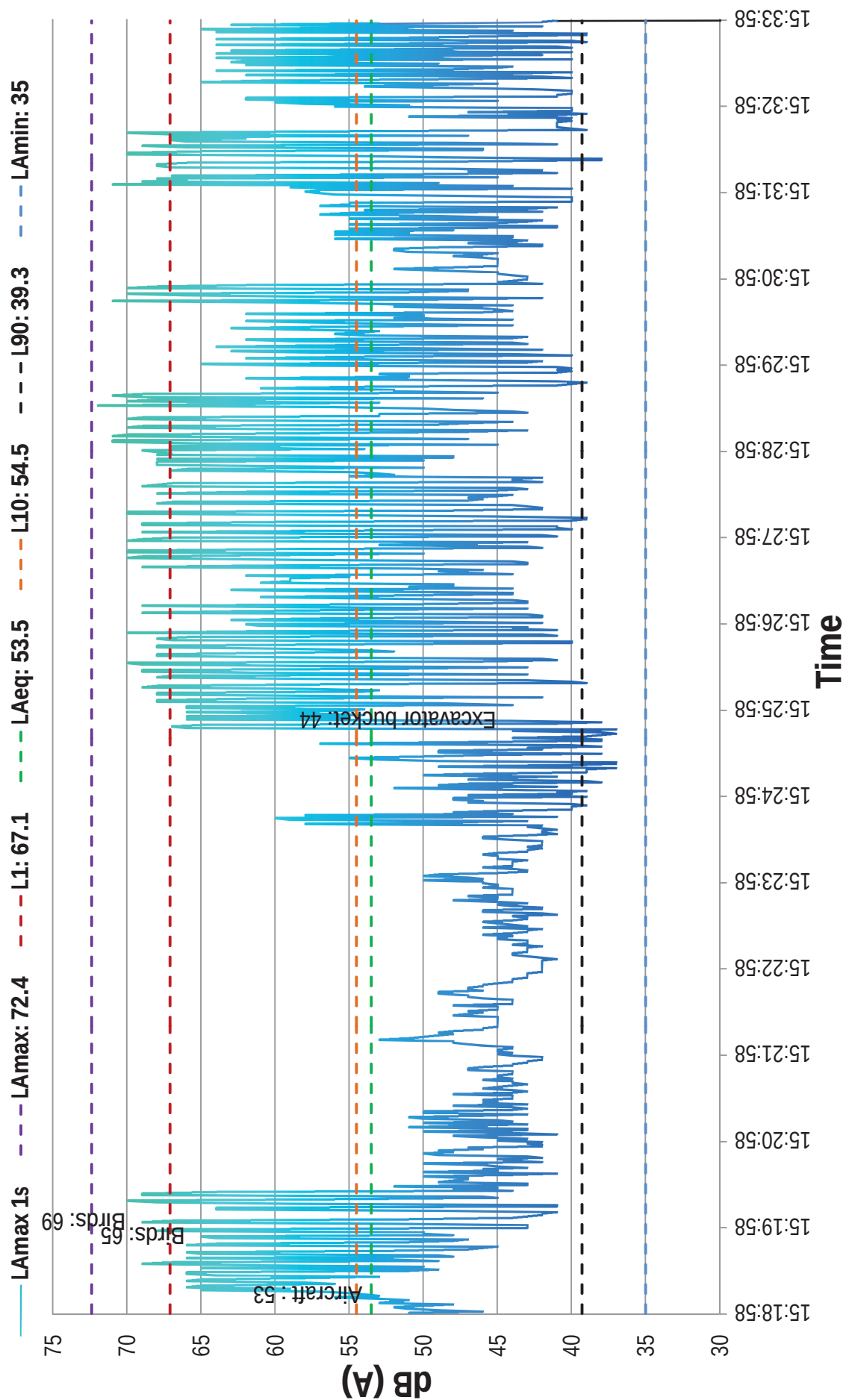


Appendix C – Attended noise monitoring charts

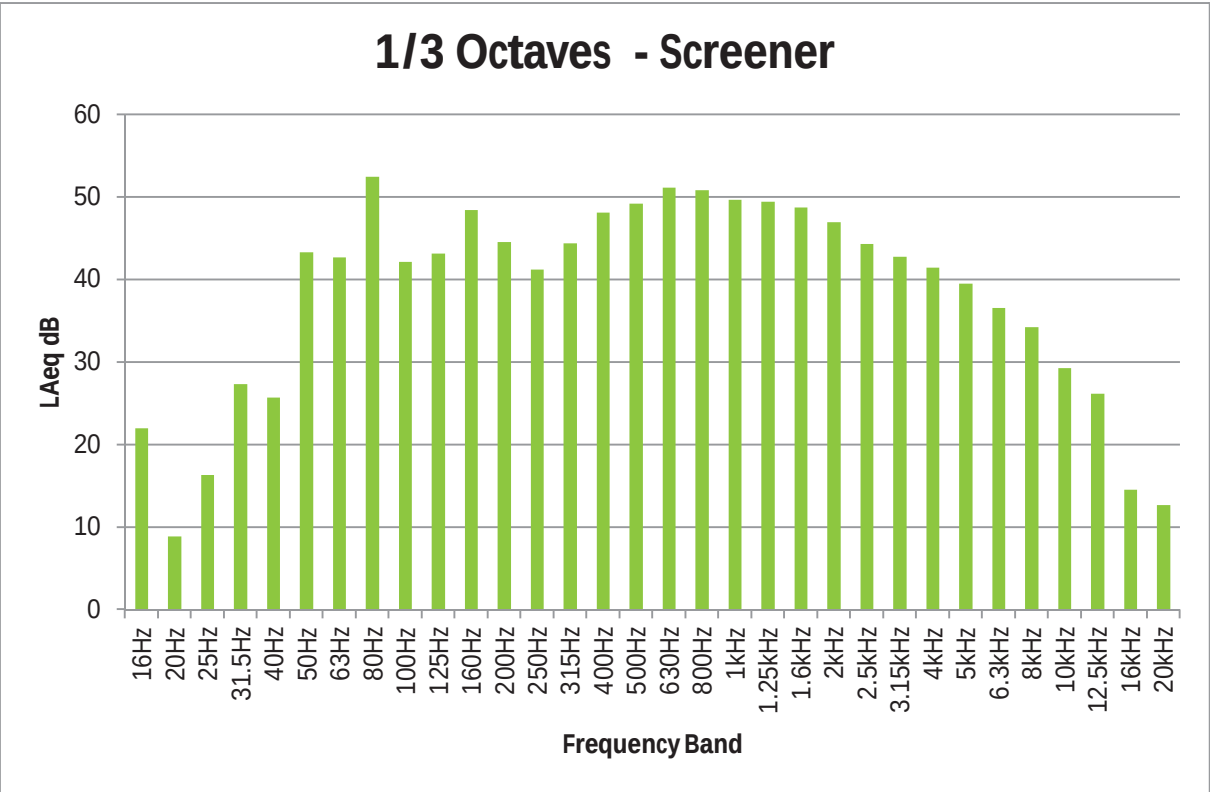
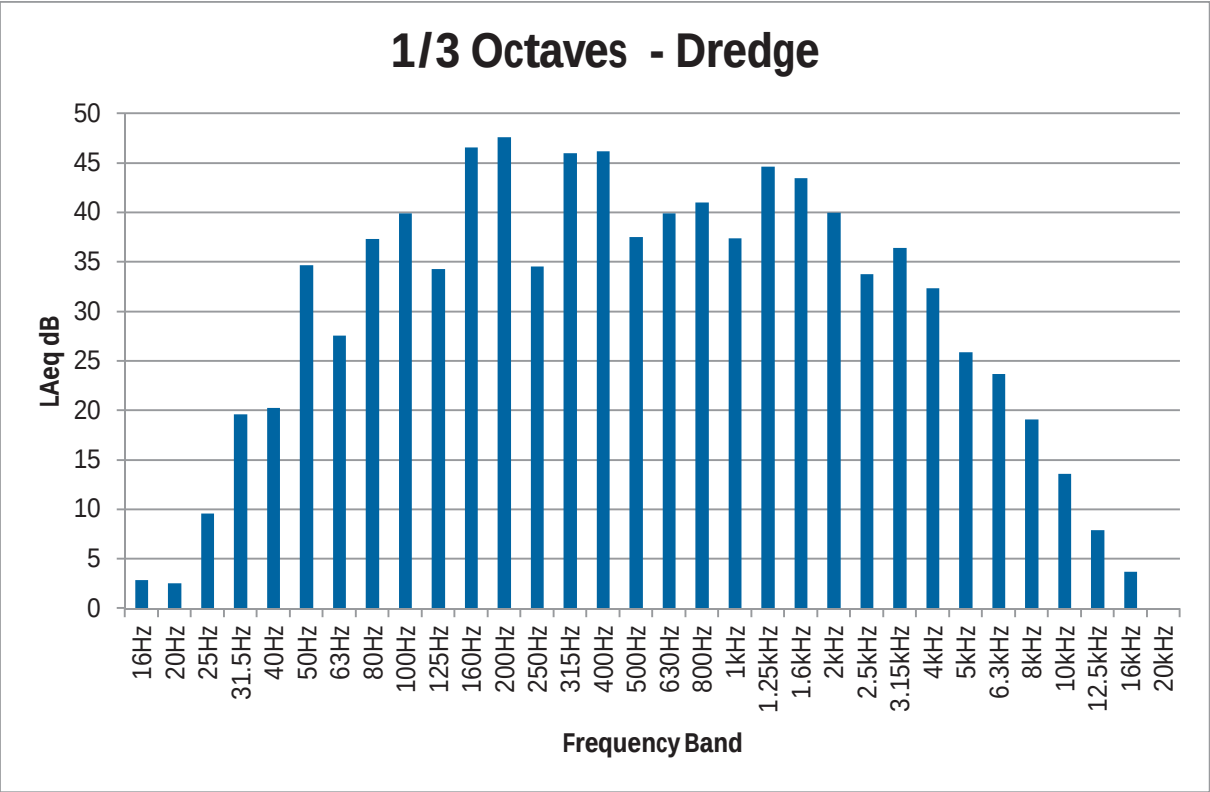
9 October, 2013 Attended Monitoring Results - Location 1

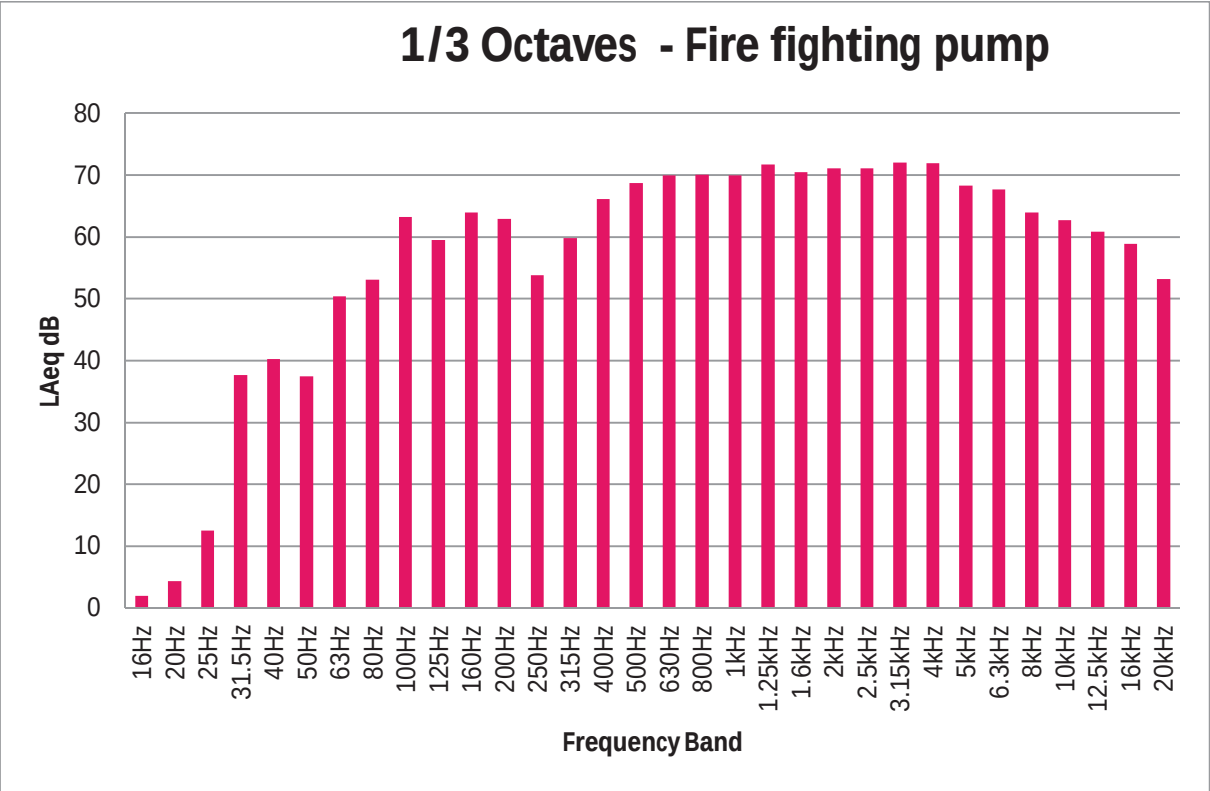


9 October, 2013 Attended Monitoring Results - Location 2



Appendix D – Third octave tonality analysis





Appendix E – Predicted operational noise levels



Doonbah Sand Quarry

Stage 1 - 70 Vehicles per day
Predicted noise levels
490,000 tpa
Noise criterion: 41 dB(A)
Grid height: 1.5m
ISO 9613





Doonbah Sand Quarry

Stage 2 - 70 Vehicles per day

Predicted noise levels

490,000 tpa

Noise criterion: 41 dB(A)

Grid height: 1.5m

ISO 9613





Doonbah Sand Quarry

Stage 3 - 70 Vehicles per day
Predicted noise levels
490,000 tpa
Noise criterion: 41 dB(A)
Grid height: 1.5m
ISO 9613





Doonbah Sand Quarry

Stage 4 - 70 Vehicles per day

Predicted noise levels

490,000 tpa

Noise criterion: 41 dB(A)

Grid height: 1.5m

ISO 9613





Doonbah Sand Quarry

Stage 1 - 50 Vehicles per day

Predicted noise levels

490,000 tpa

Noise criterion: 41 dB(A)

Grid height: 1.5m

ISO 9613





Doonbah Sand Quarry

Stage 2 - 50 Vehicles per day

Predicted noise levels

490,000 tpa

Noise criterion: 41 dB(A)

Grid height: 1.5m

ISO 9613



Doonbah Sand Quarry

Stage 3 - 50 Vehicles per day
Predicted noise levels
490,000 tpa
Noise criterion: 41 dB(A)
Grid height: 1.5m
ISO 9613





Doonbah Sand Quarry

Stage 4 - 50 Vehicles per day

Predicted noise levels

490,000 tpa

Noise criterion: 41 dB(A)

Grid height: 1.5m

ISO 9613



Appendix F – Predicted operational noise levels - mitigated



Doonbah Sand Quarry

Stage 1 - Mitigated - 70 Vehicles per day

Predicted noise levels

490,000 tpa

Noise criterion: 41 dB(A)

Grid height: 1.5m

ISO 9613





Doonbah Sand Quarry

Stage 2 - Mitigated - 70 Vehicles per day

Predicted noise levels

490,000 tpa

Noise criterion: 41 dB(A)

Grid height: 1.5m

ISO 9613



Doonbah Sand Quarry

Stage 3 - Mitigated - 70 Vehicles per day

Predicted noise levels

490,000 tpa

Noise criterion: 41 dB(A)

Grid height: 1.5m

ISO 9613



Doonbah Sand Quarry

Stage 4 - Mitigated - 70 Vehicles per day

Predicted noise levels

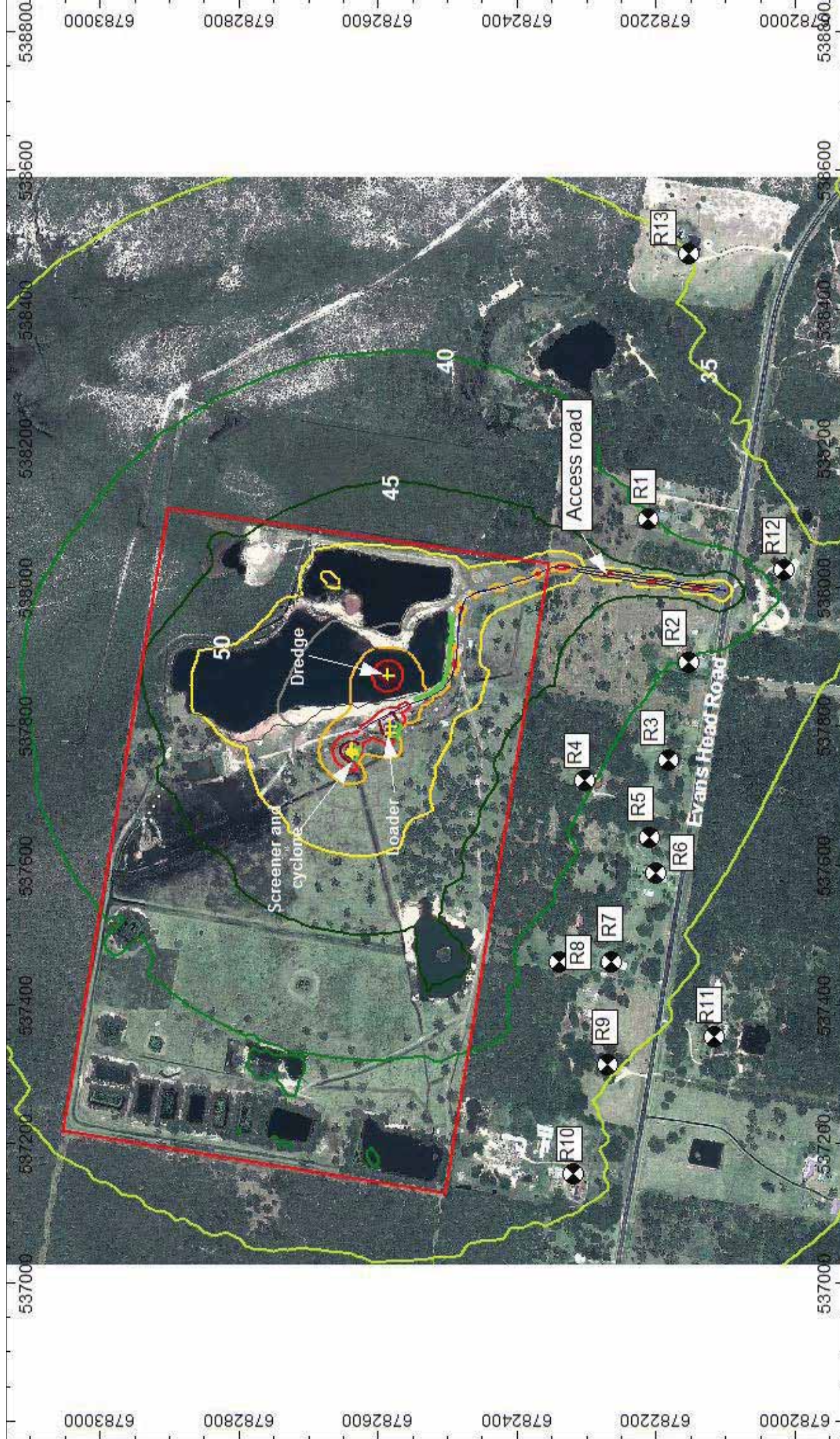
490,000 tpa

Noise criterion: 41 dB(A)

Grid height: 1.5m

ISO 9613





Doonbah Sand Quarry

Stage 1 - Mitigated - 50 Vehicles per day

Predicted noise levels

490,000 tpa

Noise criterion: 41 dB(A)

Grid height: 1.5m

ISO 9613



Doonbah Sand Quarry

Stage 2 - Mitigated - 50 Vehicles per day

Predicted noise levels

490,000 tpa

Noise criterion: 41 dB(A)

Grid height: 1.5m

ISO 9613



Doonbah Sand Quarry

Stage 4 - Mitigated - 50 Vehicles per day

Predicted noise levels

490,000 tpa

Noise criterion: 41 dB(A)

Grid height: 1.5m

ISO 9613



Doonbah Sand Quarry

Stage 3 - Mitigated - 50 Vehicles per day

Predicted noise levels

490,000 tpa

Noise criterion: 41 dB(A)

Grid height: 1.5m

ISO 9613

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	T Gribble	C Evenden		S Lawer		26/11/2014

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Appendix F – Air Impact Assessment



Rixa Quarries Pty Ltd

**Proposed Expansion of Doonbah Quarry, Woodburn-Evans
Head Road, Doonbah**

Air Quality Impact Assessment

November 2014

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Appendices

- Appendix A – Proposed extraction plans
- Appendix B – Ausplume output file

1. Introduction

1.1 Project overview

GHD has been engaged by Rixa Quarries Pty Ltd (Rixa) to prepare an Environmental Impact Statement (EIS) for the proposed expansion of the Doonbah Quarry ('the quarry'), an existing sand quarry located at Lot 2 DP 1040274 on Woodburn Evans Head Road, Doonbah, NSW (the 'subject site'). The location of the quarry is within the Richmond Valley Council (RVC) Local Government Area (LGA). The quarry would be operated under a 'profit a prendre' (royalty) arrangement with the owner of the property.

Quarry operations at the site date back to 1961. In 1997, the quarry was granted approval to extract up to 35,715 m³ (approximately 57,000 tonnes) per annum (DA 128/95). The quarry has now exhausted the resources available under this approval.

The proposal is to expand the existing quarry to have an extraction rate of up to 490,000 tonnes per annum. The primary purpose of the quarry would be to supply sand to the current and proposed Pacific Highway upgrade works, and for supply to local councils and contractors. The quarry is well located to service the Pacific Highway upgrade works between Woolgoolga and Ballina which is to take place over a timeframe of approximately 5 years.

To provide the required material, the extraction area of the quarry would need to be expanded from 6.28 ha to approximately 18.3 ha, with a depth of 15 metres below ground level or -12 metres Australian Height Datum (AHD). It is estimated that the quarry would have an available resource of 4,000,000 tonnes which would allow extraction for a period of between 20 and 30 years, depending on demand.

1.2 Purpose of this report

GHD was engaged by Rixa Quarries Pty Ltd (Rixa Quarries) to prepare an Air Quality Impact Assessment (AQIA) report to address the potential air quality impacts from the proposed expansion of the existing sand quarry located at 405 Woodburn-Evans Head Road, Doonbah, NSW (referred to in this report as the proposal).

The proposal is to expand the existing quarry from 50,000 tonnes per annum to an extraction rate of up to 490,000 tonnes per annum. The primary purpose of the quarry would be to supply sand to the current and proposed Pacific Highway upgrade works, and for supply to local Councils and contractors.

1.3 Scope

The focus of this AQIA has been on dust, being the primary emission to air from the proposal.

The following scope of work was undertaken:

- Desktop review of site plans, aerial photographs, and topographic maps to gain an understanding of the existing environment in terms of local terrain, existing/proposed operations and sensitive receptors within the study area.
- A review of available ambient air quality monitoring data to gain an understanding of existing air quality in the vicinity of the proposal.
- Determine applicable dust impact criteria with consideration to the NSW *Approved Methods*.

- Synthesis of a site-representative meteorological data file with which to gain an understanding of the local wind climate and use as model input for conducting atmospheric dispersion modelling.
- Derive a dust emission inventory for the proposed operations with which to identify significant sources of air pollution, in particular dust emissions, and estimate the emission rates for each item of equipment used on the proposal site. Then use this to undertake dust dispersion modelling using the regulatory atmospheric dispersion model Ausplume to predict the incremental dust impact from proposal operations at surrounding residences.
- Recommend targeted mitigation and management measures as required to reduce dust impacts from proposal operations and, if warranted, recommend dust monitoring programmes.

1.4 Limitations

This report has been prepared by GHD for Rixa Quarries Pty Ltd and may only be used and relied on by Rixa Quarries Pty Ltd for the purpose agreed between GHD and Rixa Quarries Pty Ltd as set out in Section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Rixa Quarries Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer to Section 1.5 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Rixa Quarries Pty Ltd and others who provided information to GHD, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.5 Assumptions

The following assumptions were made in this assessment:

- The equipment used on site would be limited to those assessed in this report.
- The Evans Head Automatic Weather Station data and Ballina Airport cloud data are representative of the Doonbah regional context.

2. Existing environment

2.1 Site location and sensitive receptors

The existing proposal site is located at 405 Woodburn-Evans Head Road, Doonbah. The site is primarily surrounded by undeveloped bushland to the north, east and west. A number of rural-residential properties are located along the southern boundary and on the southern side of Woodburn-Evans Head Road. The nearest residential dwelling is located within 100 metres of the proposal site boundary but more than 250 metres from any potential active dust source.

Figure 2-1 shows a site aerial image and the location of identified sensitive receptors. These receptors have been identified to represent those sensitive receptors with the greatest potential for adverse dust impact.



Figure 2-1 Site location and identified sensitive receptors

2.2 Ambient air quality

The NSW Office of Environment and Heritage (OEH) operate ambient air quality monitoring stations throughout NSW, however, the nearest monitoring stations to the site are either Tamworth or Newcastle, both of which are several hundred kilometres away and subjected to additional industrial and urban sources.

The primary sources of particulate (dust) emissions for the area around Evans Head are likely to be general agricultural activities, dust and vehicle emissions from traffic along unsealed roadways and the Pacific Highway as well as smoke from domestic wood heaters or vegetation burn-offs or wild fires.

GHD expect that a reasonable representation of the ambient PM₁₀ 24-hour concentration levels would be in the order of 10 - 20 µg/m³ – the upper bound being what is typically encountered in much larger urbanised environments. An ambient PM₁₀ concentration of 15 µg/m³ has been adopted as the background level.

2.3 Local meteorology

The transport and dispersion of the air emissions from the site will be influenced by prevailing synoptic wind flows and vertical temperature profiles that will alter both diurnally and with wind direction.

Long term weather data was sourced from the Bureau of Meteorology's (BoM) Evans Head RAAF Bombing Range Automatic Weather Station (AWS). This AWS is located approximately 10 km south of the site. Given the relatively flat land features in the area, weather data collected at this location is considered to be representative of weather conditions at the site and has been utilised in preparing this report. Cloud data from Ballina Airport was used for the stability classification (using the Turner Workbook approach allowed for in the *Approved Methods*) – this being the nearest site with ceilometer data and the same climatic zone.

Figure 2-2 and Figure 2-3 show the annual (all hours) and daytime (7 am to 6 pm) wind climate in the area. Prevailing winds are shown to be from the north and south, with the strongest winds most often from the south and southeast. Winds from the northeast sector have the lowest frequency of occurrence.

It is the incidence of daytime winds that are of greatest concern in regards to the transport and dispersion of dust emissions from the site. Due to the nature of operations, the majority of dust generated at the site is during (daylight) operational hours when material handling and vehicle movements are occurring. There will be some wind erosion sources from exposed soil outside of operational hours but these are wind speed dependent with lighter winds occurring more often overnight. The daytime distribution of wind directions is not significantly different than for the entire diurnal cycle albeit with more southerly component winds associated with daytime sea breeze effects. , However, the average wind speed is higher during the day (5.0 m/s during the day versus approximately 4.2 m/s during the night) than the more likely stable atmospheric conditions that occur at night. Wind erosion or dust lift-off can become significant under the strongest winds (generally greater than 5 m/s).

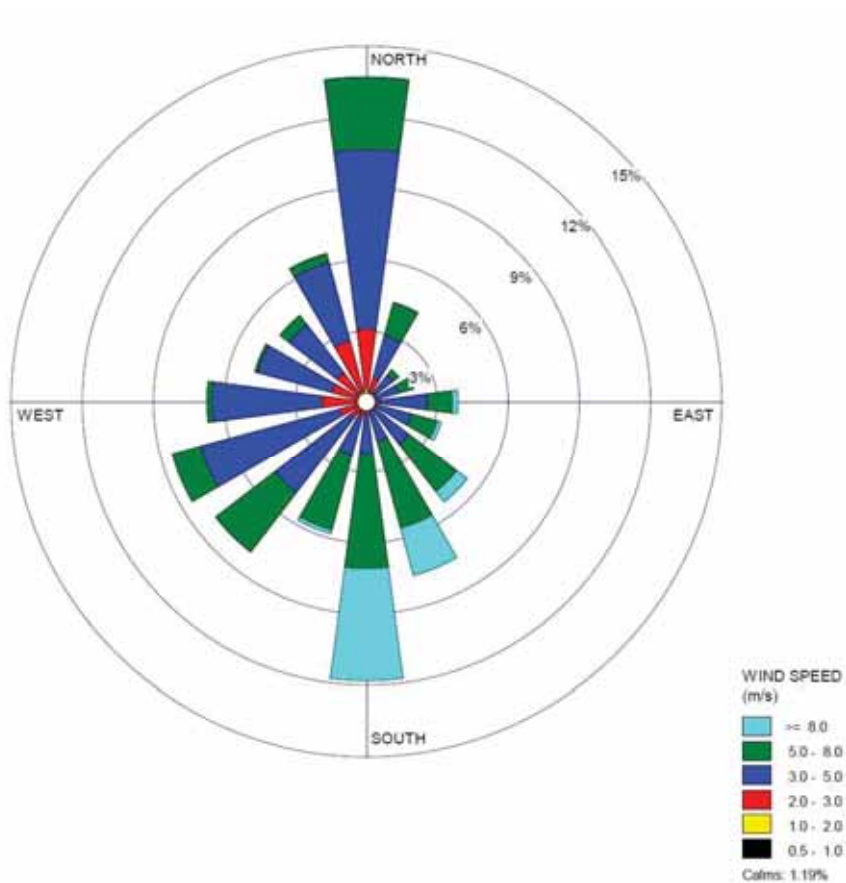


Figure 2-2 Evans Head annual (all hours) wind rose – 2011

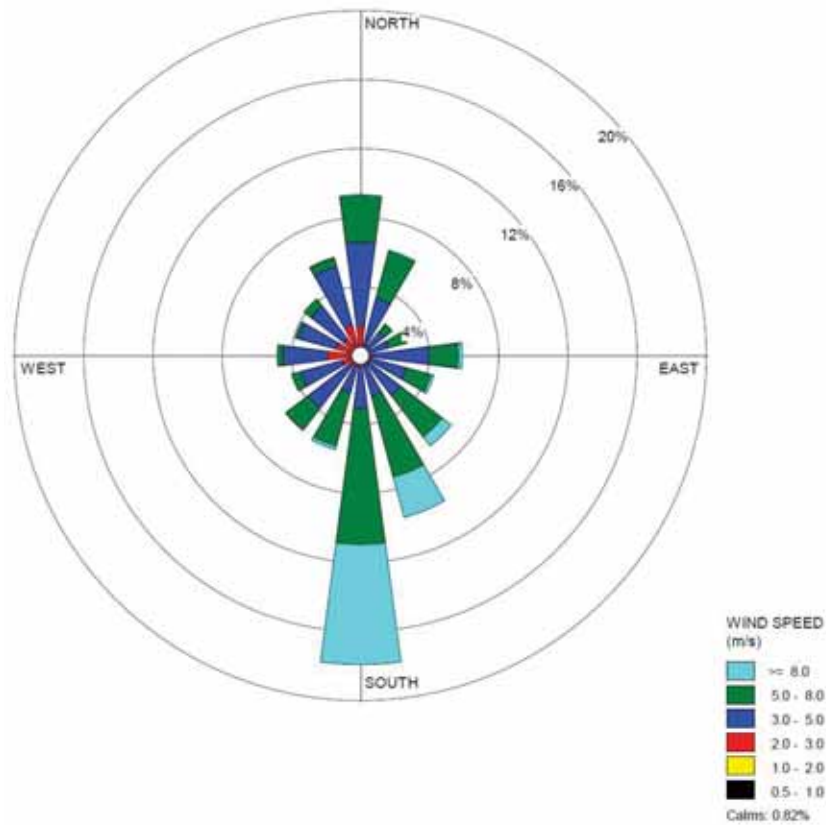


Figure 2-3 Evans Head daytime (7 am – 6 pm) wind rose – 2011

3. Dust impact assessment criteria

Air quality impact assessment criteria are prescribed within the NSW OEH *Approved Methods*.

To ensure the environmental outcomes are achieved, dust emissions from premises must be assessed against the assessment criteria given in Table 3-1.

Table 3-1 Dust assessment criteria

Pollutant	Averaging period	Criterion
PM ₁₀	24 hours	50 µg/m ³
	Annual	30 µg/m ³
TSP	Annual	90 µg/m ³
Dust deposition (insoluble fraction)	Annual	2 g/m ² /month*

* Maximum Increment. Maximum allowable cumulative impact of 4 g/m²/month.

The above concentration criteria are provided as cumulative (incremental plus background) levels.

4. Project description

4.1 Proposed site operations

The proposed quarry operation would be carried out in response to demand. It is therefore difficult to predict exactly how the extraction profile and footprint would progress. In general, the extraction is proposed to move to the west of the existing extraction area and then south in three stages. Topsoil would be removed initially and the sand extracted using an excavator. Once the excavation fills with water, a dredge will be introduced to extract the sand to a depth of 15 metres (-12 metres AHD).

To provide access to the different types of sand, each stage may be at a different stage of extraction at the same time.

The proposed expansion would increase the extraction area from 6.3 hectares to about 18.3 hectares which would be an increase of 12 hectares. The depth of the excavation would also increase by approximately 11 metres.

Following extraction, the material would be screened, washed and where necessary blended with other materials from the quarry, or material imported to the quarry. The materials would be stockpiled in designated locations on-site and identified by numbering. Samples from each stockpile would be analysed for compliance with client specifications before being transported offsite. This process takes approximately 20 days.

The proposed extraction plans are provided in Appendix A, including extraction area, cross sections, long sections, site layout and final levels.

4.2 Extraction rate

It is estimated that the remaining sand resource to be extracted at the site would yield approximately two million tonnes of material. However it is difficult to accurately estimate the annual extraction rate of material from the quarry which may be required to service the demand from the Pacific Highway upgrade works. It is proposed to extract and process up to 490,000 tonnes per annum, although this rate of extraction is expected to be uncommon. It is more likely that the annual extraction rate during the upgrade of the Pacific Highway would be around 300,000 to 350,000 tonnes per annum. After the highway upgrade is complete, the annual extraction rate is anticipated to reduce to about 100,000 tonnes per annum.

Based on the assessment of the underpinning demand, and after allowing for downtime from wet weather, etc. it is realistic to expect the expanded quarry to only operate for 40 weeks a year. A maximum daily extraction and haul rate of about 2,250 tonnes is expected, with an average daily win and haul rate of about 1,600 tonnes. The average daily win and haul rate would reduce significantly following the completion of the highway upgrade.

4.3 Hours of operation

The hours of operation would depend on demand with some periods of high activity and other times when activity is limited to the occasional loading of haulage trucks. The proposed hours of operation are:

- Weekdays - 7.00 am - 6.00 pm
- Saturdays - 8.00 am - 1.00 pm
- Saturday afternoons and Sundays – maintenance only
- Public holidays - No work

4.4 Proposed equipment

Table 4-1 lists the plant and equipment that would operate on site.

Table 4-1 Proposal equipment

Item	Number on site	Frequency of use	Description of use
Excavator (35 tonne)	2	20-90%	Excavating material and stockpiling. Used constantly during initial excavation and then less frequently, once the dredge is operating.
Dredge	1	20-90%	Main form of extraction.
Screen	1	90%	Aggregate production.
Front-end Loader	1	80%	Loading material onto the haul trucks.
Haul Trucks	Up to 70 loaded trips per day (140 daily truck movements)	-	Delivery of materials to customers.
Water Cart (15,000L)	1	0-60%	Watering haul roads and excavation areas, as required.
Light vehicles	10 vehicles per day	-	Employee vehicles.
Water Pump	1	50%	To supply water cart.
Generator	1	90%	Supply power to the screen.
Hand tools	Numerous	10%	General activities.

4.5 Site access and traffic generation

Access to the site is from Woodburn Evans Head Road via an existing access road that runs to the quarry pit. Delivery of materials to highway projects would be via Woodburn Evans Head Road directly to the Pacific Highway at Woodburn. In respect of materials to be delivered for non-highway works, it is not possible to predict the delivery routes for such materials. The volume of materials available for non-highway works would be limited during the timeframe of the highway upgrade works but of greater volume following completion of the upgrade.

During operation, it is likely that there would be a maximum of five employees or plant operators on the site at any one time. This would yield a daily workforce traffic generation in the order of 10 vehicle trips per day (vtpd). It is assumed the majority of the workforce would arrive between 6:30 am and 7:30 am and depart generally between 4:00 pm and 6:30 pm.

Truck and dog trailer combinations have a capacity of approximately 32 tonnes. At an average daily production, which would generate a win and haul rate of approximately 1,600 tonnes, the proposal is expected to generate about 50 truck and dog loads or 100 truck movements per day. At its peak, the proposal is expected to win and haul about 2,250 tonnes per day which would involve about 70 truck and dog loads or 140 truck movements per day.

As with all quarries, demand for materials would fluctuate, resulting in truck movements at peak generation for short periods and limited truck movements operating at other times.

5. Emissions inventory

5.1 Dust emissions

This air quality assessment focuses on dust, this being the primary emission to air from the proposal with potential for off-site impact. The particulate matter fractions of interest assessed in this report are airborne concentrations of Total Suspended Particulate (TSP) and fine particulate matter (PM₁₀) as well as total deposited dust.

The individual processes that generate significant amounts of particulate matter (dust) were identified to be:

- Sand quarrying e.g. excavation.
- Material processing and handling e.g. screening and loading.
- Vehicle induced dust emissions on haul road.
- Wind erosion of exposed unstable soil surfaces and localised stockpiles.

Note that the resource material is mostly near or below the water table. So much of the product handling will occur as a 'wet process' (dredging for example) although the initial excavation and materials handling after stockpiling will be at lower moisture levels.

Emission rates from naturally wind-borne dust and mechanically induced dust were characterised using Emission Factors (EFs) provided in the National Pollutant Inventory (NPI) Emission Estimation Technique Manual (EETM) for Mining¹. The techniques used to estimate emissions from mining operations are based primarily on activity rate (e.g. tonnes per hour).

The proposed maximum material throughput of up to 2,250 tonnes per day equates, on average, to approximately 205 tonnes per hour (tph) over an 11 hour day. Although it is not expected that the proposal would operate at 205 tph consistently, this production rate has been chosen to represent a worst-case scenario to derive emission rates. A more average production rate has also been modelled based on an average daily win and haul rate, equating to approximately 1,600 tonnes per day or 145 tph.

The following assumptions were made in calculating the dust emission rates for proposal activities:

- The access road to enter and leave the site is unsealed.
- Truck and dog trailer combinations have a capacity of 32 tonnes. At the peak production rate of 2,250 tonnes per day, this equates to approximately 70 truckloads per day. As each haul truck would enter and exit the site, this equates to a maximum of 140 haul truck movements per day. At the average production rate of 1,600 tonnes per day, 50 truckloads would be required per day. Each haul truck was assumed to travel 640 m each way to enter and leave the quarry from Evans Head Road.
- The use of a water truck has been assumed not to generate dust emissions, as its use would act to suppress emissions. Therefore, the water truck has not been included in the emissions inventory.

¹ National Pollutant Inventory (NP) Emission Estimation Technique Manual for Mining, Version 3.1.

- It was assumed that all the sand extracted, processed and stockpiled from the quarry is high in moisture content.
- It was assumed that 100% of the sand was processed (i.e. 205 tph at peak production input into the screener). GHD has conservatively assumed that the entire stockpile and processing area consists of unconsolidated areas. Therefore, wind erosion was modelled as acting over the entire pit area of 24,500 m² – even if a large part of the pit operations is by dredge in a fully submersed pit.

Table 5-1 and Table 5-2 summarise the emission factors adopted and calculated emission rates for each item of equipment and activity within the proposal area. Emission calculations have been supplied for:

- Peak production rate of 205 tph.
- Average production rate of 145 tph.

Table 5-1 Dust emission inventory – peak production 205 tph

Equipment	TSP Emission Factor	PM ₁₀ Emission Factor	Unit	Application / assumptions	Estimate of TSP Emission Rate (kg/hr)		Estimate of PM ₁₀ Emission Rate (kg/hr)	
					No controls	With controls	No controls	With controls
Excavator	0.025	0.012	kg/t	1 excavator, handling 205 tph. Extracting material. No control.	2.56	2.56	1.23	1.23
Screening plant	0.080	0.060	kg/t	205 tph of material processed. No control. Dry (but high moisture content) material.	8.18	8.18	6.14	6.14
Excavator	0.004	0.0017	kg/t	Stockpiling of processed material. Handling 205 tph. No controls.	0.41	0.41	0.17	0.17
Loader ⁽¹⁾	0.030	0.013	kg/t	1 loader, handling 205 tph. Loading material into haul trucks. 50% control applied when water sprays are used on screening plant and stockpiles are watered ⁽²⁾ .	6.14	3.07	2.66	1.33
Haul trucks (unsealed road)	3.880	0.960	kg/VKT ⁽³⁾	Maximum 140 truck movements per day. Haul route 640 metres. Equals 89.6 km per day total travel. (Only applicable to unsealed section.) • 75% controls for Level 2 watering (>2 L/m ² /hr)	34.8	8.69	8.60	2.15
Wind erosion	See Section 6.2.2							
Total hourly emission rate					52.1	22.9	18.8	11.0

(1) Loader processes include wheel generated dust emissions and fugitive emissions from loading of material into trucks.

(2) A 50% control factor applied when wet suppression used on screening plant. Moisture carry over would mean that processed material in stockpiles would also have higher moisture content. Stockpiles may also be watered.

(3) VKT: Vehicle Kilometres Travelled.

Table 5-2 Dust emission inventory – average production 145 tph

Equipment	TSP Emission Factor	PM ₁₀ Emission Factor	Unit	Application / assumptions	Estimate of TSP Emission Rate (kg/hr)		Estimate of PM ₁₀ Emission Rate (kg/hr)	
					No controls	With controls	No controls	With controls
Excavator	0.025	0.012	kg/t	1 excavator, handling 145 tph. Extracting material. No control.	1.82	1.82	0.87	0.87
Screening plant	0.080	0.060	kg/t	145 tph of material processed. No control. Dry (but high moisture content) material.	5.82	5.82	4.36	4.36
Excavator	0.004	0.0017	kg/t	Stockpiling of processed material. Handling 145 tph. No controls.	0.29	0.29	0.12	0.12
Loader ⁽¹⁾	0.030	0.013	kg/t	1 loader, handling 145 tph. Loading material into haul trucks. 50% control applied when water sprays are used on screening plant and stockpiles are watered ⁽²⁾ .	4.36	2.18	1.89	0.95
Haul trucks (unsealed road)	3.880	0.960	kg/VKT ⁽³⁾	Maximum 100 truck movements per day. Haul route 640 metres. Equals 64.0 km per day total travel. (Only applicable to unsealed section) • 75% controls for Level 2 watering (>2 L/m ² /hr)	24.83	6.21	3.14	1.54
Wind erosion	See Section 6.2.2							
Total hourly emission rate					10.4	6.30		

(1) Loader processes include wheel generated dust emissions and fugitive emissions from loading of material into trucks.

(2) A 50% control factor applied when wet suppression used on screening plant. Moisture carry over would mean that processed material in stockpiles would also have higher moisture content. Stockpiles may also be watered.

(3) VKT: Vehicle Kilometres Travelled.

Figure 5-1 and Figure 5-2 show the breakdown of emission sources from proposal activities with and without controls such as water sprays. Emissions are based on an average production rate of 145 tph and assume an unsealed access road.

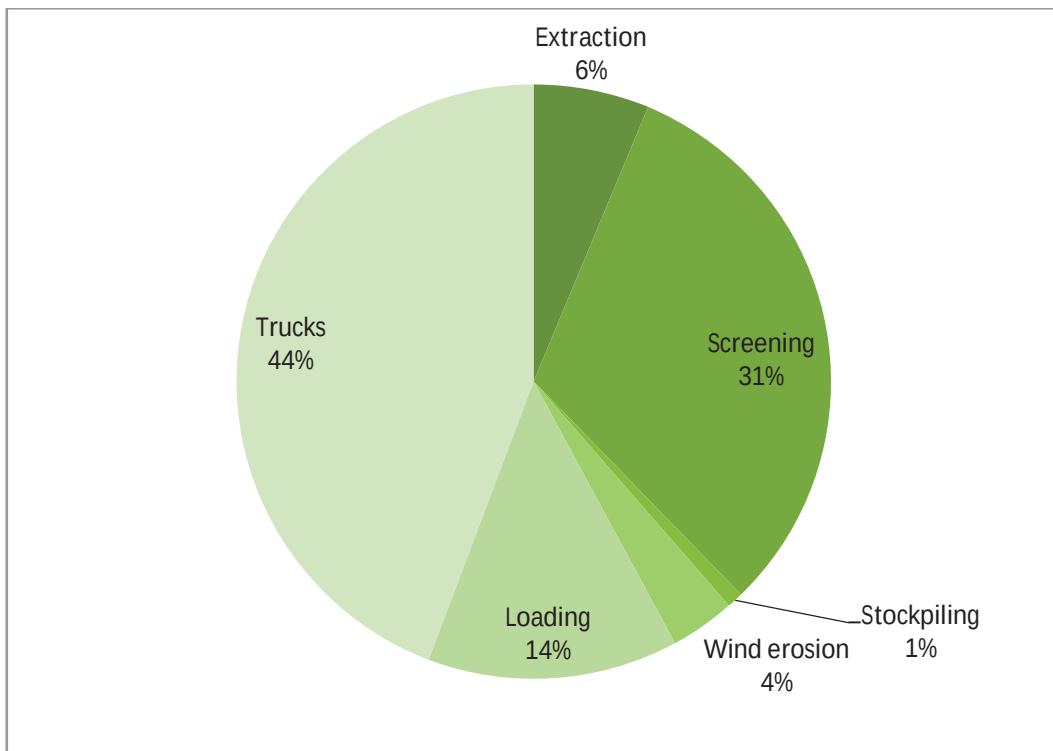


Figure 5-1 Breakdown of PM₁₀ emissions – no controls

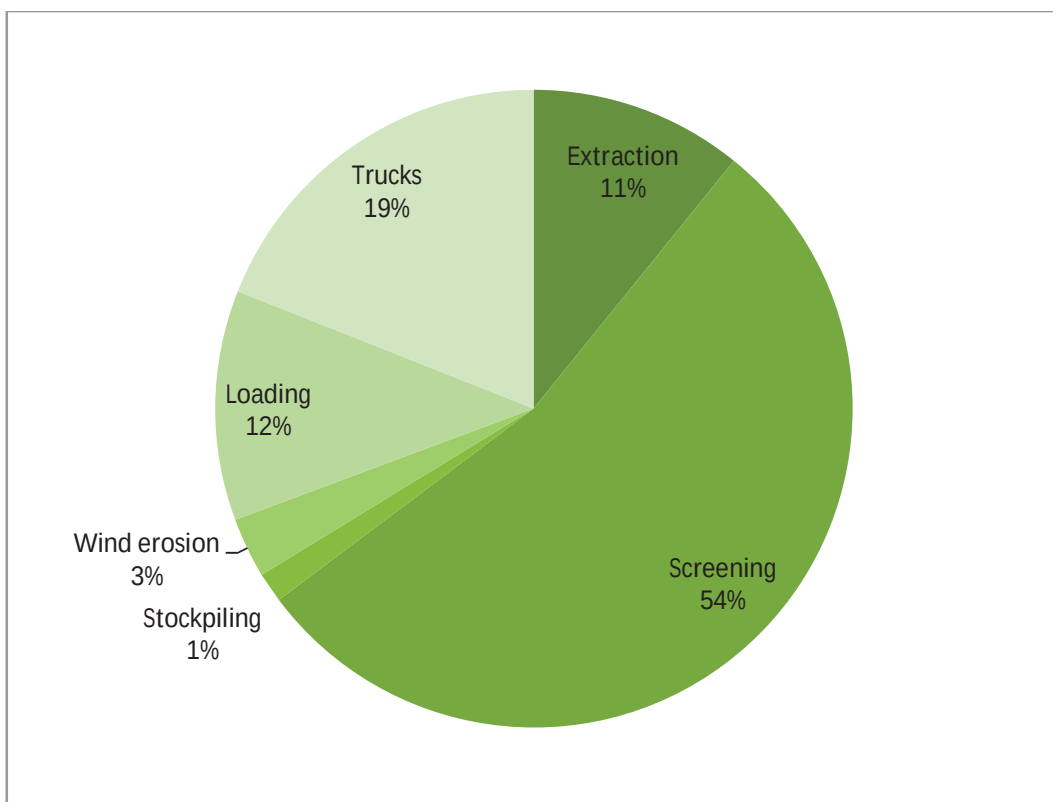


Figure 5-2 Breakdown of PM₁₀ emissions – with controls

Table 5-3 gives a technical summary of the source characteristics used as input to the dispersion model.

Table 5-3 Source characteristics

Source	Horizontal spread (m)	Vertical spread (m)	Source height (m)
Screen	5	3	0
Loader	5	2	0
Excavator	5	3	0
Haul trucks	10	3	0
Wind erosion	150	1	0

5.2 Emissions other than dust

Other air emissions such as combustion products (e.g. vehicle exhaust) would also be present within the proposal site. However, due to the small number of vehicles and their limited time on-site, the potential for impact from these emissions is negligible. Therefore, vehicle exhaust emissions have not been considered further in this assessment.

6. Impact assessment methodology

Atmospheric dispersion modelling was conducted to predict the maximum ground level concentrations (GLC) of dust (TSP and PM₁₀) resulting from emissions to air from the proposal. Dust deposition rates were also predicted. The predicted GLC's and dust deposition rates were then assessed against the relevant criteria.

Dispersion modelling of emissions to air requires the selection of an appropriate model and then the selection of three general types of input. These are:

- Hourly site-specific or site-representative meteorological data for a period of not less than one year. The meteorological data file used in this assessment is discussed in Section 2.3.
- Source characterisation (which includes emission rate inventory and source geometry).
- Model configuration – in which the various model settings are selected to best characterise the physical processes specific to this site and to make best use of the available emissions and meteorological data.

The source characterisation and model configuration are detailed below under relevant section headings.

6.1 The model

Ausplume version 6.0 is a regulatory approved dispersion model and was used in this assessment. Using the *Approved Methods* guidance, the terrain is not considered too complex for the model assumptions as all sources are ground-based volume and area sources, rather than point sources.

6.2 Source characterisation

6.2.1 Mobile and fixed plant

Processing and mobile equipment, such as the screening plant, loader and excavators have been modelled as individual 'volume' sources using the corresponding emission rates and characteristics presented in Table 5-1, Table 5-2 and Table 5-3.

The movement of haul trucks along the access road has been represented by a series of volume sources, evenly spaced along the access road length. Emission rates have been split evenly between each volume source along the haul road and for both sealed and unsealed sections of the haul road.

6.2.2 Wind erosion

Wind erosion was modelled as an area source over the surface area of the quarry pit area with dust emission rates set for each wind speed category proportional to the wind speed cubed as shown in Table 6-1.

Table 6-1 Wind erosion dust emission rates

Wind speed category (m/s)	Specific TSP emission rate (kg/hr/m ²)	Specific PM ₁₀ emission rate (kg/hr/m ²)
> 10.80	0.00024	0.00012
8.24 > 10.80	0.00012	0.00006
5.15 > 8.23	0.000041	0.000021
3.10 > 5.14	0.000010	0.000005
1.55 > 3.09	0.0000021	0.0000011
0 > 1.54	0	0

6.2.3 Dust deposition

Dust deposition parameters, where the model requires a particle size distribution; have been set² as provided in Table 6-2.

Table 6-2 Dust deposition parameters

Fraction No.	Mass fraction	Particle size (micron)	Particle density (g/cm ³)
1	0.052	1.8	2.6
2	0.140	4.0	2.6
3	0.223	8.0	2.6
4	0.322	17.0	2.6
5	0.263	31.0	2.6

6.2.4 Model configuration

The dispersion model was run based on the maximum production rate of 205 tph and the more likely production rate of 145 tph. Dust impacts have been predicted with and without controls, as detailed in Table 5-1 and Table 5-2. Annual average impacts for TSP and dust deposition have been modelled based on the peak and average production rates of 205 tph and 145 tph respectively.

Key components of the Ausplume model configuration used in this assessment are as follows:

- Ground level concentrations (GLC) were predicted over a 2 km by 2 km receptor grid, with a grid resolution of 50 m
- As a conservative measure, dry depletion was not selected for PM₁₀ model runs. Dry depletion was included in the TSP and dust deposition model runs
- Irwin's 'Rural' wind profile exponents were used
- Horizontal dispersion was parameterised according to equations for the Pasquill-Gifford curves
- A roughness height of 0.8 m ('Forest') was used to represent the bushland that surrounds the site

Further details on the Ausplume configuration can be found in the Ausplume output file attached in Appendix B.

² Based on data provided in the NSW Minerals Council Technical Paper: Particulate Matter and Mining Interim Report, 2000.

7. Impact assessment

A summary of the predicted results from dispersion modelling are presented below.

Maximum predicted ground level concentrations and deposition rates at each of the identified receptors have been added to the adopted background levels to determine the cumulative impact, which can then be compared against the NSW assessment criteria.

In addition to the conservative approach taken in the dispersion modelling, it is acknowledged that tall, thick vegetation surrounds the site in most directions. This would assist to dampen wind speeds and filter airborne dust as it travels from the site. These conditions cannot be fully represented in the dispersion model and therefore adds a level of conservatism to model predictions.

Another conservative assumption is the moisture content of the extracted material. The NPI emission factors are for a high moisture extracted ore. The material here will initially be processed through the screening section of the plant soon-after coming from the dredge (or excavation if pit not inundated with water but material not too far above the water table). The emission factors for screening, stockpiling and loading are sensitive to the moisture content of the material being transferred. The assumed moisture content of the NPI factors is a lower bound which will most often be exceeded for this particular operation.

7.1 PM₁₀ impacts

The 24-hour average impacts for PM₁₀ have been predicted at each of the identified receptors. As discussed in Section 2.2, an ambient PM₁₀ concentration of 15 µg/m³ has been adopted as the background level. Therefore, with the aim of meeting the criterion of 50 µg/m³, the incremental impact must be 35 µg/m³ or less at receptor locations.

Table 7-1 presents the highest predicted 24-hour average PM₁₀ concentrations at each receptor. Predicted results indicate there is potential for the 24-hour average PM₁₀ criterion to be exceeded at a number of sensitive receptors without dust control measures at both average and peak production rates. Based on peak production rate of 2,250 tonnes per day, there is potential for the 24-hour criterion to be exceeded at two residences (R2 and R4), even with the implementation of dust control measures.

Based on the average production rate of 1,600 tonnes per day, the 24-hour average criterion is predicted to be met at all but one receptor (R2) with the inclusion of dust control measures. This is based on activities occurring during meteorological conditions that cause maximum off-site impact (i.e. poor dispersive conditions, such as consistent winds in the direction of the nearest receptors).

Analysis of predicted results for peak production with control measures revealed that the frequency at which the adopted criterion was predicted to be exceeded is approximately five days per year at the most exposed receptors, based on the site-representative meteorology used. Under average operating conditions, the adopted criterion was predicted to be exceeded for only one day throughout the year. This indicates that on a day-to-day basis, off-site dust impacts should not be an issue; however it highlights the significance of local meteorological conditions on the potential for off-site dust impacts.

The proposal would operate at peak production (205 tph) only on occasion, and when it does, it is unlikely that this event would be coupled with the adverse (5 out of 365 days) meteorological conditions required to cause maximum off-site dust impact. Therefore, assuming dust control measures are implemented, short-term PM₁₀ impacts off-site can be managed to the requirements of the *Approved Methods*.

PM₁₀ concentration levels over an annual average are predicted to be well below the adopted criterion.

Figure 7-1 to Figure 7-2 shows the maximum predicted ground level concentration contours for proposal operations at average production of 145 tph with and without dust control measures.

Table 7-1 Predicted incremental PM₁₀ 24-hour average ground level concentrations – (µg/m³)

Receiver	Cumulative criterion	Adopted background	Adopted incremental impact criterion	Peak production rate		Average production rate	
				No controls	With controls	No controls	With controls
R1	50	15	35	101	33	72	24
R2				97	62	69	44
R3				43	31	30	22
R4				57	42	40	30
R5				27	20	20	15
R6				26	17	19	12
R7				27	16	19	12
R8				35	24	25	17
R9				23	16	17	12
R10				15	11	10	8
R11				17	10	12	7
R12				98	32	70	23
R13				35	16	25	11

* Bold numbers indicate an exceedance of the incremental impact criterion of 35 µg/m³.

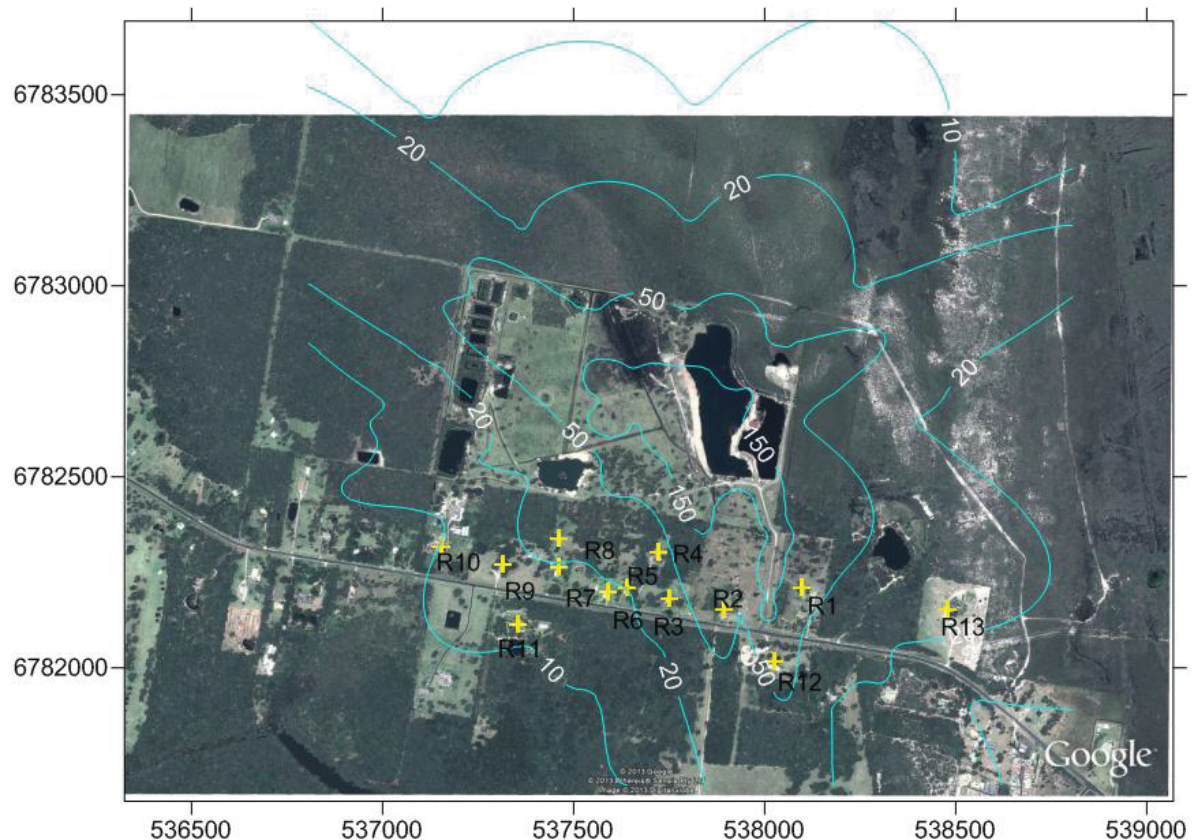


Figure 7-1 PM₁₀ 24-hour average highest concentrations, no controls (µg/m³)

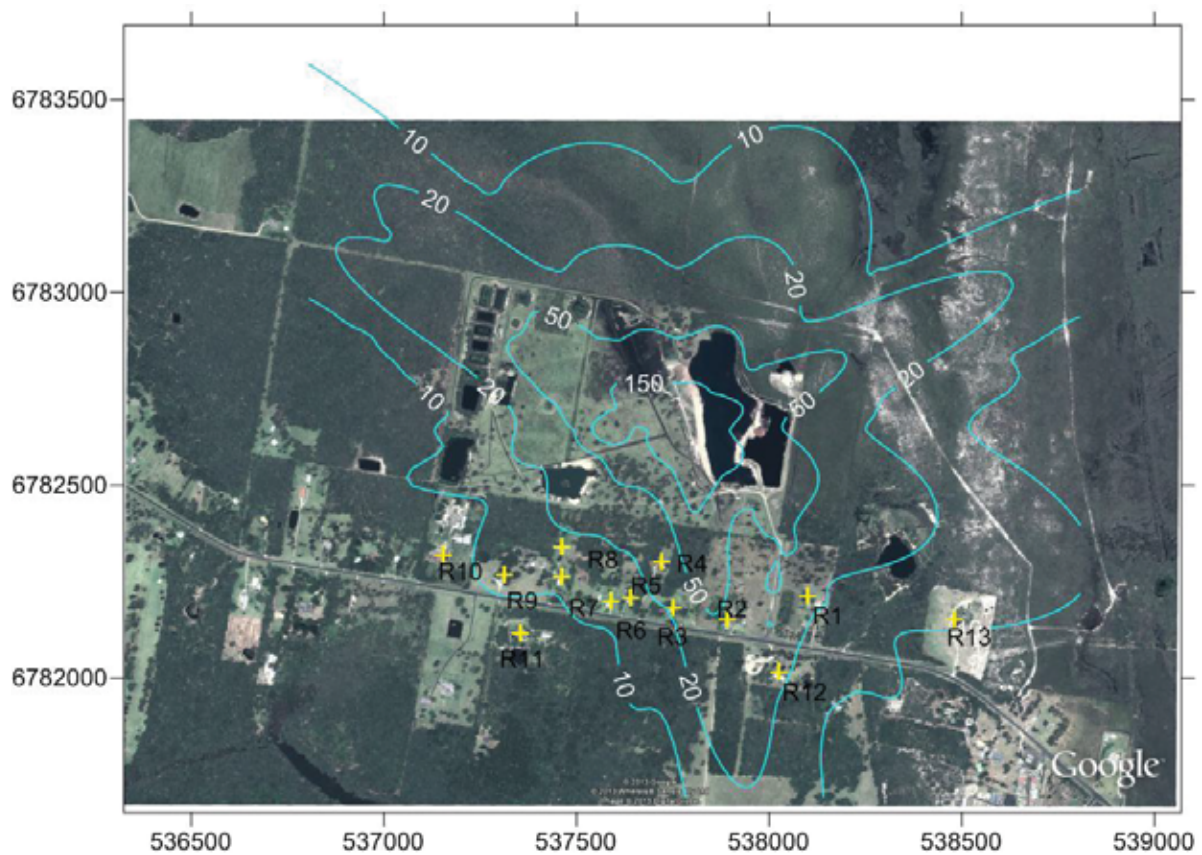


Figure 7-2 PM_{10} 24-hour average highest concentrations, with controls ($\mu g/m^3$)

7.2 TSP

Predictions of maximum ground level TSP concentrations have been made based on peak and average production rates without dust control measures and an unsealed access road.

Table 7-2 shows the maximum predicted ground level TSP concentration levels, which indicate that even without dust control measures, the predicted incremental impact at the most exposed sensitive receptor is well below the TSP criterion of $90 \mu g/m^3$. It is also evident from the results that even with the addition of a typical TSP background concentration of $30 \mu g/m^3$, the total (cumulative) impact would still be below the assessment criterion.

Table 7-2 Predicted TSP annual average concentrations ($\mu g/m^3$)

Receptor	Peak production rate	Average production rate
R1	50	35
R2	28	20
R3	18	13
R4	25	18
R5	14	10
R6	11	8
R7	8	6
R8	9	7
R9	5	4
R10	3	2
R11	5	3
R12	22	16
R13	6	4

7.3 Dust deposition

Predictions of dust deposition rates have been made based on the peak production rates and an unsealed access road.

In the absence of site-specific dust deposition data, a conservative background dust deposition level of 2 g/m²/month was adopted. Table 7-3 shows the maximum predicted incremental dust deposition rates at sensitive receptors for emissions with controls. The incremental dust deposition criterion of 2 g/m²/month is expected to be readily met at all identified receptors.

Table 7-3 Predicted dust deposition rates with controls

Receptor	Dust deposition (g/m2/month)
R1	0.31
R2	0.16
R3	0.11
R4	0.18
R5	<0.1
R6	<0.1
R7	<0.1
R8	<0.1
R9	<0.1
R10	<0.1
R11	<0.1
R12	0.12
R13	<0.1

7.4 Future movement of activities within the proposal area

Future operations would be carried out in stages and in response to demand. Extraction is proposed to move to the west of the existing extraction area and then south in three stages.

As the quarry working area progressively moves around the site, the signature of dust emissions from the site may also change. While the unsealed access road and location of the processing plant and stockpiles would not change, the dredge is mobile and would be moved to the active working area. Due to the infinite number of potential operating configurations on site, only one configuration has been assessed in this report, with processing equipment towards the centre of the site and the dredge located at the centre of stage 4 operations. The operation of the dredge is not expected to significantly contribute to the total air emissions from the site.

Based on the predicted dust impacts under worst-case operating conditions, the relocation of equipment around the proposal site is not anticipated to greatly affect the potential for adverse dust impacts at identified receptors. This is supported by the fact that the processing plant and haul routes have been identified as the primary sources of dust generation on site. The locations of the sources will not change as the quarry stages progress. However, when some quarrying activities (such as manual excavation using a mobile excavator) are located closer to off-site sensitive receptors, it would become increasingly important to implement appropriate dust control measures as outlined in Section 8, particularly during dry and windy conditions (and when maximum, rather than typical, plant throughput).

8. Mitigation measures

Effective management of dust emissions is critical to the successful operations of the proposal.

While day-to-day dust impacts from proposal operations are not expected to be an issue, providing appropriate control measures are implemented, the following recommendations are made to assist in minimising the potential for off-site impacts.

The moisture content of the material processed can have a substantial effect on emissions. Water sprays are generally the most simple and effective form of dust suppression on processing activities. Water sprays work by increasing the moisture content of material. The surface wetness causes fine particles to agglomerate on or to adhere to the faces of larger stones, with a resulting dust suppression effect.

Moisture carry over would mean that processed material in stockpiles would also have higher moisture content. In addition, stockpiles may also be regularly watered, allowing for a controlled emission factor to be applied to loading operations.

Wind erosion is expected to contribute less than 4% of total site PM₁₀ emissions. Therefore, in general, over a 24-hour period, wind erosion is not considered to be a problem. However, the sudden onset of weather systems that involve sharp increases in wind speed can have the effect of quickly stripping the fine surface silt content from exposed non-vegetated or non-rehabilitated soil, particularly if the silt content on that soil is high through recent mechanical activity. If not dealt with pro-actively, this can cause short-term (in the order of minutes) peaks in inhalable dust concentrations. It is therefore recommended that the quarry manager be provided with daily weather updates (e.g. the Bureau of Meteorology have a standard daily service) that will contain warnings of the sudden onset of strong winds. In the event of such warning, the manager could then take steps to ensure that exposed areas that could reasonably be subjected to wind erosion are consolidated by the timely application of water sprays.

8.1 General dust mitigation measures

General measures that will be implemented as part of the existing dust control management plan include:

- Rehabilitated areas will be revegetated as early as possible after completion.
- Newly stripped topsoil stockpiles will be immediately watered and revegetated with a grass cover or similar.
- Haul truck routes will be watered as required, particularly during peak periods of vehicle movements and extended dry spells.

Additional dust management measures are provided below in Table 8-1.

Table 8-1 General management of air emissions

Emission Source	Proposed Management
Dust generated from transport activities on-site and off-site	Use of water sprays/trucks and sprays to wet down access roads. Clean sealed roads at access and egress points regularly to minimise the re-suspension of dust on sealed roads. Continue to control on-site traffic by designating specific routes for haulage and access and limiting vehicle speeds to below 25 km/hr. All trucks hauling material should be covered before exiting the site and should maintain a reasonable amount of vertical space between the top of the load and top of the trailer.

Emission Source	Proposed Management
Dust generated from loading, unloading and storage/stockpiling of material on-site	Use water sprays to minimise truck dust emissions. Ensure materials are appropriately stored and contained to prevent releases to the atmosphere (e.g. wind fences, water sprays).
Dust from wind erosion	Aim to minimise the size of storage piles where possible and re-vegetate inactive storage piles to assist in reducing wind erosion emissions. Limit cleared areas of land and clear only when necessary to reduce fugitive dust emissions. Re-vegetate cleared areas of land that are no longer used.
Reactive dust management	On days of peak production, coincidental adverse weather has potential to cause off-site impact. Visual monitoring of movement of dust plumes will indicate if downwind receptors have an elevated risk of over-exposure to dust. Additional watering or adjustments to operational activity, including temporary cessation of production during the gustiest wind conditions, can be used to limit short-term excessive dust load beyond the site boundary.

9. Conclusion

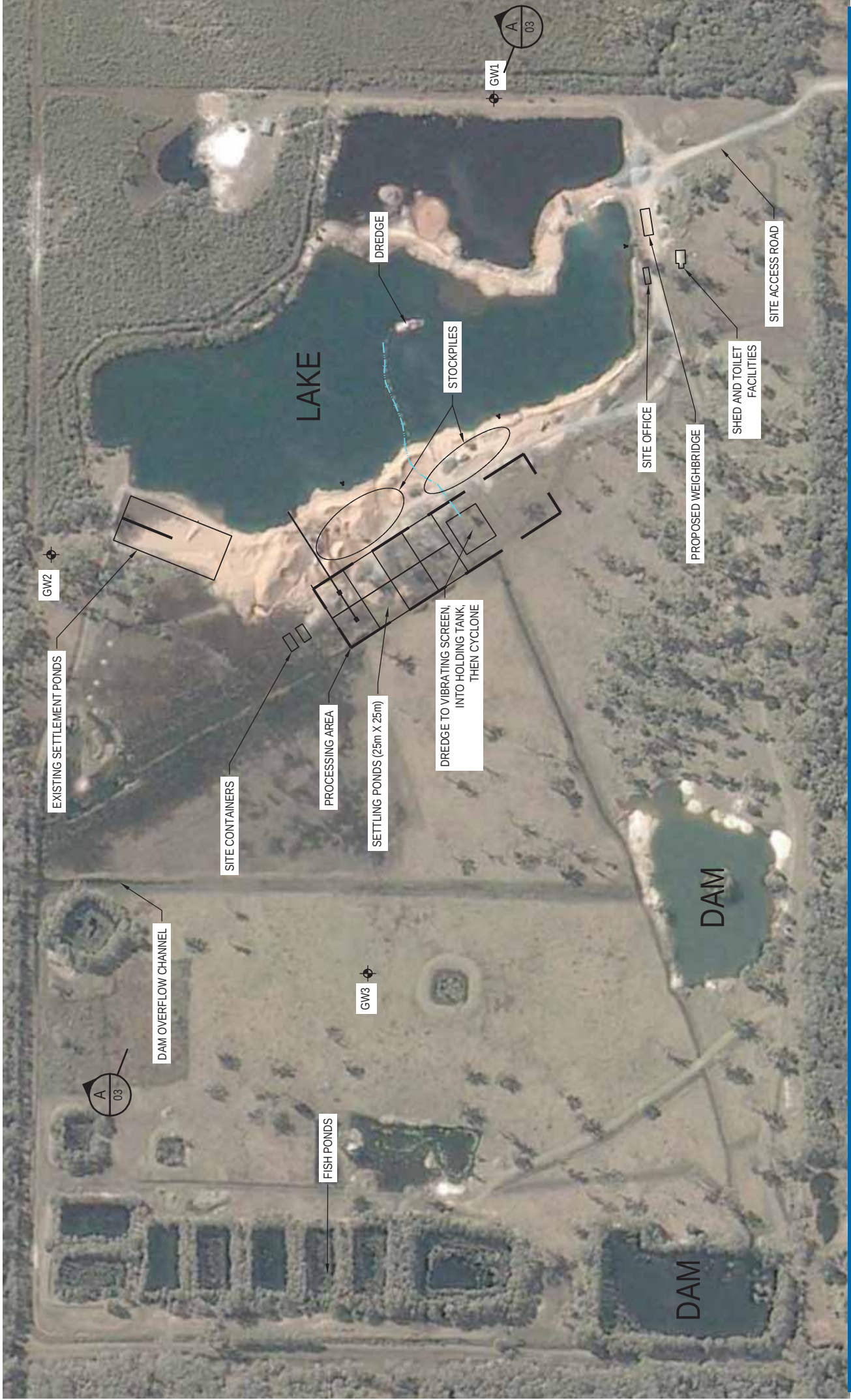
An assessment of potential air quality impacts associated with the proposed expansion of Doonbah Quarry, located off Evans Head Road, NSW, has been undertaken. The proposal is to expand an approved quarry with an extraction rate of up to 490,000 tonnes per annum.

The air quality assessment has led to the following conclusions:

- The emissions inventory identified haul trucks along the unsealed access road to be the primary source of dust emissions from the proposal.
- Following application of suitable water sprays along the access road, emissions from haul truck movements significantly reduce and the next dominant source of dust emissions within the proposal area was shown to be the processing activities, consisting of the screening plant.
- Short-term concentration levels of fine particulates (PM_{10}) was shown to pose the greatest potential for off-site dust impacts. PM_{10} and TSP concentrations over an annual average were predicted to be well below the applicable criteria.
- Predicted PM_{10} 24-hour average concentrations, modelled without dust control measures such as water sprays on crushing plant, indicate the potential to exceed the 24-hour criterion at a number of the identified sensitive receptors. However, when modelled with the application of water sprays on the access road and stockpiles, the model results indicate that PM_{10} concentrations should generally comply with the 24-hour criterion at all identified receptors.
- The predicted results highlight the importance of suitable dust control measures at times of peak production and adverse weather, such as water sprays on processing plant and watering and/or maintaining (reducing silt content by use of crushed stone, grading and compacting regularly to reduce pot-hole development) the haul road as required.
- Further discussion around dust mitigation measures are provided in Section 8. It is anticipated that through the implementation of these dust management measures, off-site dust impacts can be minimised and adverse impacts would be unlikely.
- In summary, off-site dust impacts are considered unlikely from the assessed proposal operations with suitable, timely and appropriate dust control measures.

Appendices

Appendix A – Proposed extraction plans



RIXA QUARRIES
DOONBAH QUARRY
WOODBURN, EVANS HEAD ROAD
EXISTING QUARRY

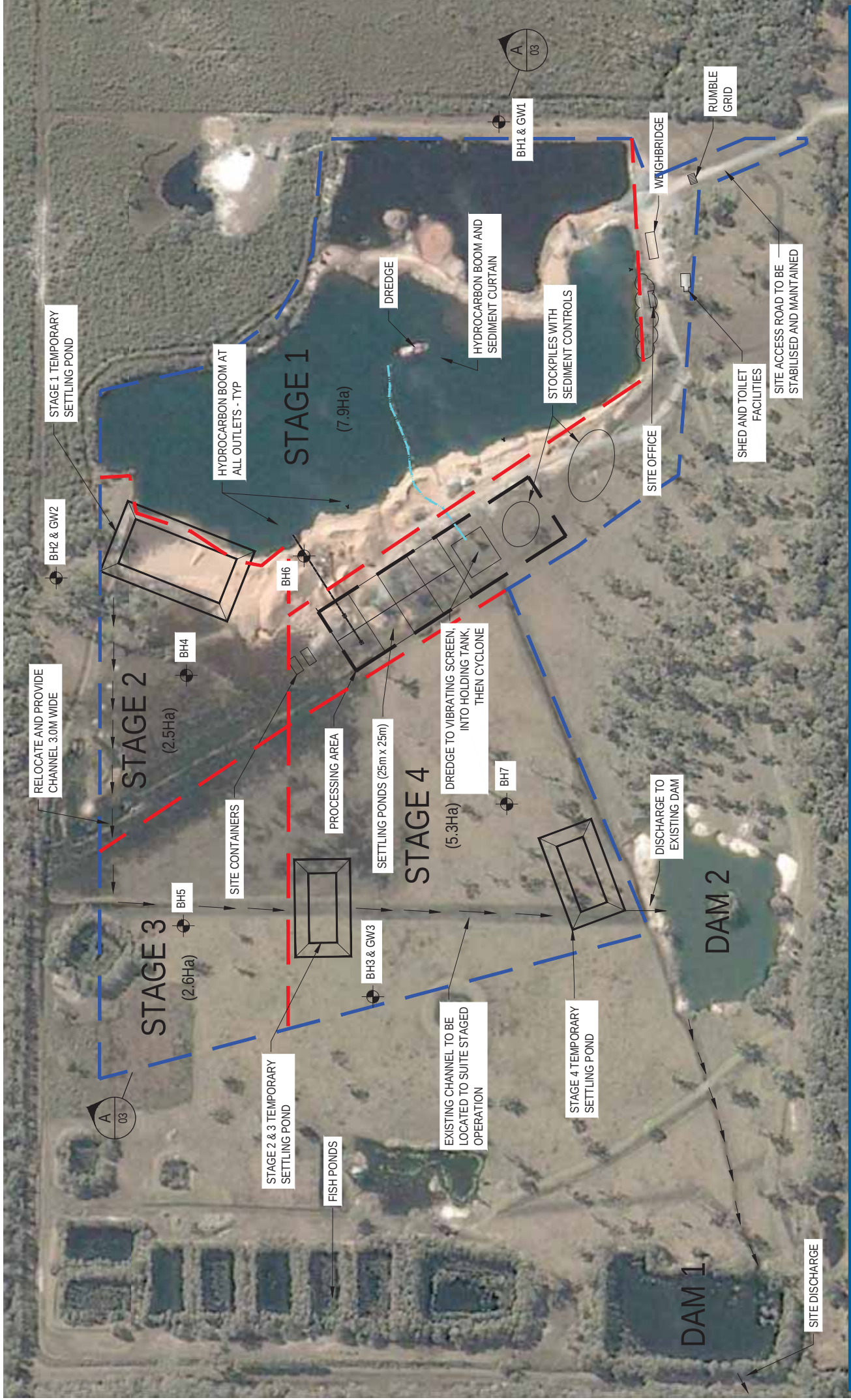
Job Number 22-17200
Revision A
Date MAR.2014

GHD

Figure 01

230 Harbour Drive Coffs Harbour NSW 2450 Australia T 61 2 6650 5600 F 61 2 6650 5601 E cfsmail@ghd.com W www.ghd.com

Proj Date: 14 March 2014 - 11:31 AM
Property: Milla Milla
Call File No: G:\2017\200\2450\milla\22-17200-01.dwg



Appendix B – Ausplume output file

1

Doonbah Quarry_PM10_controlled_average

Concentration or deposition	Concentration
Emission rate units	kg/hour
Concentration units	microgram/m3
Units conversion factor	2.78E+05
Constant background concentration	0.00E+00
Terrain effects	None
Smooth stability class changes?	No
Other stability class adjustments ("urban modes")	None
Ignore building wake effects?	No
Decay coefficient (unless overridden by met. file)	0.000
Anemometer height	10 m
Roughness height at the wind vane site	0.300 m

DISPERSION CURVES

Horizontal dispersion curves for sources <100m high	Pasquill-Gifford
Vertical dispersion curves for sources <100m high	Pasquill-Gifford
Horizontal dispersion curves for sources >100m high	Briggs Rural
Vertical dispersion curves for sources >100m high	Briggs Rural
Enhance horizontal plume spreads for buoyancy?	Yes
Enhance vertical plume spreads for buoyancy?	Yes
Adjust horizontal P-G formulae for roughness height?	Yes
Adjust vertical P-G formulae for roughness height?	Yes
Roughness height	0.800m
Adjustment for wind directional shear	None

PLUME RISE OPTIONS

Gradual plume rise?	Yes
Stack-tip downwash included?	Yes
Building downwash algorithm:	PRIME method.
Entrainment coeff. for neutral & stable lapse rates	0.60,0.60
Partial penetration of elevated inversions?	No
Disregard temp. gradients in the hourly met. file?	No

and in the absence of boundary-layer potential temperature gradients given by the hourly met. file, a value from the following table (in K/m) is used:

Wind Speed Category	Stability Class					
	A	B	C	D	E	F
1	0.000	0.000	0.000	0.000	0.020	0.035
2	0.000	0.000	0.000	0.000	0.020	0.035
3	0.000	0.000	0.000	0.000	0.020	0.035
4	0.000	0.000	0.000	0.000	0.020	0.035
5	0.000	0.000	0.000	0.000	0.020	0.035
6	0.000	0.000	0.000	0.000	0.020	0.035

WIND SPEED CATEGORIES

Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Rural" values (unless overridden by met. file)

AVERAGING TIMES

24 hours
average over all hours

Doonbah Quarry_PM10_controlled_average

SOURCE GROUPS

Group No.	Members							
1	WIND							
2	EXTEX							
3	HAUL1	HAUL2	HAUL3	HAUL4	HAUL5	HAUL6	HAUL7	
	HAUL8	HAUL9	HAUL10					
4	WIND	EXTEX	SCREEN	EXC1	LOAD	HAUL1	HAUL2	
	HAUL3	HAUL4	HAUL5	HAUL6	HAUL7	HAUL8	HAUL9	
	HAUL10							

1

Doonbah Quarry_PM10_controlled_average

SOURCE CHARACTERISTICS

INTEGRATED POLYGON AREA SOURCE: WIND

X0(m)	Y0(m)	Ground El	No. Vertices	Ver. spread	Height
537665	6782775	0m	4	1m	0m

Integrated Polygon Area Source Vertice Locations (in metres)

No.	X	Y	No.	X	Y
1	537665	6782775	2	537776	6782770
3	537859	6782519	4	537787	6782517

Emission rates by stability and wind speed, in kg/hour per square metre:

Wind speeds (m/s):	< 1.5	1.5_ 3.1	3.1_ 5.1	5.1_ 8.2	8.2_10.8	>10.8
Stability A:	0.00E+00	2.10E-06	1.00E-05	4.10E-05	1.20E-04	2.40E-04
Stability B:	0.00E+00	2.10E-06	1.00E-05	4.10E-05	1.20E-04	2.40E-04
Stability C:	0.00E+00	2.10E-06	1.00E-05	4.10E-05	1.20E-04	2.40E-04
Stability D:	0.00E+00	2.10E-06	1.00E-05	4.10E-05	1.20E-04	2.40E-04
Stability E:	0.00E+00	2.10E-06	1.00E-05	4.10E-05	1.20E-04	2.40E-04
Stability F:	0.00E+00	2.10E-06	1.00E-05	4.10E-05	1.20E-04	2.40E-04

No gravitational settling or scavenging.

VOLUME SOURCE: EXTEX

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
537583	6782642	0m	0m	5m	2m

Emission rates by hour of day in kg/hour:

1 0.00E+00	2 0.00E+00	3 0.00E+00	4 0.00E+00
5 0.00E+00	6 0.00E+00	7 8.73E-01	8 8.73E-01
9 8.73E-01	10 8.73E-01	11 8.73E-01	12 8.73E-01
13 8.73E-01	14 8.73E-01	15 8.73E-01	16 8.73E-01
17 8.73E-01	18 8.73E-01	19 0.00E+00	20 0.00E+00
21 0.00E+00	22 0.00E+00	23 0.00E+00	24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: SCREEN

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
537764	6782640	0m	0m	5m	3m

Emission rates by hour of day in kg/hour:

1 0.00E+00	2 0.00E+00	3 0.00E+00	4 0.00E+00
5 0.00E+00	6 0.00E+00	7 0.00E+00	8 4.36E+00
9 4.36E+00	10 4.36E+00	11 4.36E+00	12 4.36E+00
13 4.36E+00	14 4.36E+00	15 4.36E+00	16 4.36E+00
17 4.36E+00	18 4.36E+00	19 0.00E+00	20 0.00E+00
21 0.00E+00	22 0.00E+00	23 0.00E+00	24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: EXC1

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
537769	6782638	0m	0m	5m	2m

Emission rates by hour of day in kg/hour:

1 0.00E+00	2 0.00E+00	3 0.00E+00	4 0.00E+00
5 0.00E+00	6 0.00E+00	7 0.00E+00	8 1.24E-01
9 1.24E-01	10 1.24E-01	11 1.24E-01	12 1.24E-01
13 1.24E-01	14 1.24E-01	15 1.24E-01	16 1.24E-01
17 1.24E-01	18 1.24E-01	19 0.00E+00	20 0.00E+00
21 0.00E+00	22 0.00E+00	23 0.00E+00	24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: LOAD

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
537800	6782583	0m	0m	5m	2m

Emission rates by hour of day in kg/hour:

1 0.00E+00	2 0.00E+00	3 0.00E+00	4 0.00E+00
5 0.00E+00	6 0.00E+00	7 0.00E+00	8 9.46E-01
9 9.46E-01	10 9.46E-01	11 9.46E-01	12 9.46E-01
13 9.46E-01	14 9.46E-01	15 9.46E-01	16 9.46E-01
17 9.46E-01	18 9.46E-01	19 0.00E+00	20 0.00E+00
21 0.00E+00	22 0.00E+00	23 0.00E+00	24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL1

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
537764	6782640	0m	0m	10m	3m

Emission rates by hour of day in kg/hour:

1 0.00E+00	2 0.00E+00	3 0.00E+00	4 0.00E+00
5 0.00E+00	6 0.00E+00	7 0.00E+00	8 1.54E-01
9 1.54E-01	10 1.54E-01	11 1.54E-01	12 1.54E-01
13 1.54E-01	14 1.54E-01	15 1.54E-01	16 1.54E-01
17 1.54E-01	18 1.54E-01	19 0.00E+00	20 0.00E+00
21 0.00E+00	22 0.00E+00	23 0.00E+00	24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL2

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
538003	6782163	0m	0m	10m	3m

Emission rates by hour of day in kg/hour:

1 0.00E+00	2 0.00E+00	3 0.00E+00	4 0.00E+00
5 0.00E+00	6 0.00E+00	7 0.00E+00	8 1.54E-01
9 1.54E-01	10 1.54E-01	11 1.54E-01	12 1.54E-01
13 1.54E-01	14 1.54E-01	15 1.54E-01	16 1.54E-01
17 1.54E-01	18 1.54E-01	19 0.00E+00	20 0.00E+00
21 0.00E+00	22 0.00E+00	23 0.00E+00	24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL3

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
538013	6782226	0m	0m	10m	3m

Emission rates by hour of day in kg/hour:

1 0.00E+00	2 0.00E+00	3 0.00E+00	4 0.00E+00
5 0.00E+00	6 0.00E+00	7 0.00E+00	8 1.54E-01
9 1.54E-01	10 1.54E-01	11 1.54E-01	12 1.54E-01
13 1.54E-01	14 1.54E-01	15 1.54E-01	16 1.54E-01
17 1.54E-01	18 1.54E-01	19 0.00E+00	20 0.00E+00
21 0.00E+00	22 0.00E+00	23 0.00E+00	24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL4

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
538023	6782289	0m	0m	10m	3m

Emission rates by hour of day in kg/hour:

1 0.00E+00	2 0.00E+00	3 0.00E+00	4 0.00E+00
5 0.00E+00	6 0.00E+00	7 0.00E+00	8 1.54E-01
9 1.54E-01	10 1.54E-01	11 1.54E-01	12 1.54E-01
13 1.54E-01	14 1.54E-01	15 1.54E-01	16 1.54E-01
17 1.54E-01	18 1.54E-01	19 0.00E+00	20 0.00E+00
21 0.00E+00	22 0.00E+00	23 0.00E+00	24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL5

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
538028	6782353	0m	0m	10m	3m

Emission rates by hour of day in kg/hour:

1 0.00E+00	2 0.00E+00	3 0.00E+00	4 0.00E+00
5 0.00E+00	6 0.00E+00	7 0.00E+00	8 1.54E-01
9 1.54E-01	10 1.54E-01	11 1.54E-01	12 1.54E-01
13 1.54E-01	14 1.54E-01	15 1.54E-01	16 1.54E-01
17 1.54E-01	18 1.54E-01	19 0.00E+00	20 0.00E+00
21 0.00E+00	22 0.00E+00	23 0.00E+00	24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL6

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
538004	6782413	0m	0m	10m	3m

Emission rates by hour of day in kg/hour:

1 0.00E+00	2 0.00E+00	3 0.00E+00	4 0.00E+00
5 0.00E+00	6 0.00E+00	7 0.00E+00	8 1.54E-01
9 1.54E-01	10 1.54E-01	11 1.54E-01	12 1.54E-01
13 1.54E-01	14 1.54E-01	15 1.54E-01	16 1.54E-01
17 1.54E-01	18 1.54E-01	19 0.00E+00	20 0.00E+00
21 0.00E+00	22 0.00E+00	23 0.00E+00	24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL7

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread

537984 6782473 0m 0m 10m 3m

Emission rates by hour of day in kg/hour:

1 0.00E+00	2 0.00E+00	3 0.00E+00	4 0.00E+00
5 0.00E+00	6 0.00E+00	7 0.00E+00	8 1.54E-01
9 1.54E-01	10 1.54E-01	11 1.54E-01	12 1.54E-01
13 1.54E-01	14 1.54E-01	15 1.54E-01	16 1.54E-01
17 1.54E-01	18 1.54E-01	19 0.00E+00	20 0.00E+00
21 0.00E+00	22 0.00E+00	23 0.00E+00	24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL8

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
537862	6782501	0m	0m	10m	3m

Emission rates by hour of day in kg/hour:

1 0.00E+00	2 0.00E+00	3 0.00E+00	4 0.00E+00
5 0.00E+00	6 0.00E+00	7 0.00E+00	8 1.54E-01
9 1.54E-01	10 1.54E-01	11 1.54E-01	12 1.54E-01
13 1.54E-01	14 1.54E-01	15 1.54E-01	16 1.54E-01
17 1.54E-01	18 1.54E-01	19 0.00E+00	20 0.00E+00
21 0.00E+00	22 0.00E+00	23 0.00E+00	24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL9

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
537831	6782556	0m	0m	10m	3m

Emission rates by hour of day in kg/hour:

1 0.00E+00	2 0.00E+00	3 0.00E+00	4 0.00E+00
5 0.00E+00	6 0.00E+00	7 0.00E+00	8 1.54E-01
9 1.54E-01	10 1.54E-01	11 1.54E-01	12 1.54E-01
13 1.54E-01	14 1.54E-01	15 1.54E-01	16 1.54E-01
17 1.54E-01	18 1.54E-01	19 0.00E+00	20 0.00E+00
21 0.00E+00	22 0.00E+00	23 0.00E+00	24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL10

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
537802	6782613	0m	0m	10m	3m

Emission rates by hour of day in kg/hour:

1 0.00E+00	2 0.00E+00	3 0.00E+00	4 0.00E+00
5 0.00E+00	6 0.00E+00	7 0.00E+00	8 1.54E-01
9 1.54E-01	10 1.54E-01	11 1.54E-01	12 1.54E-01
13 1.54E-01	14 1.54E-01	15 1.54E-01	16 1.54E-01
17 1.54E-01	18 1.54E-01	19 0.00E+00	20 0.00E+00
21 0.00E+00	22 0.00E+00	23 0.00E+00	24 0.00E+00

No gravitational settling or scavenging.

1

Doonbah Quarry_PM10_controlled_average

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):

536806.m 536856.m 536906.m 536956.m 537006.m 537056.m 537106.m
 537156.m 537206.m 537256.m 537306.m 537356.m 537406.m 537456.m
 537506.m 537556.m 537606.m 537656.m 537706.m 537756.m 537806.m
 537856.m 537906.m 537956.m 538006.m 538056.m 538106.m 538156.m
 538206.m 538256.m 538306.m 538356.m 538406.m 538456.m 538506.m
 538556.m 538606.m 538656.m 538706.m 538756.m 538806.m

and these y-values (or northings):

6781693.m 6781743.m 6781793.m 6781843.m 6781893.m 6781943.m 6781993.m
 6782043.m 6782093.m 6782143.m 6782193.m 6782243.m 6782293.m 6782343.m
 6782393.m 6782443.m 6782493.m 6782543.m 6782593.m 6782643.m 6782693.m
 6782743.m 6782793.m 6782843.m 6782893.m 6782943.m 6782993.m 6783043.m
 6783093.m 6783143.m 6783193.m 6783243.m 6783293.m 6783343.m 6783393.m
 6783443.m 6783493.m 6783543.m 6783593.m 6783643.m 6783693.m

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	538099	6782211	0.0	0.0	8	537462	6782340	0.0	0.0
2	537892	6782153	0.0	0.0	9	537314	6782271	0.0	0.0
3	537752	6782182	0.0	0.0	10	537156	6782320	0.0	0.0
4	537722	6782304	0.0	0.0	11	537353	6782116	0.0	0.0
5	537640	6782210	0.0	0.0	12	538026	6782017	0.0	0.0
6	537588	6782201	0.0	0.0	13	530480	6782153	0.0	0.0
7	537462	6782265	0.0	0.0					

METEOROLOGICAL DATA : Evans Head 2011 with surface roughness 0.4 using cei
 l

GHD

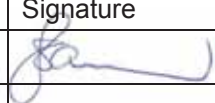
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		Name	Signature	Name	Signature	Date
0	T Gribble	B Cook		S.Lawer		26/11/2014

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Appendix G – Ecology Assessment



Rixa Quarries Pty Ltd
Proposed Expansion of Doonbah Quarry, Woodburn Evans
Head Road, Doonbah
Ecological Assessment

November 2014

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Appendix B – Protected Matters Search Results

Appendix C - Flora Species List

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Appendix E - Assessment of significance for species listed on the TSC Act

Appendix F - Assessment of significance for species listed on the EPBC Act

1. Introduction

1.1 Project overview

GHD has been engaged by Rixa Quarries Pty Ltd (Rixa) to prepare an Environmental Impact Statement (EIS) for the proposed expansion of the Doonbah Quarry ('the quarry'), an existing sand quarry located at Lot 2 DP 1040274 on Woodburn Evans Head Road, Doonbah, NSW (the 'subject site'). The location of the quarry is shown in Figure 1 and is within the Richmond Valley Council (RVC) Local Government Area (LGA). The quarry would be operated under a 'profit a prendre' (royalty) arrangement with the owner of the property.

Quarry operations at the site date back to 1961. In 1997, the quarry was granted approval to extract up to 35,715 m³ (approximately 57,000 tonnes) per annum (DA 128/95). The quarry has now exhausted the resources available under this approval.

The proposal is to expand the existing quarry to have an extraction rate of up to 490,000 tonnes per annum. The primary purpose of the quarry would be to supply sand to the current and proposed Pacific Highway upgrade works, and for supply to local councils and contractors. The quarry is well located to service the Pacific Highway upgrade works between Woolgoolga and Ballina which is to take place over a timeframe of approximately 5 years.

To provide the required material, the extraction area of the quarry would need to be expanded from 6.28 ha to approximately 18.3 ha, with a depth of 15 metres below ground level or -12 metres Australian Height Datum (AHD). It is estimated that the quarry would have an available resource of 4,000,000 tonnes which would allow extraction for a period of between 20 and 30 years, depending on demand.

1.1 Purpose of this report

This report presents the results of an ecological assessment of the proposed expansion, and has been prepared as supporting information to the EIS. It addresses the Director General's Requirements (DGRs) for the EIS in relation to biodiversity as described in Section 3.

The EIS is required for the proposed expansion in accordance with the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environmental Planning and Assessment Regulation 2000*, to assess the significance of the potential environmental impacts of the proposal.

1.2 Objectives and Scope

The objectives of the ecological assessment were to:

- Survey, identify and describe flora species (including rare and threatened flora), and vegetation communities present within the subject site and assess their conservation significance with regard to relevant Federal, State and Local Government environmental legislation
- Survey, identify and describe fauna species (including rare and threatened fauna), and their habitats which are present, or which may occur within the subject site and surrounds, and assess their conservation significance with regard to relevant Federal, State and Local Government environmental legislation
- Address the Director General's Requirements (DGRs) for the EIS in relation to biodiversity

- Assess and describe the conservation significance of the flora and fauna of the subject site including the presence of any biota listed under the *Threatened Species Conservation Act 1995* (TSC Act) and/or Matters of National Environmental Significance (MNES) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Assess the significance of the impact of the proposed development on threatened biota in accordance with Section 5A of the EP&A Act (known as the 'Seven Part Test') and the EPBC Act Significant Impact Guidelines 1.1 (DotE 2013)
- Provide recommendations for mitigating the effects of the proposed development on native flora and fauna, particularly threatened species and their habitats, and the general wider environment
- Describe potential offsetting actions based on the biodiversity values which cannot be maintained or improved, should these be required.

1.3 Disclaimer

This report: has been prepared by GHD for Rixa Quarries Pty Ltd and may only be used and relied on by Rixa Quarries Pty Ltd for the purpose agreed between GHD and the Rixa Quarries Pty Ltd as set out in section 4.1 of this report.

GHD otherwise disclaims responsibility to any person other than Rixa Quarries Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

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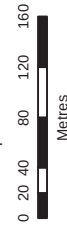
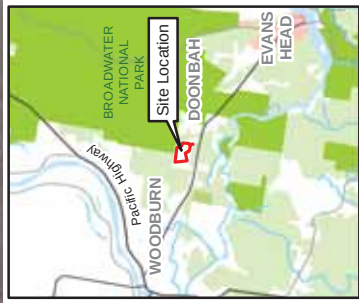
1.4 Limitations

This report should be read with consideration of the following limitations.

- The fauna survey conducted was not designed to detect all species present, rather to provide an overall assessment of the ecological values on the site. In particular:
 - It was beyond the scope of the survey to carry out detailed surveys such as fauna trapping.
 - Survey of the aquatic environment associated with water bodies within the site (i.e. fish and/or macroinvertebrate surveys) was not undertaken.
- Due to the duration and timing of the field survey it is likely that some species that utilise the site (permanently, seasonally or transiently) were not detected during the survey. These species are likely to include flora species that are difficult or impossible to locate or identify at the time of survey due to a lack of reproductive material and/or their seasonal

nature (in particular, native orchids and forbs), and mobile fauna which may occasionally utilise the site on an opportunistic basis, or cryptic species that are difficult to detect even when present.

- Site conditions (including the presence of threatened species of flora and/or fauna) are described in this report based upon conditions observed on the site during the period 8-10 April 2014, and may have changed since this date. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. Further assessment and revision of the report would be required in the event of significant changes to site conditions. This does not fall within the scope of the current assessment.



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

LEGEND



Rixa Quarries Pty Ltd
Doonbah Quarry

Job Number	22-17200
Revision	0
Date	26 Nov 2014



Doonbah Quarry Property Details and Proposed Expansion Areas

Figure 1

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© 2014. Whilst every care has been taken to prepare this map, GHD, ERSI and LPI make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.
Data source: LPI: DCDB & DTDB 2012; ERSI: Aerial Imagery 2014. Created by: fmackey
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9999 E Ent@mail@ghd.com W www.ghd.com.au

2. Site Description

2.1 Location and context

Doonbah Quarry is located approximately 4.5 km to the north west of the township of Evans Head on the NSW North Coast, on the northern side of Woodburn Evans Head Road. It is situated approximately 4.5 km inland from the Pacific Ocean. The Pacific Highway and the township of Woodburn are located approximately 3 km to the west alongside a meander of the Richmond River.

Broadwater National Park adjoins the northern boundary of the site, while rural residential allotments are situated to the south along Woodburn Evans Head Road and to the east and west of the site, including a larger allotment to the west that is predominantly vegetated.

Agricultural lands, predominantly sugar cane crops, are situated along the floodplain of the Richmond River, commencing approximately 1.5 km to the west of the site. Sections of Broadwater National Park are situated to the north, east and south of the site, and Bundjalung National Park is situated along the coast to the south of Evans Head, approximately 5 km south of the site.

The “Profit a Prendre” area is smaller than the subject site, being the area of the existing quarry, a buffer area to the south of approximately 20 m, and a trapezoidal shaped area of land to the west of this (refer Figure 1). The Profit of Prendre area and adjacent water body and access road were the ‘study area’ for this assessment.

2.1.1 Landscape and soils

The quarry and adjacent areas are situated on low elevation, relatively flat land within the greater floodplain of the Richmond River. The site and surrounding area are underlain by sand deposits that form part of an ancient dune and swale complex deposited by on-shore currents to the north of the Evans Head headland over the past 60,000 years (OEH 2012). The Richmond River contributes alluvial deposits during flood events.

Due to the low elevation of the site and its location, there is potential for acid sulfate soils to occur.

2.1.2 Geology

According to the Lismore 1:100,000 and 1:25,000 Coastal Quaternary Geology Map Series (Hashimoto and Troedson 2008) the site is defined as being underlain by the Estuarine Plain System where the Quaternary layer of the site is a layer of Pleistocene tidal-delta flat which consists of marine sand, silt, minor clay, indurated sand and shell. The north east corner of the site is defined as being Coastal Barrier System with Pleistocene beach-ridge swale and dune-deflation hollow which consists of marine sand, indurated sand, organic mud and peat.

2.1.3 Vegetation

The site has been cleared and quarried for over 100 years and has thus been largely cleared of native vegetation. Bushland remains in place to the west and partially cleared vegetation is located to the south on either side of the Woodburn Evans Head Road (refer Figure 1).

Due to vegetation clearing for the proposed expansion, an offset area has been identified. This extends over an area of 4.5 ha and is located in the south of the subject site. It contains modified pink bloodwood open forest. This area is referred to as ‘the proposed offset area’ throughout this report.

2.1.4 Watercourses and hydrology

The Evans River is located approximately one kilometre to the south of the site. This extends in a south-easterly and easterly direction and meets the Pacific Ocean at Evans Head, approximately 8 km downstream of the site. The Richmond River is located approximately 2.5 km to the north-northwest at its closest point. This extends in a northerly direction, meeting the Pacific Ocean at Ballina, approximately 40 km downstream of the site.

Although there are no watercourses within the site, there are a number of artificial drains associated with the quarry operations are situated across the site and extend between overflow dams. These do not adjoin any watercourses or drainage lines off site.

Three groundwater monitoring boreholes drilled within or on the edge of the subject site during February 2014 (GHD 2014) indicated that the groundwater in the area is between 2.25 and 2.45 metres from ground level. The subject site is situated over the coastal sand aquifer, which is considered to be a highly productive coastal sands water source due to its high yield and low salinity (refer to section 6.2).

2.1.5 Water bodies

The site contains several ponds, dams, depressions and water storage areas (refer Figure 1). The large open waterbodies present in the study area include quarry pits filled with water and situated in the east of the study area.

The property contains a series of ponds along the western boundary constructed for the purposes of breeding fish. There is a large dam to the south of the property used for stock watering, one to the north east of the property which is associated with the temporary residence at this location. There is a small dam to the north which is partially included within the subject site and a large low-lying area in the centre north which remains damp during wet periods.

2.1.6 Current and past land use

The site is currently used as a sand quarry and has been used for quarrying purposes since 1903 and as such, is substantially disturbed. Much of the land proposed for the expansion consists of the spoil piles, sand deposits, soil stock piles, timber piles and areas of excavation from previous quarrying activities. The site has been cleared particularly in the western 80 percent and is currently grazed by cattle within the cleared sections. The site contains a series of access tracks and roads which are unsealed, some of which have gravel surfaces.

At present, very little excavation is carried out, with only approximately two truck movements per day. Quarrying involves extraction of sand using a dredge from the large lake which is a quarry pit full of water. Sand is filtered on site using and the waste water is settled through a series of ponds to the north, draining to the southwest.

2.1.7 National Parks

Broadwater National Park

Broadwater National Park adjoins the northern boundary of the site. It extends from Evans Head north to the village of Broadwater. It is dominated by coastal heathland and shrubland vegetation communities interspersed with swamps. Over 400 plant species have been recorded within the Park, ten of which are listed as threatened under the TSC Act and eight of these are listed as threatened under the EPBC Act (refer to Table 1) (OEH 2012).

The Park supports more than 360 species of animals including 48 threatened species and provides important areas for migratory shorebirds that utilise the area during annual migrations. Weeds recorded in the Park include 33 species, with dominant and highly invasive species

including Bitou Bush, Groundsel Bush, Coastal Morning Glory and Lantana. Broadwater Community Dune Care Group provides ongoing weed control and revegetation resources (OEH 2012). The most recent fire in the Park occurred in August 2004, burning approximately 520 ha (OEH 2012).

Table 1 Threatened flora recorded within Broadwater National Park

Common Name	Scientific Name	Legal Status TSC Act	Legal Status EPBC Act
Bordered Guinea Flower	<i>Hibbertia marginata</i>	Vulnerable	Vulnerable
Brush Sophora	<i>Sophora fraseri</i>	Vulnerable	Vulnerable
Hairy Jointgrass	<i>Arthraxon hispidus</i>	Vulnerable	Vulnerable
Heath Wrinklewort	<i>Rutidosia heterogama</i>	Vulnerable	Vulnerable
Needle-leaf Fern	<i>Belvisia mucronata</i>	Endangered	
Red Boppel Nut	<i>Hicksbeachia pinnatifolia</i>	Vulnerable	Vulnerable
Rusty Plum	<i>Niemeyera whitei</i>	Vulnerable	
Lesser Swamp Orchid	<i>Phaius australis</i>	Endangered	Endangered
Stinking Cryptocarya	<i>Cryptocarya foetida</i>	Vulnerable	Vulnerable

Bundjalung National Park

The very northern portion of Bundjalung National Park is situated along the Evans River, approximately 600 m south of Woodburn Evans Head Road and the access to the subject site, and 1 km from the main boundary of the subject site. This portion of the National Park is separate from the main body of the park, which extends from Evans Head south to Iluka.

A high diversity of native plants have been recorded in Bundjalung National Park of which 48 are considered to have ecological significance and six are listed as endangered and vulnerable.

There have been more than 280 native fauna species identified in the area including 205 species of birds of which four are endangered and 22 are vulnerable species. Thirty mammal species have also been recorded within the park including 14 species listed as vulnerable (NPWS 1997).

Noxious weeds that have been recorded within the park include *Chrysanthemoides monilifera* var *rotunda* (Bitou Bush), *Baccharis halimifolia* (Groundsel Bush), *Asparagus aethiopicus* (Asparagus Fern), *Opuntia* sp (Prickly Pear), *Senna pendula* (Yellow cassia) and *Lantana camara* (Lantana) (NPWS 1997).

3. Legislative Context

3.1 Director General's requirements

An Environmental Impact Statement (EIS) is to be prepared for the proposed development under Part 4 of the EP&A Act. The DGRs for the EIS in relation to biodiversity are shown in Table 2 with a reference to the location of the details addressing each DGR within this report.

Table 2 Director General's Requirements and section reference

Director General's Requirements	Section Addressed
Accurate predictions of any vegetation clearing on site or for any road upgrade	Section 6.4.1
A detailed assessment of the potential impacts of the development on any threatened species or populations or their habitats, endangered ecological communities and groundwater dependent ecosystems	Section 6.11
A detailed assessment of any indirect impacts on the biodiversity values of the Broadwater and Bundjalung National Parks	Section 6.9
A detailed description of the measures to maintain or improve the biodiversity values within the site in the medium to long term	Section 7
A detailed description of the measures to maintain or improve the biodiversity values within the site in the medium to long term	Section 7
Consideration of a Biodiversity Offset Strategy	Section 7.5

3.2 NSW state legislation

3.2.1 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) provides legal status for biota of conservation significance in NSW. The Act aims to, *inter alia*, 'conserve biological diversity and promote ecologically sustainable proposal'. It provides for:

- The listing of 'threatened species, populations and ecological communities', with endangered species, populations and communities listed under Schedule 1, 'critically endangered' species and communities listed under Schedule 1A, vulnerable species and communities listed under Schedule 2
- The listing of 'Key Threatening Processes' (under Schedule 3)
- The preparation and implementation of Recovery Plans and Threat Abatement Plans
- Requirements or otherwise for the preparation of Species Impact Statement (SIS)

The TSC Act has been addressed by:

- Completing a desktop review to identify the threatened species, populations or ecological communities that have been previously recorded on, or within the locality of the site and hence could occur subject to the habitats present
- Undertaking targeted field surveys for threatened species listed under the Act within the limitations of access and the conditions at the site at the time of assessment

- Identifying, assessing and mapping EECs listed under the Act if present
- Assessing potential impacts on threatened species known, or that are likely to occur on the site
- Identifying suitable impact mitigation and environmental management measures for potential impacts to threatened species, where required
- Undertaking an assessment of significant impacts on threatened biota

Threatened species and ecological communities are discussed further in Section 5 of this report.

3.2.2 Fisheries Management Act 1994

The objects of the *Fisheries Management Act 1994* (FM Act) are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. It provides for:

- The listing of threatened species, populations and ecological communities, with endangered species, populations and communities listed under Schedule 4, 'critically endangered' species and communities listed under Schedule 4A, vulnerable species and communities listed under Schedule 5
- The listing of 'Key Threatening Processes' (under Schedule 6)
- Diseases affecting fish and marine vegetation (under Schedule 6B)
- Noxious fish and noxious marine vegetation (under Schedule 6C)
- The preparation and implementation of Recovery Plans and Threat Abatement Plans
- Requirements or otherwise for the preparation of a SIS

One of the objectives of the Fisheries Management Act is to 'conserve key fish habitats ' which includes aquatic habitats that are important to the maintenance of fish populations generally and the survival and recovery of threatened aquatic species.

To assist in the protection of key fish habitats, the Minister for Primary Industries has gazetted *Fish Habitat Management Plan No 1* (DPI 1995). This plan applies to the following developments, works or activities, each of which can impact on fish habitat:

- Dredging or reclamation
- Impeding fish passage
- Damaging marine vegetation
- De-snagging

There is potential suitable habitat within the site for threatened biota listed under the FM Act, although as noted previously, no watercourses extend through the site.

3.2.3 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) provides the basis for the legal protection of native animals and plants in NSW. A wildlife licence is required under the NPW Act to harm or pick protected fauna and flora. All surveys were carried out under a Section 132C scientific licence (SL100146).

Broadwater and Bundjalung National Parks are situated within the locality of the site (refer Section 2.1.7).

3.2.4 Noxious Weeds Act 1993

The *Noxious Weeds Act 1993* (NW Act), provides for the declaration of noxious weeds by the Minister for Primary Industries. Noxious weeds may be considered noxious on a national, state, regional or local scale. All private landowners, occupiers, public authorities and Councils are required to control noxious weeds on their land under Part 3 Division 1 of the NW Act. As such, if present, noxious weeds on the site should be assessed and controlled.

No noxious weed species were recorded on the site.

3.3 State environmental planning policies

3.3.1 SEPP 44: Koala Habitat

State Environmental Planning Policy 44 (SEPP 44) aims to encourage the 'proper conservation and management of areas of natural vegetation that provide habitat for Koalas (*Phascolarctos cinereus*) to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline'.

Schedule 1 of SEPP No. 44 identifies Council areas where the SEPP applies.

SEPP No. 44 classifies areas of land as being 'Core Koala Habitat' or 'Potential Koala Habitat'. They are defined as follows:

- Core Koala Habitat is an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.
- Potential Koala Habitat are areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15 per cent of the total number of trees in the upper or lower strata of the tree component.

The subject site is considered to be Potential Koala Habitat under SEPP No. 44.

Richmond Valley Council

The Richmond Valley Council LGA (RVC) is listed on Schedule 1 of the SEPP 44. The potential for Koalas to occur in the subject site was assessed during field surveys and potential impacts on the Koala have been considered in this report. Evidence of koalas was observed within the property and potential koala habitat trees listed under Schedule 2 are present within the subject site (refer section 5.2). There are previous records of Koalas from within one kilometre of the site (OEH 2014).

The RVC has mapped remnant native vegetation as an overlay on the Terrestrial Biodiversity Map within the LEP 2012 and has also adopted the Richmond Valley Koala Habitat Atlas and Derivative Map (AKF 2008). This mapping indicates that the subject property contains both Habitat Class B Secondary and Habitat Class C Secondary (RVC 2009). The Habitat Atlas indicates (section 5.0 Discussion) that the main three tree species utilised by Koalas include *Eucalyptus tereticornis*, *E. robusta* and *E. microcorys*.

The category of 'Habitat Class B – Secondary' consists of forest or woodland where primary Koala food tree species comprise less than 30% of the overstorey trees, or areas of forest or woodland where primary Koala food tree species together with secondary food tree species comprise at least 30% of the overstorey trees, or areas of forest or woodland where secondary food tree species alone comprise at least 30% (but less than 50%) of the overstorey trees (primary Koala food tree species absent). These areas are deemed capable of supporting medium to low-density Koala populations. This category of Koala habitat makes up 9.2% of the total RVC area (AKF 2008).

'Habitat Class C – Secondary' is described 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 (AKF 2008).

The subject site is considered Potential Koala Habitat under SEPP No. 44. Under Clause 8 (1) of SEPP No. 44,

(1) Before a council may grant consent to an application for consent to carry out development on land to which this Part applies that it is satisfied is a potential koala habitat, it must satisfy itself whether or not the land is a core koala habitat.

(2) A council may satisfy itself as to whether or not land is a core koala habitat only on information obtained by it, or by the applicant, from a person with appropriate qualifications and experience in biological science and fauna survey and management.

(3) If the council is satisfied:

(a) that the land is not a core koala habitat, it is not prevented, because of this Policy, from granting consent to the development application, or

(b) that the land is a core koala habitat, it must comply with clause 9.

The survey did not find evidence of Koala utilisation of the trees within the area proposed to be cleared. It is considered that the proposed clearing does not constitute core koala habitat (refer also to section 3.3.1 – SEPP 44).

Richmond Valley Council LEP

The Richmond Valley Local Environmental Plan 2012 (LEP) indicates that parts of the subject site are identified for biodiversity in the Terrestrial Biodiversity Map – Sheet BIO_009. It appears that the area proposed for expansion of the quarry activities is not mapped for Biodiversity. The property is mapped under the LEP as wetland (Wetlands Map Riparian Land and Waterways Map – Sheet_CL1_009). However, the land is zoned as suitable for open-cut mining with consent from Council and as such the proposal is likely to be consistent with the LEP.

3.4 Commonwealth legislation

The purpose of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is to ensure that actions likely to cause a significant impact on 'matters of national environmental significance' (MNES) undergo an assessment and approval process. Under the EPBC Act, an action includes a proposal, undertaking or activity. An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Australian Government Minister for Sustainability, Environment, Water, Populations and Communities (the 'Minister').

The EPBC Act identifies MNES as:

- World heritage properties
- National heritage places
- Wetlands of international importance (Ramsar wetlands)
- Threatened species and ecological communities
- Migratory species
- Commonwealth marine areas
- Nuclear actions (including uranium mining)

- Great Barrier Reef marine park
- A water resource, in relation to coal seam gas development and large coal mining development

The EPBC Act has been addressed in the current assessment through:

- Desktop review to determine the threatened species or ecological communities that have been previously recorded within the locality of the site and hence could occur, subject to the habitats present.
- Targeted field surveys for species and ecological communities listed under the Act.

As outlined in section 6 it is unlikely that any MNES would be significantly impacted by the proposal, therefore a referral to the Minister would not be required.

4. Methodology

4.1 Desktop review

4.1.1 Threatened species, populations and endangered ecological communities

A desktop review was undertaken to identify threatened species, populations and ecological communities listed under the TSC Act and FM Act (i.e. threatened 'biota') and matters of national environmental significance listed under the EPBC Act that could potentially occur at the site.

The following documentation and databases were reviewed prior to the field investigations:

- NSW National Parks and Wildlife Service (2012) *Broadwater National Park Plan of Management*
- Peter Parker Environmental Consultants (2004) *North Sapphire Beach Flora and Fauna Survey*
- NSW Department of Primary Industries (2007) *Primefacts – Oxleyan pygmy perch* (*Nannoperca oxleyana*)
- NSW Office of Environment and Heritage (OEH) BioNet Atlas of NSW Wildlife database records for threatened species listed under the TSC Act
- Australian Government, Department of the Environment (DotE) Protected Matters Search Tool for Matters of National Environmental Significance (MNES) under the EPBC Act
- NSW Department of Primary Industries, Threatened and protected species – records viewer for the Richmond Valley Council LGA.

4.1.2 Groundwater dependent ecosystems

The NSW Groundwater Dependent Ecosystems Policy (Serov *et al.*, 2012) defines groundwater dependent ecosystems (GDEs) as 'ecosystems which have their species composition and natural ecological processes wholly or partially determined by groundwater'. GDEs are known to occur in almost every environment across the landscape including terrestrial dry land, freshwater, marine and subterranean environments (Serov *et al.*, 2012).

In order to identify and assess the presence of GDE within the subject site, a review was undertaken of the *The Risk Assessment Guidelines for Groundwater Dependent Ecosystems – The Conceptual Framework* (Serov *et al.*, 2012), which were developed by the NSW Office of Water (NoW) and the OEH to provide an approach to GDE identification, classification, ecological valuation, and ecological risk assessment for a given activity or potential impact on a groundwater source. The document also details a series of steps to identify and infer the level of groundwater dependency and provides a summary of risk assessment guidelines for GDEs. In addition, The Bureau of Meteorology in the Groundwater Dependant Ecosystem Atlas map of potential vegetation GDEs within the vicinity of the subject site was reviewed.

4.2 Site Survey

Field surveys were completed by two ecologists between 8 April and 10 April 2014. Two days and two nights of flora, fauna and habitat assessments were undertaken. The survey techniques were based on the following guidelines:

- Department of Environment and Climate Change (DECC) (2004) *Draft Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities – Working Draft*
- DECC (2007) *The Threatened Species Assessment Guideline – The Assessment of Significance*
- Department of Urban Affairs and Planning (1998) *Draft Guidelines for the Assessment of Aquatic Ecology in EIA*
- Draft EPBC Act referral guidelines for the vulnerable Koala (DotE 2013)

4.2.1 Flora Survey

A combination of quadrats and targeted searches for threatened species was used to survey the subject site and to verify vegetation communities, in particular endangered ecological communities. Detailed descriptions of survey techniques are outlined below.

Vegetation

Native vegetation types were identified based on dominant flora species present within each structural layer (i.e. canopy, shrub and ground layers) and named according to Plant Community Types as described in the NSW Vegetation Information System (VIS). Exotic or highly modified native vegetation was defined based on structure and species composition. Boundaries were recorded with a hand-held GPS.

Flora Surveys

A total of five 20 x 20 m flora quadrats were positioned randomly within vegetation types identified within the subject site. All vascular plants (i.e. not mosses, lichens or fungi) identified within quadrats were recorded on proforma field data sheets. Information regarding vegetation structure and disturbance history was also recorded.

Plant specimens that could not be identified rapidly in the field were collected and subsequently identified using the Flora of NSW (Harden 1992-2002). Plant specimens that were problematic to identify (either insufficient sample collected or no reproductive material available at the time of the survey) were identified to genus level.

The locations of flora quadrats were recorded using a Trimble hand-held geographical positioning system (GPS) and are shown in Figure 2.

Targeted threatened flora surveys

Random meander surveys according to the method of Cropper (1993) were undertaken throughout the subject site. These surveys involved targeted searches for threatened plants known to occur in the locality and noting any species not detected in other surveys.

Nomenclature

Plant nomenclature is in accordance with *The Flora of New South Wales* Volumes 1 to 4 (Harden, 1992 - 2002) and taxonomic updates in PlantNET - The Plant Information Network System of Botanic Gardens Trust, Sydney, Australia (Version 2.0, <http://plantnet.rbgsyd.nsw.gov.au>).

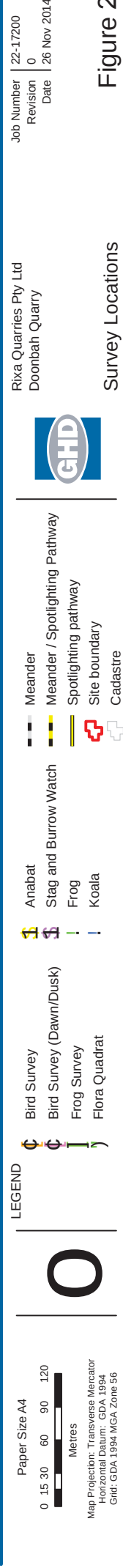


Figure 2

4.2.2 Fauna Survey

Habitat assessment

A habitat assessment was undertaken across the site as a guide to likely impacts and to help describe the suite of native fauna likely to occur in the study area. Particular attention was paid to habitat features and resources considered diagnostic of threatened species such as hollow-bearing trees, wetlands and specific feed trees.

Diurnal bird surveys

Diurnal bird surveys were performed at dawn and dusk as well as at other times of day, for at least 20 minutes per hectare of suitable habitat, consistent with the DECC (2004) survey guidelines.

Anabat monitoring

Fixed Anabat[®] detectors were deployed at dusk on two consecutive nights, recording from dusk until the following morning to target potential habitat for threatened species.

Nocturnal surveys

Nocturnal surveys included spotlighting walked transect surveys and driven tracks, stagwatching of suitable hollow-bearing trees, burrow watching, additional opportunistic spotlighting throughout the entire survey period.

Targeted searches for frogs were completed.

Herpetofauna surveys

Herpetofauna surveys included active searches for frogs and reptiles, call playback for frogs in wetland habitats, systematic nocturnal pond-side searches and systematic checking of woody debris where appropriate.

Koala surveys

Searches for evidence of the Koala, including SEPP 44 feed tree identification, locating scratches in bark and scat surveys were completed across the study area. A total of approximately 46 trees were surveyed.

Records

All details of survey conditions and species observations were recorded on proforma field datasheets. The locations of threatened species and important habitat resources (such as nest or roost trees) have been captured and mapped. Previous records and habitat assessments have been used to compile a full list of species potentially impacted by the proposal.

The location of fauna survey points and other key locations are shown in Figure 2.

4.3 Assessment of Likelihood of occurrence of threatened biota

Following collation of database records and species and community profiles a 'likelihood of occurrence' assessment was undertaken with reference to the broad habitats contained within the study area. This was further refined following field surveys. The likelihood of threatened and migratory biota occurring in the study area was assessed based on presence of records from the locality, species distribution and habitat preferences, and quality of potential habitat present in the study area. The results of this assessment are provided in Appendix A.

Table 3 provides a key to the likelihood of occurrence in the study area of threatened biota known or likely to occur in the locality.

Table 3 Key to the likelihood of occurrence for threatened species assessment

Likelihood	Definition
Known	Species or community known to occur within the site (i.e. recorded during field survey)
High	Presence of potential high value habitat (e.g. breeding and foraging habitat; important movement corridors)
Moderate	Presence of potential medium value habitat (e.g. disturbed breeding conditions; constrained foraging habitat; movement corridors)
Low	Presence of potential low value habitat (e.g. disturbed conditions; isolated small habitat area; fragmented movement corridors)
Unlikely	No preferred habitat or corridors present

4.4 Assessment of Endangered Ecological Communities

Vegetation types within the study area were assessed against identification criteria for state and Commonwealth listed threatened ecological communities (critically endangered ecological communities, threatened ecological communities and endangered ecological communities). Vegetation and habitats were compared with descriptions provided in OEH (2014) and DotE (2014) profiles.

5. Results

5.1 Database Searches

5.1.1 Atlas of NSW Wildlife database

A search of the BioNet Atlas of NSW Wildlife database found 995 species of flora and fauna have been previously recorded within a 10 km radius of the centre of the quarry site. This list included 38 threatened fauna species and 10 threatened flora species that are listed under the NSW TSC Act. These species are listed in the likelihood of occurrence table in Appendix A where an assessment of the likelihood of each species to occur at the site is provided.

5.1.2 EPBC Act Protected Matters Report

Based on the results of the EPBC Protected Matters Search Tool (PMST) one community listed as threatened under the EPBC Act is predicted to occur within the locality: This community is known as Lowland Rainforest of Subtropical Australia and is listed as critically endangered under the EPBC Act (DotE 2014).

The PMST report indicated that 64 threatened species listed under the EPBC Act are known or are predicted to occur within the locality. This includes 17 flora species, one reptile, three frogs, one fish, five birds and six mammals as well as 15 listed migratory birds. The remaining 10 species were identified as marine species for which no suitable habitat is present within the site.

Other matters protected under the EPBC Act included 73 listed marine species, 13 whales and other cetaceans and two Commonwealth Lands identified as Defence Housing Authority and Telstra Corporation Limited sites within the search area (refer Appendix B).

A summary of the Matters of National Environmental Significance (MNES) relating to a search within a 10 km radius around the site, is provided in Table 4.

Table 4 Summary of MNES for the Doonbah quarry site

Matter of National Environmental Significance	May occur or relate to the site
World Heritage Properties	None
National Heritage Places	None
Wetlands of International Importance	None
Great Barrier Reef Marine Park	None
Commonwealth Marine Areas	None
Listed Threatened Ecological Communities	1
Listed Threatened Species	64
Listed Migratory Species	46

5.1.3 Threatened and protected species – records viewer

A search of the DPI records viewer for the Richmond Valley LGA returned one species (Oxleyan pygmy perch), which has been recorded within approximately 200 m of the site to the north, east and south. This species is listed as endangered under the *Fisheries Management Act*

1994. There are approximately 30 other records of this species within approximately 3 km of the subject site, mostly within National Park estate.

5.2 Field Surveys

5.2.1 Weather conditions during survey

Data from the nearest weather station, the Evans Head RAAF Bombing Range AWS (Station 058212) daily weather observations indicated that during the week prior to field survey 59.8 mm of rain was recorded. During the survey 2.2 mm of rain in total was recorded.

The temperature range during the survey was from minimum 16.3 C on 8 April to maximum of 25.3 C on Thursday 10 April 2014. Winds were recorded from the south, south east and south south east, between 20 and 52 km/h. Relative humidity ranged between 64 and 97 percent.

5.2.2 Flora Species

A total of 135 species of flora were recorded within the study area, comprising 103 native and 32 exotic species. The Poaceae (grasses, 19 species: 11 native; eight exotic), Myrtaceae (16 species: 15 native, one exotic) and Cyperaceae (sedges, 13 species: 12 native; one exotic) were the most diverse families recorded.

No threatened plant species were recorded.

The full list of plant species recorded is presented in Appendix C. Species recorded are discussed below in relation to the vegetation communities occurring within the proposal site.

5.2.3 Noxious and environmental weeds

The *Noxious Weeds Act 1993* provides for the declaration of noxious weeds in local government areas. Landowners and occupiers must control noxious weeds according to the control category specified in the Act. Public authorities must control noxious weeds according to the control category to the extent necessary to prevent their spread to adjoining land.

No weed species that are declared noxious in the Richmond Valley LGA were recorded within the subject site.

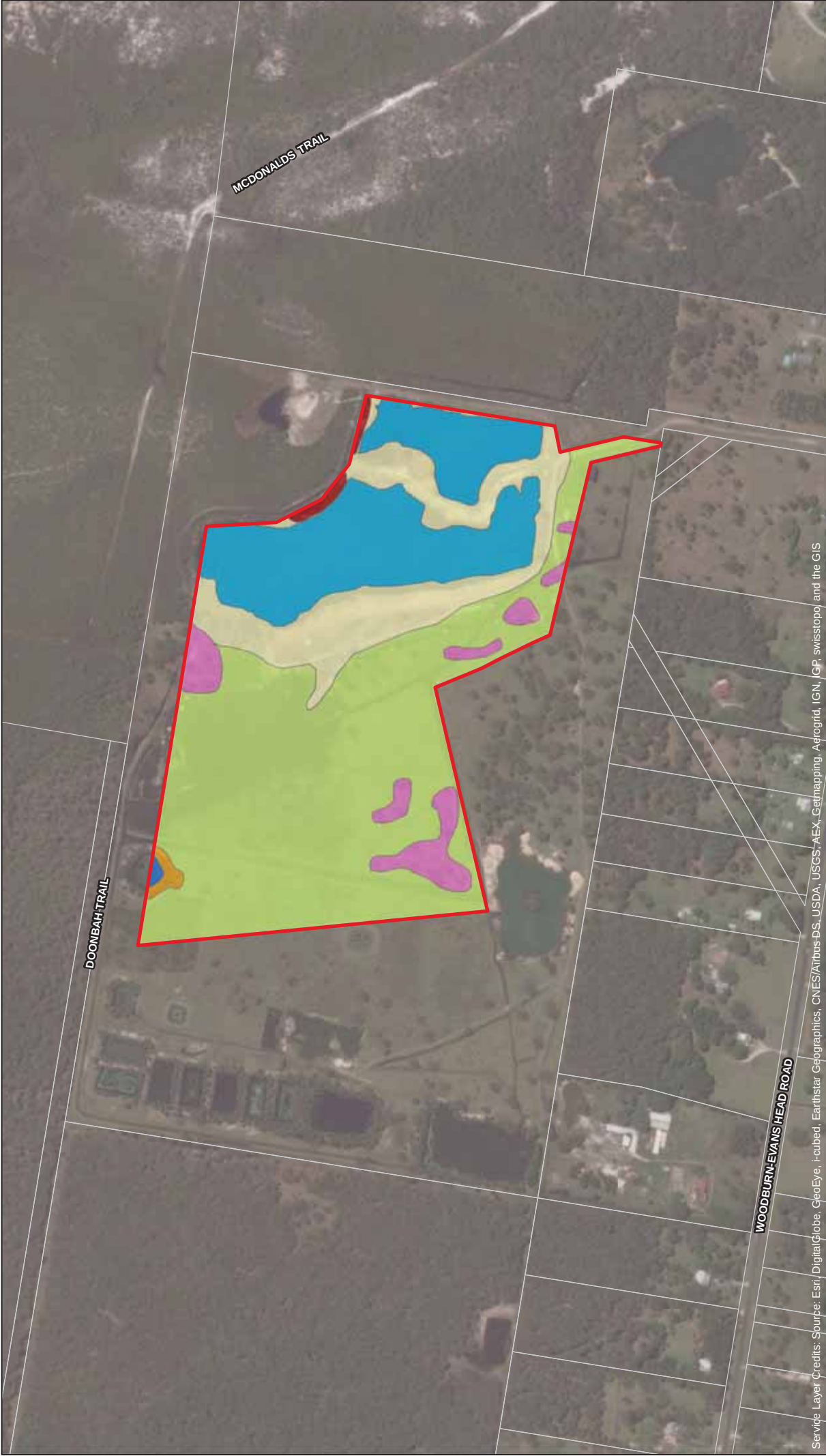
Environmental weeds that occur within the site include *Cirsium vulgare* (Spear thistle), *Senecio madagascariensis* (Fireweed), *Verbena bonariensis* (Purpletop) and *Bidens pilosa* (Cobblers Pegs). These weeds are predominantly confined to areas within the site that have been disturbed as part of the existing quarry operations.

5.2.4 Vegetation communities

Based on the fine-scale vegetation mapping and flora sampling, five vegetation types were recorded within the study area, of which three are native and two are exotic. These were:

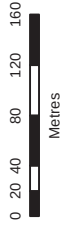
- Coastal heath on sands of the North Coast
- Modified Pink Bloodwood – Red Mahogany Open Forest
- Paperbark Swamp Forest on coastal lowlands
- Exotic grassland
- Disturbed land / Existing quarry

Vegetation communities are shown on Figure 3 and described in detail below.



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS

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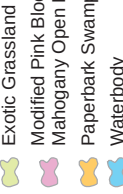
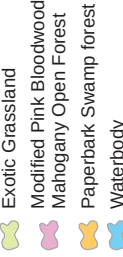
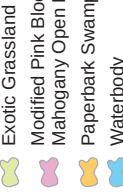
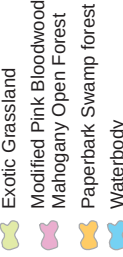
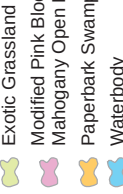
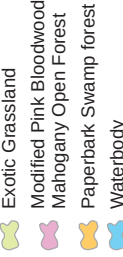
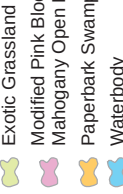
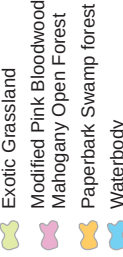
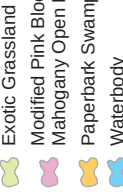
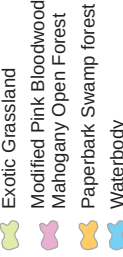
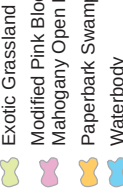
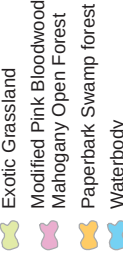
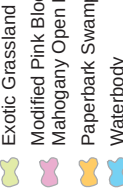
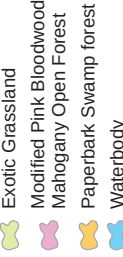
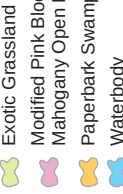
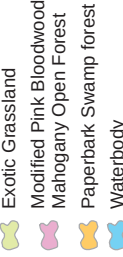
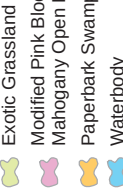
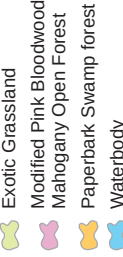
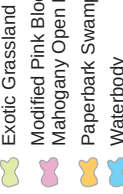
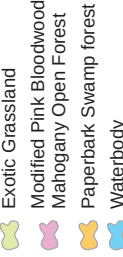
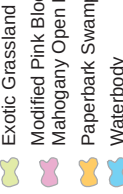
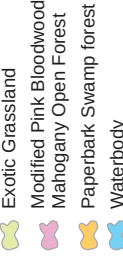
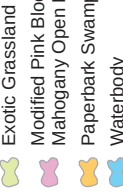
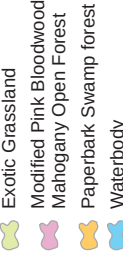
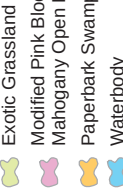
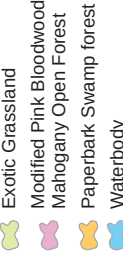
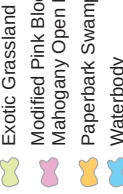
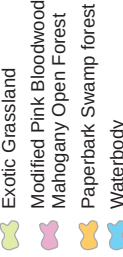
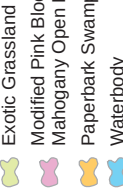
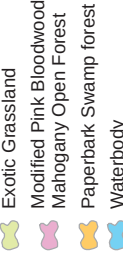
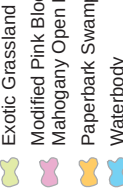
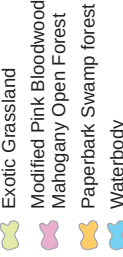
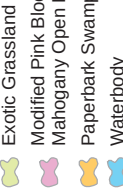
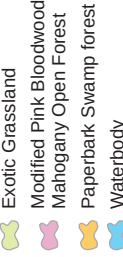
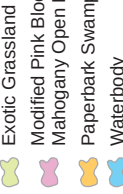
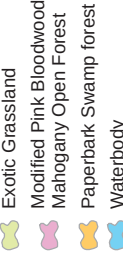
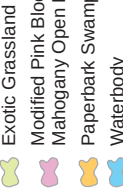
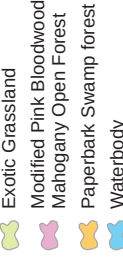
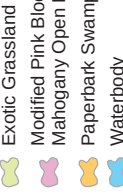
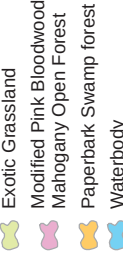
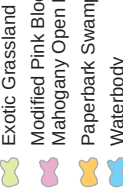
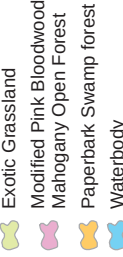
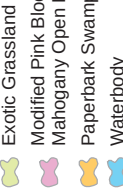
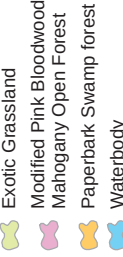
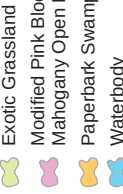
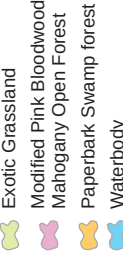
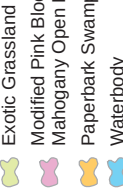
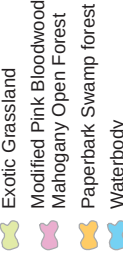
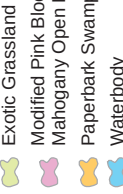
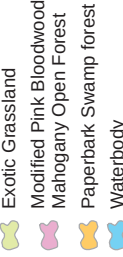
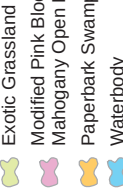
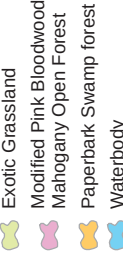
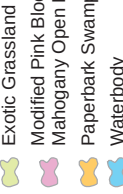
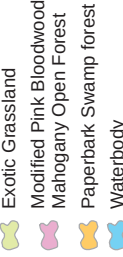
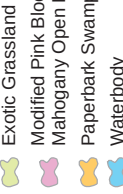
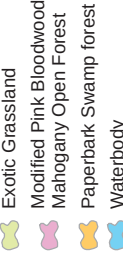
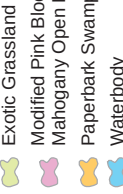
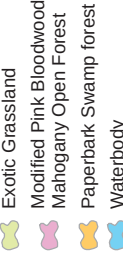
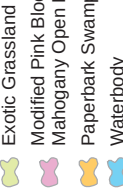
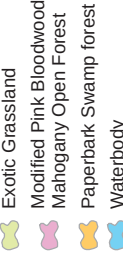
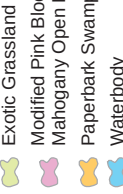
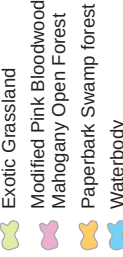
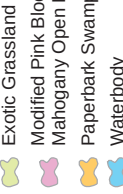
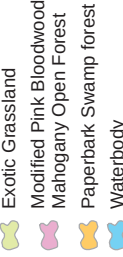
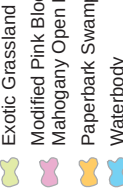
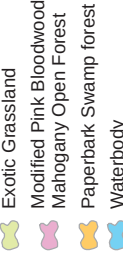
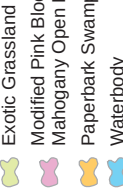
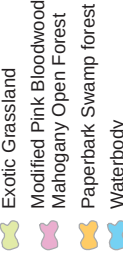
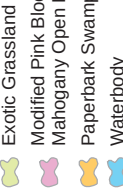
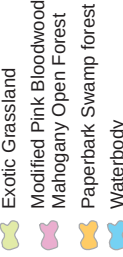
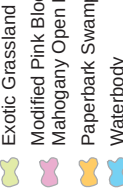
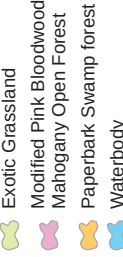
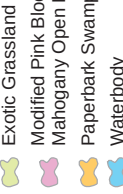
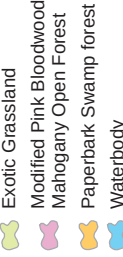
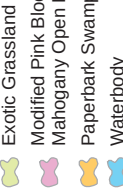
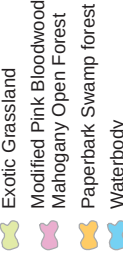
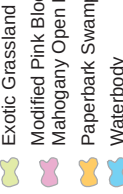
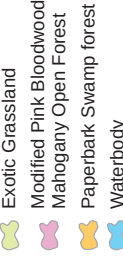
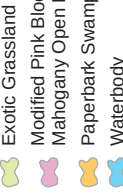
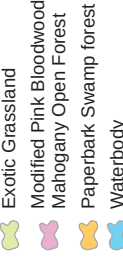
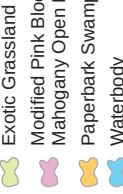
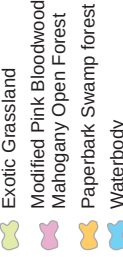
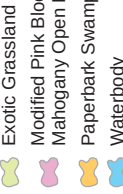
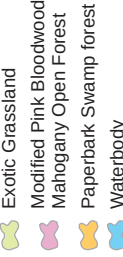
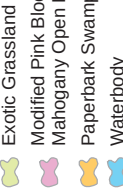
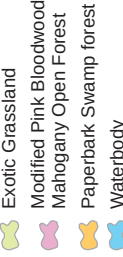
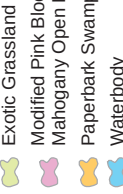
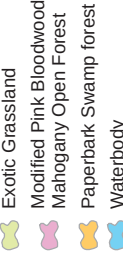
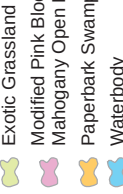
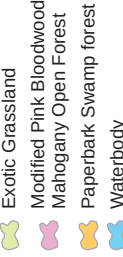
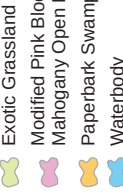
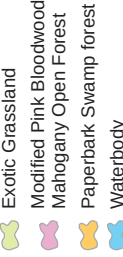
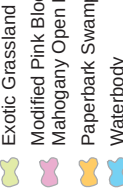
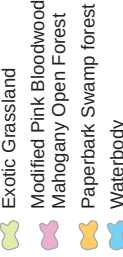
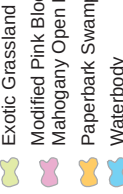
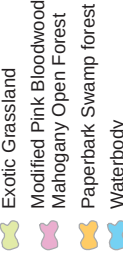
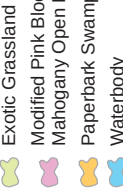
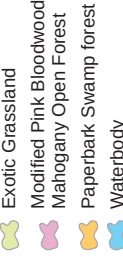
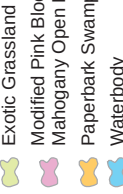
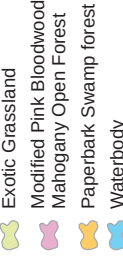
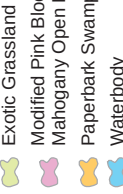
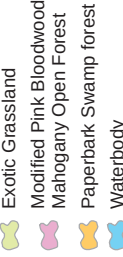
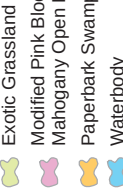
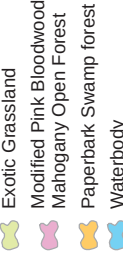
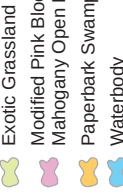
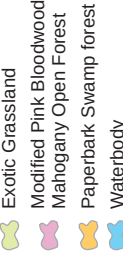
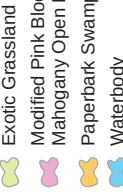
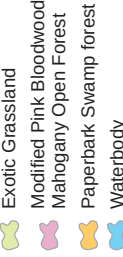
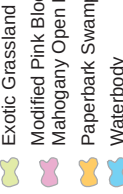
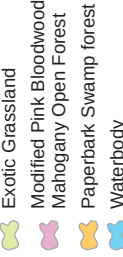
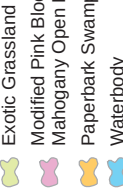
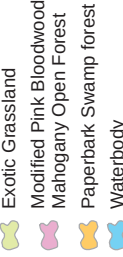
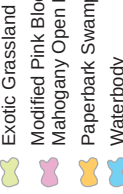
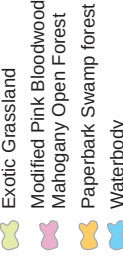
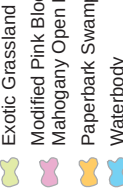
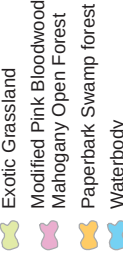
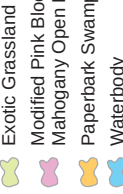
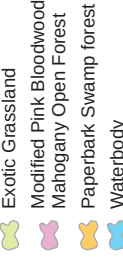
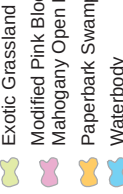
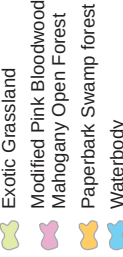
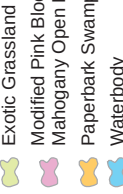
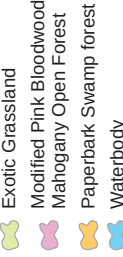
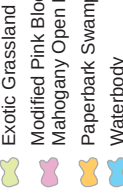
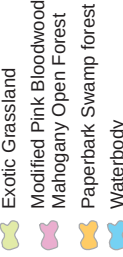
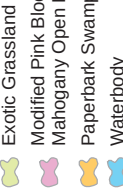
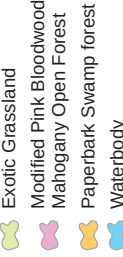
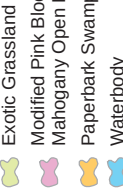
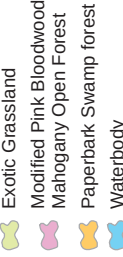
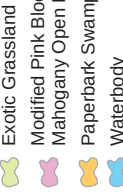
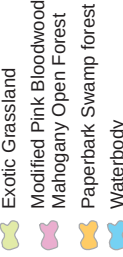
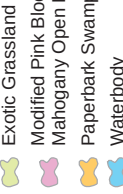
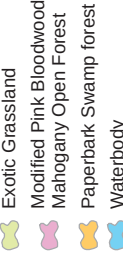
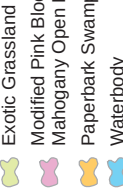
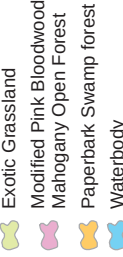
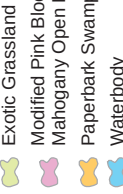
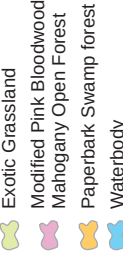
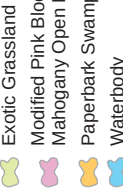
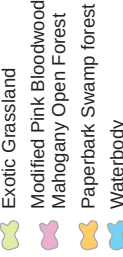
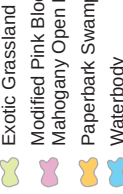
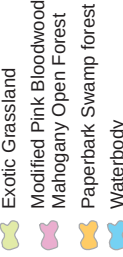
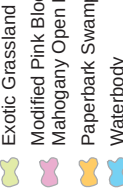
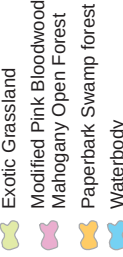
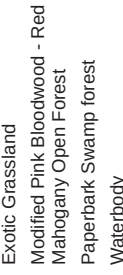
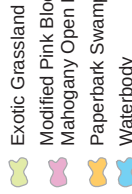
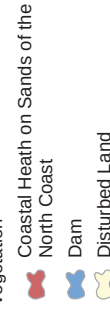


Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

LEGEND



Vegetation



Modified Pink Bloodwood – Red Mahogany Open Forest

This vegetation type occurs on alluvial floodplain soils in a number of patches in the south western, south and northern portions of the study area. It is a highly modified community that has had its understorey and midstorey largely cleared and persists only as isolated scattered trees over a predominantly grassy understorey (refer Plate 1).

Trees present in the canopy layer include *Corymbia intermedia* (Pink Bloodwood), *Eucalyptus resinifera* (Red Mahogany) and *Eucalyptus tereticornis* (Forest Red Gum). These trees are growing to approximately 20 m and displayed signs of stress in the form of canopy dieback. It is possible that this dieback is being caused by grazing cattle and/or altered hydrological regimes.

The tall shrub *Acacia aulacocarpa* (Salwood) is also present in low abundance. This species typically grows in close association with taller Eucalypt species. The ground layer of this community is dominated by the exotic grass *Axonopus fissifolius* (Broad Leaved Carpet Grass). A moderate diversity of native grasses, sedges and herbs are also present within the understorey although they occur in relatively low abundance. These include *Imperata cylindrica* (Blady Grass), *Gahnia aspera* (Rough Saw Sedge), *Cynodon dactylon* (Couch), *Themeda australis* (Kangaroo Grass), *Goodenia pinnatifida* (Scrambles Eggs), *Centella asiatica* (Indian Pennywort), *Cyperus polystachyon*, *Juncus usitatus*, *Lomandra longifolia* (Spiny Headed Mat-rush), *Spiranthes australis* (Ladies' Tresses) and *Glycine clandestinum* (Twining Glycine).

A number of dead or dying *Melaleuca quinquenervia* (Broad Leaved-paperbark) are present within this community, along with regenerating plants. The cause of this was not known.

This vegetation community is commensurate with a modified form of the EEC Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.



Plate 1 **Modified Pink Bloodwood – Red Mahogany Open Forest in the north of the study area**

Paperbark Swamp Forest on coastal lowlands

This vegetation type is confined to a narrow band surrounding the edges of a small dam located in the north-west of the subject site (refer to Plate 2). It is dominated by *Melaleuca quinquenervia* (Broad Leaved Paperbark) with occasional *Eucalyptus robusta* (Swamp Mahogany). The understorey of this community is significantly disturbed and is dominated by the exotic grasses *Axonopus filifolius* (Broad Leaved Carpet Grass) and *Paspalum dilatatum* (Paspalum). Other species present include *Cyperus polystachyon*, *Baumea juncea* and *Philydrum lanuginosum* (Frogmouth).

This vegetation community is commensurate with the EEC Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.



Plate 2 Paperbark Swamp Forest on coastal lowlands

Coastal heath on sands of the North Coast

Coastal heath on sands occurs as a narrow band of vegetation along the north eastern edge of the study area. This vegetation would have been previously cleared during quarrying activities but has subsequently regenerated. It consists of a diverse mixture of shrubs and small trees over a sedge dominated understorey (refer to Plate 3). Common species include *Leptospermum polygalifolium* (Tantoon), *Eucalyptus bancroftii* (Orange Gum), *Melaleuca quinquenervia* (Broad leaved Paperbark), *Melaleuca squamea* (Swamp Honey-myrtle), *Banksia aemula* (Wallum Banksia), *Banksia ericifolia* (Heath-leaved Banksia), *Banksia oblongata* (Fern-leaved Banksia), *Callistemon salignus* (Willow Bottlebrush), *Leptospermum trinervium* (Slender Tea-tree), *Leptocarpus tenax*, *Baloskion tetraphyllum*, *Eurychorda complanata*, *Xanthorrhoea fulva*, *Monotoca elliptica* (Tree Broom Heath) and *Epacris pulchella* (Wallum Heath).



Plate 3 Regenerating Coastal Heath in the north east of the subject site

Exotic grassland

This is the dominant vegetation community within the subject site. It is comprised predominantly of the exotic grasses *Axonopus fissifolius* (Narrow-leaved Carpet Grass), *Paspalum dilatatum* (Paspalum) and *Andropogon virginicus* (Whisky Grass) with *Hypochaeris radicata* and *Silene gallica* also common (refer to Plate 4). Native grasses present within this community in lower abundance include *Cynodon dactylon* (Couch) and *Imperata cylindrica* (Blady Grass). Regenerating *Melaleuca quinquenervia* (Broad Leaved Paperbark) in the form of seedlings were observed on lower lying areas.



Plate 4 Exotic grassland

Disturbed land / existing quarry

Areas of disturbed land were present surrounding the existing quarry pits and settling ponds. These areas contained soil stockpiles, access tracks and other site infrastructure. Disturbed areas were typically devoid of vegetation, and comprised bare ground with occasional *Juncus* spp. and other sedges.



Plate 5 Disturbed land surrounding the existing quarry site

5.2.5 Fauna Species

A total of 34 bird species, three frog species (including one introduced) and eight mammal species (including three introduced species) were recorded (refer fauna species list in Appendix D).

Evidence of the presence of Koala in the form of tree trunk scratches and a scat were observed in open forest in the southern part of the subject site.

An analysis of the recordings from the Anabat® monitor indicates the species shown in Table 5 were definitely present at the time of survey, one of which (Little Bent-wing bat, *Miniopterus australis*) is listed as vulnerable under the TSC Act. The Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*) and Hoary wattled bat (*Chalinolobus nigrogriseus*) listed as vulnerable under the TSC Act, were identified as probably present through Anabat recordings.

Table 5 Results of Anabat analysis for Doonbah Quarry

Date	Scientific Name	Common Name
Definite		
8/04/2014	<i>Miniopterus australis</i> (v*)	Little Bent-wing bat
8/04/2014	<i>Tadarida australis</i>	White-striped free-tailed bat
8/04/2014	<i>Vespadelus darlingtoni</i>	Large forest bat
8/04/2014	<i>Vespadelus pumilus</i>	Eastern forest bat
Probable		
8/04/2014	<i>Miniopterus schreibersii oceanensis</i> (v)	Eastern Bent-wing Bat
8/04/2014	<i>Chalinolobus gouldii</i>	Gould's wattled bat
8/04/2014	<i>Chalinolobus nigrogriseus</i> (v)	Hoary wattled bat
8/04/2014	<i>Vespadelus regulus</i>	Southern forest bat

*indicates a species listed as vulnerable under State legislation.

Introduced species

There was evidence of *Bufo marinus* (Cane Toad) inhabitation across the study area with carcasses observed around the lakes and large live Cane Toads were observed inhabiting burrows to the north west of the study area. Tracks of Dogs were noted and burrows were present that appeared to have been excavated by Rabbits. Cattle occurred across the study

area as a herd managed by the property owner. Honey bees were also housed in hives at one location near the southern dam. A further bee hive was noted in a large tree hollow outside the proposed expansion area.

5.2.6 Habitat Types

Four habitat types were recorded within the site during the field survey. These were:

- Low heath shrubland on sand
- Modified open forest with tall *Eucalypts* including hollow-bearing trees
- Waterbodies
- Disturbed land

The extent of these habitat types are generally consistent with mapped vegetation types. Habitat types mapped within the study area are described below.

Low heath shrubland on sand

This habitat type is located to the north and east of the subject site and adjoined the more extensive areas of this habitat type in the adjacent Broadwater National Park. It is comprised of regenerating *Banksia* and other coastal heath species on sand and consists of a dense shrub thicket 2 to 4 m in height with some emergent trees scattered throughout (see Plate 6). The large freshwater lakes adjacent to this habitat, increased the available habitat diversity. Along the northern boundary of the study area, there are patches of dense shrubland which were transitional with the woodland species. Most of this habitat is outside the proposed expansion footprint.

Species observed in this habitat type included the *Phylidonyris novaehollandiae* (New Holland Honeyeater), *Acanthorhynchus tenuirostris* (Eastern Spinebill) and *Zosterops lateralis* (Silvereye).



Plate 6 Low *Banksia* shrubland on sand – habitat

Modified open forest with tall eucalypts

This habitat type extended along the southern boundary of the site, adjoining retained vegetation on adjacent rural residential properties. It occurred in reasonably small isolated patches within the study area. The habitat has been modified by partial clearing, alteration of the hydrological regime and ongoing cattle grazing (refer Plate 7). Within the designated offset area (refer Figure 1) this habitat type is less disturbed, with evidence of recruitment of the canopy species throughout. Naturally regenerating seedlings within this habitat type as a whole, showed evidence of herbicide application which is consistent with the current pasture management practices. This habitat types contains trees with hollows of various sizes which could provide suitable roosts for arboreal mammals and birds.

A mob of *Macropus giganteus* (Eastern Grey Kangaroo) with approximately 30 individuals was observed grazing within this habitat to the west of the study area and into the adjacent grazing lands within the bounds of the subject site. Open woodland bird species including *Cracticus tibicen* (Australian Magpie), *Eolophus roseicapilla* (Galah) and *Climacteris picumnus* (Brown Treecreeper) were observed across this habitat type. Groups of *Calyptorhynchus funereus* (Yellow-tailed Black-cockatoo) were observed in pine trees on a neighbouring property to the south.

A single *Wallabia bicolor* (Swamp Wallaby) was observed towards the northern boundary of the study area and was seen to return into the adjacent forested area in the National Park. No *Phascolarctos cinereus* (Koala) were observed within the study area, however evidence of the species in the form of a scat and scratch marks on a *Eucalyptus tereticornis* (Forest Red Gum) were recorded from the designated offset area to the south of the study area, and it is considered highly likely that Koala would occupy the scattered eucalypts across the grassy woodland area (DECC 2007).



Plate 7 Modified open forest with tall Eucalypts

Waterbodies

Two large open waterbodies that are the full quarry pits were located in the east of the study area (see Plate 8). These have an area of approximately 5 ha in size together. A narrow sandy spit separates the two lakes and water quality testing undertaken to support the EIS indicates

that there is some difference in pH (large lake 4.14 and small lake 5.06 pH units) (GHD 2014). The rainfall event (58 mm on 7 April 2014) immediately prior to commencement of field surveys raised the level of the lakes (Pers. Comm. Quarry Manager). There was evidence of submerged grasses within 50 cm of the waterline in both lakes. The high acidity is likely to restrict the species that could occur within the lakes. Although some macroinvertebrates were noted (for example, family *Notonectidae*, Backswimmers), and some bubbles were observed rising from the bed of the lakes, no tadpoles were observed.

Hirundo donax (Welcome Swallow) were observed hawking above the waters of the lakes and *Chenonetta jubata* (Australian Wood Duck) and *Phalacrocorax sulcirostris* (Little Black Cormorant) were observed on the surface of the water. Individuals of these species were in low abundance within the study area.

There are no fish present in the lakes (pers. comm. 2014) and the sides are mostly steep, not providing suitable mudflats or sandflats for forage for waterbirds in general.



Plate 8 Open waterbodies

On the boundary of the study area to the north east, adjacent to the access track (refer Figure 2), a large hole (approximately 3 m in diameter) was observed with still, tannin-stained water and a dense vegetation cover extending around the perimeter (see Plate 9). Given that *Nannoperca oxleyana* (Oxleyan Pygmy Perch) has been recorded within the areas immediately adjacent to the study area (north and east), it is considered highly likely that this species could occur in this or any similar waterbody within the property.



Plate 9 Protected waterbodies

Disturbed land

Much of the study area is highly disturbed as a result of ongoing quarrying activities (see Plate 10). The disturbances include construction of access tracks and roads, excavation of pits where sand is removed, importation of other soils and materials such as extracted trees into the study area, and the regular movement of machinery and equipment. There are several parts of the current quarry where soil has been disturbed and sand stockpiled. Following the heavy rainfall prior to the field survey, the depressions left from soil movement were holding water and provided non-permanent pools where frogs were heard on the first night of survey.



Plate 10 Disturbed land

5.3 Groundwater dependent ecosystems

The potential vegetation GDEs within the vicinity of the subject site have been mapped by Bureau of Meteorology in the Groundwater Dependant Ecosystem Atlas. They include ecosystems that rely on the surface presence of groundwater and ecosystems that rely on the subsurface presence of groundwater. GDEs known to occur within the locality include:

- *Melaleuca quinquenervia*, *Eucalyptus tereticornis*, *Lophostemon suaveolens* woodland on coastal alluvial plains
- Closed heath on seasonally waterlogged sand plains
- *Eucalyptus tereticornis* woodland to open forest on alluvial plains
- *Corymbia citriodora*, *Eucalyptus crebra* open forest on sedimentary rocks
- Open Coastal Brushbox Forest
- Paperbark Forest.

The NSW Office of Water has produced a report that identifies high probability GDEs on the coastal plains of NSW (DPI 2012). This report indicates that, Paperpark, Bloodwood-Mahogany and Heath/Banksia vegetation types growing on Richmond Coastal Sands are likely to have a high degree of groundwater dependence (DPI 2012).

Given the relatively shallow groundwater levels recorded at the site, it is likely that all native vegetation communities occurring at the subject site would have some groundwater

dependence during periods of low rainfall and associated low surface water. Using the definitions in the NSW Groundwater Dependent Ecosystems Policy (Serov *et al.*, 2012), vegetation communities at the subject site can be defined as partially dependant, facultative GDEs and classified as terrestrial ecosystem partially dependant on groundwater.

5.4 Likelihood of occurrence of threatened biota

5.4.1 Threatened Ecological Communities

One threatened vegetation community was recorded during field surveys within the study area; the EEC Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.

A description of this EEC is provided below and the full list of EECs known from the region, including their habitat requirements and conservation status, is presented in Appendix A.

5.4.2 Threatened flora

The desktop literature review indicated that 11 threatened plant species listed under the TSC Act and 17 threatened flora species listed under the EPBC Act have been previously recorded, or are predicted to occur in the locality. The full list of plant species of conservation significance predicted to occur or previously recorded in the locality, including their habitat requirements and conservation status is presented in Appendix B.

The majority of the threatened flora species known or predicted to occur in the locality are considered unlikely to occur on the site as they have limited ranges and/or habitat requirements, which are not present at the site or surrounding proposal site. Based on known habitat associations and the nature and condition of habitat available, there suitable habitat within the study area for one threatened flora species, *Rutidosia heterogama* (Heath Wrinklewort). This species is listed as vulnerable under the TSC and or EPBC Act.

5.4.3 Threatened fauna

The literature review and database searches provided a predictive list of fauna species for the locality (including 10 km around the centre of the study area). The list of species from both the TSC and EPBC Acts was revised to comprise 61 species that would be likely to occur or whose habitat would be likely to occur within the study area.

Many of the listed species may utilise the subject site as part of a larger range or to access seasonally available food sources, or as part of a route to another destination.

The predictive list of 61 threatened species generated from the database searches and literature review indicated that 25 birds, 16 mammals, three amphibians, one fish and one reptile species were likely to be present, or appropriate habitat was likely to be present on the site. A further eight listed migratory, five migratory wetland and two marine species were also listed. The details for these species are provided in the table in Appendix A.

A 'likelihood of occurrence' assessment was prepared with reference to the predicted species and the broad habitats contained within the study area. The likelihood of threatened and migratory biota occurring in the study area was assessed based on presence of records from the locality, species distribution and habitat preferences, and quality of potential habitat present in the study area. The results of this assessment are provided in Appendix A.

Of the species predicted to occur on site, two species (*Phascolarctos cinereus* (Koala), and *Phascogale tapoatafa* (Brush-tailed Phascogale)), listed as vulnerable under both State and Commonwealth legislation, are known to occur within the proposed development area. A further six species have a high likelihood of occurrence while a further 22 species are moderately likely

to occur on site. The remaining 31 species are considered to have a low likelihood of occurrence on site because of the type and condition of the available habitat.

The 12 species known to occur and/or considered to have a high likelihood of occurrence or whose habitat is considered to be likely to occur on site, are listed in Table 6.

Table 6 Threatened species known to or likely to occur on site

Scientific Name	Common Name	TSC Act Status	EPBC Act Status
Amphibians			
<i>Crinia tinnula</i>	Wallum Froglet	Vu	
Birds			
<i>Erythroriorchis radiatus</i>	Red Goshawk	CE	Vu
<i>Neophema pulchella</i>	Turquoise parrot	Vu	
Mammals			
<i>Miniopterus australis</i>	Little Bentwing-bat	Vu	
<i>Miniopterus schreibersii oceanensis</i> (probable*)	Eastern Bent-wing Bat	Vu	
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	Vu	
<i>Phascolarctos cinereus</i>	Koala (combined populations of Qld, NSW & the ACT)	Vu	Vu
<i>Petaurus poliocephalus</i>	Grey-headed Flying-fox	Vu	Vu
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	Vu	
<i>Chalinolobus nigrogriseus</i> (probable)	Hoary wattled bat	Vu	
<i>Syconycteris australis</i>	Common Blossom-bat	Vu	
Fish		FM Act Status	
<i>Nannoperca oxleyana</i>	Oxleyan Pygmy Perch	En	En

*Refer to section 5.2.5 of this report for definition

Amphibians

Crinia tinnula (Wallum Froglet) are usually associated with acidic swamps on coastal sand plains (OEH 2014), however can occur in drainage lines and with other vegetation communities. It is considered likely that this species would occur on site in various locations associated with drains and acidic ponds.

Birds

The *Erythroriorchis radiatus* (Red Goshawk) prefer mixed vegetation types including *Melaleuca* swamp forest and riparian *Eucalyptus* forest of coastal rivers (OEH 2014). Given the population of water birds associated with the open lakes and adjacent forests, it is considered likely that this species would occur on site or forage over the site at least on occasion.

Neophema pulchella (Turquoise parrot) occur on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland (OEH 2014). There is potential foraging and roosting habitat for this species in woodland areas within and surrounding the site.

Mammals

The *Phascogale tapoatafa* (Brush-tailed Phascogale) has previously been recorded on site (refer Figure 2) (OEH 2014) in association with the dam on the southern-central boundary of the property. It is considered highly likely that this species would occur.

Phascolarctos cinereus (Koala) has a large home range and is known to utilise a variety of vegetation types, including *Eucalypt* species, as both food and habitat trees. An open understorey is also required to permit access from tree to tree for Koala. Indications of Koala were observed in the southern open woodland part of the property (scratches and scat) and a Koala has previously been recorded (OEH 2014) within 200 m of the south eastern boundary of the site (refer Figure 2).

Under SEPP 44 – Koala Habitat Protection – Schedule 2, *Eucalyptus tereticornis* is listed as a food tree species. *E. tereticornis* is listed as a primary food tree species and *E. resinifera* is a listed secondary food tree under the North Coast Koala Management Area (DECC 2007). These two species were dominant within the open forest observed within the site.

Bats

The three bat species (*Pteropus poliocephalus* (Grey-headed Flying-fox); *Saccolaimus flaviventris* (Yellow-bellied Sheath-tail-bat); *Scoteanax rueppellii* (Common Blossom-bat)) are all considered to have a high likelihood of occurrence on the site. Each of these species is known to utilise a range of vegetation communities and occurs within coastal areas (OEH 2014).

No camp site for Grey-headed Flying-fox was observed, and the National Flying-fox Monitoring Viewer (DotE 2014) indicates that the closest camp site is approximately 3 km to the south west of the site on the southern side of the Evans River.

The Little Bentwing-bat (*Miniopterus australis*) which is listed as vulnerable under the TSC Act was definitely recorded on site using the Anabat monitor. Two other species were probably recorded (sounds were not definitive on the recording). These were the Hoary Wattled-bat (*Chalinolobus nigrogriseus*) and the Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*).

Fish

The *Nannoperca oxleyana* (Oxleyan Pygmy Perch) is known to occur in Banksia-dominated coastal heath swamps, lakes and creeks, usually with acidic and tannin stained water (DPI 2014). With a preference for slow-moving or still waters with dense aquatic vegetation this species is considered most likely to occur to the north east of the site within the *Banksia* vegetation community. It is not considered likely to occur within the large lakes because of the lack of dense aquatic vegetation that is a necessary component of its habitat.

5.4.4 Endangered populations

No endangered populations were recorded or are considered highly likely to occur within the study area.

5.4.5 Migratory fauna

No migratory fauna species were recorded or are considered highly likely to occur within the study area.

5.4.6 SEPP 44 Koala habitat assessment

The site contains one Koala feed tree species listed on Schedule 2 of SEPP 44, namely *Eucalyptus tereticornis* (Forest Red Gum). *E. tereticornis* comprises approximately 25% of the

total number of trees in the upper or lower strata of the tree component within the open grassy woodland areas. Based upon the SEPP 44 definition, the site therefore contains 'potential koala habitat'.

Targeted surveys for Koalas and searches for signs of recent Koala activity were conducted, and evidence of the species was detected within the subject site, but outside of the study area. In addition, there is an OEH (2014) record of Koala within the immediate vicinity of the site (within 200 m to the south east of the property).

There is no evidence that the study area supports a local population of the Koala, including breeding females. Therefore, based upon the SEPP 44 definition, the site does not constitute 'core Koala habitat'.

The subject site is considered highly likely to provide suitable habitat for the Koala and so potential impacts on the species with respect to the requirements of the EP&A Act have been assessed in this report (Section 7).

5.5 Conservation significance summary

Figure 4 shows the key ecological aspects of the site including the distribution of EECs in the study area. A summary of conservation significance is provided in Table 7.

Table 7 Study area conservation significance

Attribute	Survey Finding
Threatened Flora Species	- No threatened flora species were recorded within study area - There is potential habitat for one threatened flora species (Heath Wrinklewort)
Threatened Fauna Species	- Signs of one vulnerable fauna species (Koala) were observed in the southern open woodland part of the property (scratches and scat) - Although the vegetation in the study area has been highly modified disturbed due to historical clearing and subsequent weed infestation, it contains potential habitat for a number of threatened fauna species (refer Table 6) - Areas of modified Pink Bloodwood Open Forest are likely to provide koala habitat. Areas where this habitat occurs in the study area as well as the adjoining proposed offset area - A large number of hollow-bearing trees were recorded within or in close proximity to the study area
Migratory Species	No migratory fauna species were recorded or are considered likely to occur within the study area
Endangered Populations	No endangered populations were recorded or are considered likely to occur within the study area
Endangered Ecological Communities	One EEC (swamp sclerophyll forest on coastal floodplains) was recorded within the study area
Ground Water Dependent	The subject site contains partially dependant,

Attribute	Survey Finding
Ecosystems	facultative GDEs

6. Potential Ecological Impacts

6.1 Overview

This Section provides an assessment of the potential ecological impacts of the proposal, including a quantitative assessment of direct impacts of construction based on concept designs for the proposed expansion. Secondary or indirect impacts on native biota within the broader site and potential offsite impacts are also considered, including an assessment and discussion in relation to potential indirect impacts upon Broadwater and Bundjalung National Parks.

The assessment of potential ecological impacts arising from the proposal is based upon consideration of the footprint of the proposed expansion and proposed activities associated with operation of the sand quarry in relation to the findings of this study in relation to conservation significant species, populations and ecological communities.

The concept plan for the proposal is shown on Figure 3.

As indicated in the project description specified in the EIS, the proposed expansion will involve:

- Pre-strip activities (i.e. clearing) and topsoil stockpiling activities
- Sand extraction
- Screening
- Stockpiling
- Product loading and hauling.

6.2 Proposed Method of Extraction

The proposal is to expand the existing quarry to an extraction rate of up to 490,000 tonnes per annum. The primary purpose of the quarry would be to supply sand to the current and proposed Pacific Highway upgrade works, and for supply to local councils and contractors.

The quarry operation would be carried out in response to demand. It is therefore difficult to predict exactly how the extraction would progress. In general, the extraction is proposed to move to the west of the existing extraction area and then south in four stages. Topsoil would be removed initially and the sand extracted using an excavator. Once the excavation fills with water, a dredge will be introduced to extract the sand to a depth of 15 metres (-12 metres AHD).

To provide access to the different types of sand, each stage may be at a different stage of extraction at the same time.

This expansion would increase the extraction area to about 16.4 ha which would be an increase of 10.1 ha on the current extraction area. The depth of the excavation would increase by approximately 11 metres.

6.2.1 Imported materials

Following the extraction of the raw material from the quarry and screening, additional material may be required for blending to satisfy client specifications. This material may need to be imported to the quarry and could include rock, topsoil or landscaping products. The quantity of this material would be dependent upon the material's end use and is difficult to predict. It is likely that some of the blending materials would be stockpiled on site.

This material would be brought to site via trucks returning from their delivery of quarried materials.

6.2.2 Project Life

Estimated quarry reserves are in the order of two million tonnes. If extraction was carried out at the maximum rate of 490,000 tonnes per annum the site would have an extractive life of approximately four years, however this extraction rate is deemed unlikely. As mentioned above, it is likely that demand would be high during the highway upgrade works (approximately five years) and then reduce, resulting in a life of the extraction operation in the order of 15 to 30 years.

6.3 Existing and historical impacts

Quarry operations at the site date back to 1961. In 1997, the quarry was granted approval to extract up to 35,715 m³ (approximately 57,000 tonnes) per annum (DA 128/95).

6.3.1 Vegetation clearing and habitat loss

Clearing for the existing quarry would have occurred in the early 1900s, and would have likely resulted in localised impacts as the extensive areas of bushland surrounding the site would have provided habitat for affected species.

6.3.2 Habitat degradation

The existing and historical use of the subject site would have resulted in degradation to the habitats retained outside of the quarry area. Degradation to habitat would have likely resulted from clearing, altered fire regimes, ground disturbance, introduction of weeds, compaction to soils resulting from grazing or quarrying activities. As such, much of the habitat within the study area has previously been degraded to some extent. This is evidenced by the condition of the eucalypt vegetation on the site, while more resilient communities, such as the coastal heath have regenerated post-disturbance.

6.4 Direct impacts

6.4.1 Vegetation clearing

The study area contains approximately 12.75 ha of vegetation (which excludes disturbed land and waterbodies from the total area of the site). The areas of each vegetation type present within the study area are provided in Table 8.

The proposed expansion would result in the clearing of approximately 1.3 ha of native vegetation and 11.3 ha of exotic grassland (refer Table 8). Vegetation clearing in these communities would involve removal of non-threatened native plants, including mature hollow bearing trees.

Table 8 Vegetation clearing

Vegetation Type	TSC Act Status	Area Impacted (ha)
Coastal Heath on Sands of the North Coast	-	0.16
Modified Pink Bloodwood - Red Mahogany Open Forest	Swamp Sclerophyll Forest EEC	1.16
Paperbark Swamp forest	Swamp Sclerophyll Forest EEC	0.12
Exotic Grassland	-I	11.32
Disturbed Land	-	3.62
Waterbodies		4.99
TOTAL		21.4

6.4.2 Fauna mortality or injury from vehicles

Description of impact

Fauna, including threatened species, could be directly impacted by collision with quarry operation vehicles, and could be killed or injured as a result.

At its peak, the quarry is expected to win and haul about 2,250 tonnes of sand per day which would involve about 70 truck and dog loads or 140 truck movements per day. Once the Woolgoolga to Ballina Pacific Highway Upgrade is complete, the demand is expected to decrease, as would the number of truck movements.

As with all quarries, demand for materials would fluctuate, resulting in truck numbers potentially exceeding these numbers for short periods and having no trucks operating at other times

Movements of vehicles will only occur during the approved operating hours of the quarry, which would be 7 am to 6 pm Monday to Friday and 8 am to 1 pm on Saturdays. Vehicles are subject to a speed limit of 10 km per hour within the site.

Impacts associated with movement of heavy vehicles may have previously been realised in the subject site (i.e. there is an existing potential fauna mortality or injury that is not a “new” impact that is a result of the proposed expansion).

Due to the noise associated with the vehicles, the limited operating hours, and the speed limit, the risk of interaction with vehicles and subsequent mortality or injury is considered to be low.

6.4.3 Habitat removal

Description of impact

Removal of habitat can reduce denning or nesting resources, as well as available food or foraging resources (fruits, nectar, seed etc.) and foraging substrate such as woody debris. This can affect the breeding, and lifecycle of individuals, and could result in mortality, or affect species distribution and abundance.

Clearing for the proposed expansion would remove 1.3 ha of modified open forest vegetation and 11.3 ha of exotic grassland from within the subject site.

A total of 22 hollow-bearing trees would be cleared, although these are proposed for retention within the site as logs on the ground to provide habitat for ground-dwelling fauna. These trees could currently provide nesting, denning and breeding habitat for a range of hollow dependent fauna species including the Brush-tailed Phascogale (*Phascogale tapoatafa*). In addition, these trees would also provide foraging habitat for Koalas.

Fauna species that occupy or utilise the habitats within the proposed expansion area will be displaced to other areas of habitat. Based upon the condition of the habitats, species that utilise the subject site are unlikely to be solely dependent upon any of the resources within the proposed expansion area. Similar, but significantly less disturbed habitats are present locally within the reserve system, part of which is contiguous with the site to the north, as such there is considerable scope for native fauna to obtain alternative habitat.

Native bird species occupy the site and will be affected by the removal of native vegetation and other habitat resources. The majority of these species are mobile, widespread and common. Further, there are large quantities of equivalent habitat and resources in the locality, including large patches of remnant native vegetation which occurs to the north and east of the site. Overall it is likely that the impact on local populations of native birds will be minor.

There is the potential for adverse effects on smaller or less mobile terrestrial mammals sheltering within the native vegetation to be removed as a result of direct surface disturbance

during the construction. Smaller species may be sheltering in dense vegetation or beneath woody debris during construction, however would be likely to disperse on approach of heavy machinery.

Arboreal mammals and microbats are also likely to occur at the site and would forage across the entire site. The proposed expansion will remove foraging habitat and potential roost sites within tree hollows for these species (such as *Miniopterus australis* (Little Bentwing-bat)). However, extensive foraging habitat is available outside of the expansion area both within the subject site and adjacent reserves.

6.4.4 Habitat fragmentation

Description of impact

Clearing vegetation and habitats can reduce the ability of species to disperse through habitats if connectivity is reduced or removed. This can affect the breeding, and lifecycle of individuals, as well as the species distribution.

The proposed development is not likely to increase the level of disturbance to connectivity within the locality from the levels already occurring through the operation of the current quarry. It is expected there will be a decrease in the amount of open woodland however this habitat type will remain *in situ* to the south, west and north of the proposed development. The habitat is already somewhat disconnected and fragmented and it is considered unlikely that the proposed development will increase this to any significant extent.

Fauna is unlikely to be displaced by noise, construction and other human activity as the site is currently operated as a quarry. Displaced terrestrial fauna are likely to move into the surrounding vegetation of greater habitat value with the potential to increase pressures on populations through interspecific competition for resources.

As this clearing is within an already modified environment it is unlikely that it will have additional negative effects on the quality of habitats in the broader locality through edge effects, fragmentation of habitat and the disruption of fauna movement corridors more than are already present at the site.

The proposed expansion is likely to remove approximately 22 hollow-bearing habitat trees. No hollows were observed to be occupied at the time of the survey however seasonal variation is likely to bring about the use of hollows by various species for breeding purposes.

The proposed construction would not directly disturb natural water bodies, drainage lines or freshwater wetlands. The waterbodies within the study area are artificial and currently provide a series of settlement ponds connected by drains relating to the ongoing quarry operations.

In the short term the proposed expansion would remove some habitat resources for native fauna, including foraging substrate and aerial foraging habitat for species that feed on insects.

The proposed expansion do not involve any structures that would pose a significant obstruction or hazard to birds or bats in the context of existing land uses in the locality.

The proposed expansion will not isolate any vegetation or wildlife corridors outside the immediate surface disturbance area.

6.5 Indirect impacts

6.5.1 Habitat degradation

Description of impact

Habitat degradation, can result from increased noise, light, nutrients, and may result from:

- Clearing of vegetation resulting in edge effects. Negative impacts may include an increase in incursion of weeds, sedimentation or access for predators
- Direct damage to habitats resulting from vehicle movements or grazing, this can affect habitats by introducing weeds, or enhancing conditions for weed growth, which may impact upon growth and structure of native vegetation communities
- Noise from vehicles and equipment utilised during expansion and operation

Similar to habitat removal, degradation of habitat can affect availability of resources, and could result in mortality, or affect species distribution and abundance.

Due to the historical clearing and condition of the existing vegetation, the proposed expansion is not likely to create new edges as the clearing is wholly within the subject site where only scattered trees occur.

Grazing will continue outside of the proposed expansion area, and is considered to be an existing impact.

Noise pollution as a result of an increase in the level of activity of vehicles, machinery and excavation may deter native fauna from utilising the study area and immediate surrounding areas as habitat. The Proposal could affect the migration and dispersal ability of native fauna particularly in relation to noise and vehicular movements. The Proposal may result in increased noise pollution which has the potential to disrupt the breeding cycle and the foraging and roosting behaviour of some native fauna species.

Habitats on the site are presently subject to potential degrading processes associated with quarry vehicle movements (e.g. potential spread of weeds) and cattle grazing.

6.5.2 Sediments, dust and runoff

Description of impact

Impacts from sedimentation, dust and run off have the potential to impact sensitive environments surrounding the site.

There are sensitive environmental receptors adjacent to the development footprint, including intact native vegetation that forms part of Broadwater National Park.

Potential indirect impacts on terrestrial flora and fauna from construction activities are not considered likely to be significantly different from the existing dust and vehicle exhaust emissions generated from construction vehicles and equipment. There may be an increase in the number of vehicles and the level of activity within the quarry however the activities will be consistent with those already being undertaken within the site.

Soil protection measures and techniques form part of the ongoing operation of the site. Any localised increases in erosion hazard as a result of construction would be limited to the immediate construction footprint and there would be appropriate control devices and buffers between the disturbance footprint and sensitive receptors.

6.5.3 Weed invasion and edge effects

Description of impact

'Edge effects' refers to changed environmental conditions at the interface of intact vegetation and cleared areas. Edge effects may result in impacts such as changes to vegetation type and structure, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna. It is unlikely that there will be an increase in edge effects as a result of

the clearing of vegetation within the subject site as the area is already partially cleared and managed, including grazed by cattle regularly.

Construction may increase the degree of weed infestation through dispersal of weed propagules (seeds, stems and flowers) into nearby areas of native vegetation via erosion (wind and water) and through construction vehicles.

6.5.4 Pests and pathogens

Description of impact

Construction activities within the subject site have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*) and Myrtle Rust (*Uredo rangelii*) throughout the site through vegetation disturbance. There is little available information about the distribution of these pathogens within the locality, and no evidence of these pathogens was observed during surveys. Phytophthora and Myrtle Rust may result in the dieback or modification of native vegetation and damage to fauna habitats.

6.6 Impacts upon groundwater dependent ecosystems

Description of impact

There is the potential for the project to result in groundwater drawdown as a result of evaporation of groundwater from quarry pits.

Under the NSW Aquifer Interference Policy the Level 1 minimal impact considerations for Highly Productive Coastal Sands Water Sources specify that the allowable predicted impact must be less than or equal to 10% cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, at a distance of 40 m from any high priority groundwater dependent ecosystem or high priority culturally significant site listed in the schedule of the relevant WSP (DPI 2012).

A groundwater assessment has been completed as part of the EIS for this proposal. This assessment states that 'the likely typical climatic variations for sand are estimated to be in the order of 2 m based on review of NSW Office of Water bores adjacent to the site (GHD 2014). This is likely to be within the radius of influence. The profile of the drawdown is unknown but the maximum drawdown under average evaporation conditions will be 0.36 m. Therefore, it is likely that the drawdown 40 m from the closest GDE will be approximately equal to or less than 10% of cumulative variation in the water table'.

There is also some potential that the water drawdown that would occur as a result of the proposal may have an impact on terrestrial ecosystem partially dependant on groundwater that may occur adjacent to the site. However given the expected maximum rate of drawdown it is not considered likely that these impacts would be significant.

6.7 Duration of impacts

The expansion of the quarry is expected to result in permanent removal of native vegetation and habitats within the proposed footprint for at least the duration of the quarry operations. There is however potential for future rehabilitation of the site should quarrying cease in the future.

Indirect impacts, such as noise, light, dust and traffic are existing impacts, and these are intermittent impacts associated with quarry operations, and would continue to operate while the quarry is in operation.

6.8 Key Threatening Processes

A key threatening process (KTP) is defined in the TSC Act (OEH 2013d) as an action, activity or proposal that:

- Adversely affects two or more threatened species, populations or ecological communities
- Could cause species, populations or ecological communities that are not currently threatened to become threatened

KTPs are listed under the TSC Act, the FM Act and also under the EPBC Act. A number of KTPs are listed under more than one Act. Those potentially relevant to the proposed expansion are discussed in Table 9. Mitigation measures to limit the impacts of these KTPs are discussed in Section 8.

Table 9 Key Threatening Processes relevant to the proposed expansion

KTP	Status	Comment
Clearing of native vegetation	TSC Act; EPBC Act	Clearing of native vegetation has occurred historically within and around the subject site. The proposal would result in the clearing of approximately 1.3 ha of native vegetation. The vegetation to be removed is in moderate condition due to past clearing and agricultural activities. The clearing of this vegetation is not likely to significantly affect any threatened biota. The implementation of a Vegetation Management Plan is recommended to minimise impacts on native vegetation. The proposal would result in a minor increase in the operation of this KTP.
Loss of hollow-bearing trees	TSC Act	Past clearing at the site is likely to have resulted in a loss of hollow-bearing trees. At present there is a mixture of mature and immature vegetation within the proposal site. This KTP would be exacerbated by the removal of 22 hollow-bearing trees within the subject site.
Removal of dead wood and dead trees	TSC Act	There are small quantities of dead wood in the subject site that would provide habitat resources for native fauna. The EMP would include measures for the salvage and reinstatement of woody debris which would partially mitigate against the operation of this KTP. The proposal would result in a minor increase in the operation of this KTP.
Infection of native plants by <i>Phytophthora cinnamomi</i>	TSC Act; EPBC Act	Construction activities have the potential to introduce the root-rot fungus <i>Phytophthora cinnamomi</i> into the site, which could lead to dieback of vegetation. The implementation of a Vegetation Management Plan is recommended to limit impacts on native vegetation. The proposal is unlikely to increase the operation of this KTP.
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	TSC Act	Construction activities have the potential to introduce Myrtle Rust to the site. The implementation of a Vegetation Management Plan is recommended to limit impacts on native vegetation. The proposal is unlikely to increase the operation of this KTP.
Invasion of native plant communities by exotic perennial grasses	TSC Act	Exotic perennial grasses are present in high abundance within the study area. Construction activities have the potential to spread exotic perennial grasses within and surrounding the site, which could lead to the further invasion of this

KTP	Status	Comment
		species into native plant communities. Weed control measures including decontamination of personnel and plant equipment prior to entering construction areas and establishment of appropriate sedimentation controls would be developed as part of the EMP. Provided these mitigation measures are implemented. The proposal is unlikely to increase the operation of this KTP.

6.9 Assessment of indirect impacts upon Broadwater and Bundjalung National Parks

In accordance with the Australian Government, Matters of National Environmental Significance, Significant impact guidelines 1.1 under the EPBC Act (DoE 2013), consideration of potential indirect and offsite impacts from the proposal on the adjacent National Parks is provided below.

6.9.1 Indirect and offsite impacts

Indirect and offsite impacts include 'downstream' or 'downwind' impacts, such as impacts on wetlands or ocean reefs from sediment which may be washed or discharged into river systems

In the event that sediment is discharged from the subject site, the flow direction will be to the southwest across adjacent properties for approximately 600 m before entering a watercourse which flows into the Evans River, south of the subject site, and away from Broadwater National Park.

Prevailing winds at the Doonbah Quarry are predominantly from the east indicated by accumulated records between 1998 and 2010 at the Evans Head RAAF Bombing Range AWS (BOM 2014). Seasonal variations are apparent with winds often from the west during summer months and the east during winter months. Given that the excavated material is sand which is quite coarse and relatively heavy, when compared to clay particles, it is unlikely that this material would travel any great distance in the wind. Should finer materials become airborne, the prevailing winds would transport these particles away from Broadwater and Bundjalung National Parks.

6.9.2 Upstream impacts

'Upstream impacts' are impacts associated with the extraction of raw materials and other inputs which are used to undertake the action

The proposed action does include the extraction of raw materials, that is, materials from the sand deposits. The excavation will impinge on groundwater which has been recorded at between 2.25 and 2.45 m below AHD (ground level) when it reaches maximum depth at approximately 15 m below AHD. While the excavation consists of sand mixed with water, the process removes much of the water back into the existing water-filled lakes. This then drains across the property to the southwest. It is assumed that the lakes fill from time to time with localised rainfall and remain at a minimum of groundwater level at other times.

It is not considered that upstream impacts are likely to result from an extension of the existing quarrying activities. It is expected that quarry pits will fill, as has occurred with the existing pits, to groundwater level and remain at a consistent level with the existing lakes which is not considered likely to impact on upstream the National Park.

6.9.3 Facilitated impacts

Facilitated impacts are those which result from further actions (including actions by third parties) which are made possible or facilitated by the action.

It is not considered likely that there would be any facilitated impacts on the National Parks from the expansion of the existing quarry.

6.10 Assessment of significance

6.10.1 Species assessed

One EEC, seven fauna species and one flora species were considered likely to occur within the study area.

The likely significance of impacts of the proposal on these threatened species and communities has been assessed in accordance with the State government's *Threatened species assessment* guidelines (DECC 2007). Impacts on MNES have been assessed in accordance with the EPBC Act significant impact guidelines (DotE 2013). Species assessed are listed in Table 10.

A summary of the assessments of significance is provided below. The full assessments are provided in Appendix E and F.

Table 10 Species Assessed

Species or EEC	State assessment	Commonwealth assessment
<i>Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.</i>	Yes	N/A
<i>Rutidosis heterogama</i> (Heath Wrinklewort)	Yes	Yes
<i>Crinia tinnula</i> (Wallum Froglet)	Yes	N/A
<i>Erythroriorchis radiatus</i> (Red Goshawk)	Yes	Yes
<i>Miniopterus australis</i> (Little Bentwing-bat)	Yes	N/A
<i>Miniopterus schreibersii oceanensis</i> (Eastern Bent-wing Bat)	Yes	N/A
<i>Phascogale tapatoafa</i> (Brush-tailed Phascogale)	Yes	N/A
<i>Phascolarctos cinereus</i> (Koala)	Yes	Yes
<i>Petaurus poliocephalus</i> (Grey-headed Flying-fox)	Yes	Yes
<i>Chalinolobus nigrogriseus</i> (Hoary Wattled bat)		N/A
<i>Saccolaimus flaviventris</i> (Yellow-bellied Sheath-tail-bat)	Yes	N/A
<i>Syconycteris australis</i> (Common Blossom-bat)	Yes	N/A
<i>Nannoperca oxleyana</i> (Oxleyan Pygmy Perch)	Yes	Yes

6.11 Impacts on threatened species and communities

6.11.1 Threatened Communities

Swamp Sclerophyll forest on Coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions

The Pink Bloodwood - Red Mahogany Forest and Paperbark Swamp Forest vegetation types (refer Section 5.2.3), within the study area, while disturbed, are considered to be commensurate with the Swamp Sclerophyll forest on Coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC, listed under the TSC Act.

This EEC occurs from the north coast of NSW, south to Kiama and has been recorded from numerous local government areas within NSW, including Ballina and the Richmond Valley. The extent of Swamp Sclerophyll Forest prior to European settlement has not been mapped across its entire range. One estimate based on a compilation of regional vegetation maps suggests that less than 27 percent of the broadly defined vegetation class remains (Keith 2004).

The EEC is associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. The structure of the community is typically open forest, although partial clearing may have reduced the canopy to scattered trees. This community is characterised by open to dense tree layer of eucalypts and paperbarks, with trees up to or higher than 25 m and includes areas of fern land and tall reed or sedge land, where trees are sparse or absent (OEH 2011).

The proposal would result in the removal of 1.2 ha of Swamp Sclerophyll Forest EEC.

Assessments of significance pursuant to section 5A of the EP&A Act have been prepared for this EEC. This assessment is provided in Appendix E. The proposed expansion are unlikely to have a significant effect on Swamp Sclerophyll forest EEC, due to the relatively small amount of this community that would be removed as a result of the proposed expansion, and the relative large extent of similar vegetation types that occur within the study locality.

6.11.2 Threatened Flora species

The Proposal would not impact any known individuals or populations of threatened plants listed under the EPBC or TSC Acts. Based on a review of previous records of threatened flora, an assessment of habitat within the proposal site, and known distributional ranges and habitat associations, it is considered that there is moderate habitat within the study area for one threatened flora species (*Rutidosia heterogama* (Heath Wrinklewort)). This species occurs mostly in heath on sandy soils, often along disturbed roadsides. Within the study area there is suitable habitat for this species within areas of Coastal Heath in the northwest of the site.

Rutidosia heterogama (Heath Wrinklewort) is a small perennial plant in the Asteraceae family. The species is listed as vulnerable under both the TSC and EPBC Acts. Within NSW the species has been recorded from Cessnock to Kurri Kurri with isolated populations also known from the Central Coast north from Wyong to Newcastle. There are also populations between Wooli and Evans Head in Yaraygir and Bundjalung National Parks (OEH 2014).

The likely significance of impacts of the proposal on *Rutidosia heterogama* (Heath Wrinklewort) has been assessed in accordance with DECC's *Threatened species assessment guidelines* and DoE *Significant Impact Guidelines 1.1* for MNES (DECC 2007, DoE 2013). These assessments are provided in Appendix D and E.

The proposed expansion is unlikely to have a significant effect on, *Rutidosia heterogama* (Heath Wrinklewort) due to the relatively small amount of potential habitat that would be cleared as a

result of the proposed expansion, and the relative large extent of similar vegetation types that occur within the study locality.

6.11.3 Threatened Fauna species

Based on a review of previous records of threatened fauna, an assessment of habitat within the proposal site, and known distributional ranges and habitat associations, it is considered that the following 11 species have a high likelihood of occurring or have been observed within the subject site (Appendix D).

- *Crinia tinnula* (Wallum Froglet) – vulnerable under the TSC Act
- *Nannoperca oxleyana* (Oxleyan Pygmy Perch) – endangered under the EPBC Act and the *Fisheries Management Act 1994*
- *Erythrorchis radiatus* (Red Goshawk) – vulnerable under the EPBC Act
- *Chalinolobus nigrogriseus* (Hoary Wattled Bat) – vulnerable under the TSC Act
- *Miniopterus australis* (Little Bentwing-bat) – vulnerable under the TSC Act
- *Miniopterus schreibersii oceanensis* (Eastern Bent-wing Bat – vulnerable under the TSC Act
- *Phascogale tapoatafa* (Brush-tailed Phascogale) – vulnerable under the TSC Act
- *Phascolarctos cinereus* (Koala) – vulnerable under both TSC and EPBC Acts
- *Saccolaimus flaviventris* (Yellow-bellied Sheath-tail-bat) – vulnerable under both the TSC and EPBC Acts
- *Petaurus poliocephalus* (Grey-headed Flying-fox) – vulnerable under both the TSC and EPBC Acts
- *Syconycteris australis* (Common Blossom-bat) – vulnerable under the TSC Act

The likely significance of impacts of the proposal on the above threatened fauna species has been assessed in accordance with DECC's *Threatened species assessment guidelines* and DotE *Significant Impact Guidelines 1.1* for MNES (DECC 2007, DotE 2013). These assessments are summarised below and presented in Appendix D and E.

The proposed expansion would have a direct negative effect on habitat for native fauna through vegetation clearing as described above. The removal of vegetation would remove associated habitat resources such as foraging substrate, foraging resources (fruits, nectar, seed etc.), aerial foraging habitat for species that feed on insects and woody debris. As this clearing would occur in a disturbed vegetation community that is currently grazed with cattle. It is not likely that there will be additional negative effects on the quality of habitats in the broader locality through edge effects, fragmentation of habitat and the disruption of fauna movement corridors more than are already present at the site.

The proposal would clear approximately 22 hollow-bearing habitat trees. The hollow-bearing trees are located within the areas mapped as modified pink bloodwood – red mahogany open forest (Figure 2) as well as around the water reservoir to the northwest. The hollows within the trees are of varying sizes. It was noted that European honey bees, also farmed on the property and located outside the study area, within the property along the southern boundary, were also resident in a number of tree hollows. No evidence of use of any of the hollows observed was recorded during field surveys. Two trees with various sized hollows located in the north western corner of the study area, near the circular water reservoir, were watched at dusk and into the night for any activity, however none was recorded. There are many more hollows present in the open woodland to the south of the study area which forms the designated offset area.

The proposal does not involve any structures that would pose a significant obstruction or hazard to birds or bats in the context of existing land uses in the locality.

The area of potential habitat to be removed represents only a small fraction of similar available habitat in the locality. The similar modified open woodland to the west of the study area would be retained and would provide similar habitat to that which is proposed to be removed from the south of the study area.

For the above reasons it is considered that the proposal is unlikely to have a significant impact on any threatened fauna species that may occur within the site.

6.11.4 Assessment of significance summary

Based upon the assessments of significance (Appendix D and E), it is concluded that it is unlikely that the proposed expansion of Doonbah Quarry would have a significant impact upon any threatened species, populations or endangered ecological communities or their habitats.

7. Mitigation Measures

7.1 Overview

This section contains details of the measures that are recommended to be implemented to maintain or improve the biodiversity values within the subject site in the medium to long term.

7.2 Avoidance and minimisation of impacts

The proposed expansion has been designed to avoid and/or minimise impacts on areas with high biodiversity values. This includes an area of EEC that is proposed for an offset site (refer Figure 1). The intended use for the development means that further avoidance of vegetation is not feasible.

During the detailed design process, the impact of the proposal on areas with high biodiversity values should be minimised wherever possible by minimising the area of native vegetation to be cleared.

7.3 Mitigation of impacts

7.3.1 Environmental Management Plan (Operations)

An EMP would be prepared for the proposed quarry operation. The EMP would include, as a minimum, industry-standard measures for the management of fauna, flora, soil, weeds and pollutants, as well as site-specific measures including those outlined below. Management Plans relating to water and air have been developed.

The EMP would be required to address the following as a minimum:

- An erosion and sediment control plan (ESCP), which would require:
 - Installation of erosion and sediment control measures prior to commencement of excavation
 - Regular inspection of erosion and sediment control measures, particularly following rainfall events, to ensure their ongoing functionality
 - Stockpiles to be restricted to identified construction compounds, in areas of cleared land and exotic grassland and managed to ensure no offsite impacts of dust generation or sedimentation
 - Bunding of stockpiles to be considered especially in close proximity to vegetation and/or watercourses
- A vegetation management plan (VMP), which should include the following:
 - Delineation and protection of exclusion zones around native vegetation to be retained
 - Communication with operational personnel regarding the conservation value of surrounding habitats and their responsibilities with regards to protecting these habitats during operations
 - Hygiene procedures to prevent the introduction and spread of pathogens such as Phytophthora and Myrtle Rust in areas of native vegetation. These would include exclusion zones around retained areas of native vegetation and/or provision of machine and footwear washdown stations for all equipment and personnel working in areas of native vegetation and
 - Proposed weed control methods and targeted areas and weed disposal protocols

- Identification and mapping of sensitive receivers (such as native vegetation and water bodies) adjacent to the subject site
- Measures to prevent the spread of weeds, including hygiene procedures for vehicles and equipment, footwear and clothing
- Identification of mature and/or hollow-bearing trees to be retained
- Measures to reduce impact on hollow-bearing trees from operational traffic and equipment such as exclusion zones
- A tree felling protocol, including pre-clearing surveys for nests or sheltering terrestrial fauna and rescue and salvage of fauna where possible, and progressive clearing approaches
- Re-use of fallen trees with hollows within offset areas or adjacent vegetation areas that are to be retained
- Installation of hollows of appropriate sizes to facilitate use by the identified species likely to occur within the offset area
- Measures to avoid impacts of the expansion upon Broadwater National Park, including exclusion zones for stockpiling and limitations on vehicle movements

7.4 Offsetting

7.4.1 Overview

Offsets are measures that compensate for the residual adverse impacts of an action on the environment.

A total of 22 hollow-bearing trees will be cleared during Stages 2 and 3 of the proposed quarry expansion. These trees are likely to provide areas of potential nesting or denning habitat for hollow-dependent species, and also potential foraging habitat for the Koala.

Also, approximately 1.3 ha of vegetation that is consistent with the description of the TSC Act endangered ecological community (EEC) of Modified Pink Bloodwood – Red Mahogany Open Forest and Swamp Sclerophyll Forest will be cleared for the quarry expansion (refer to section 5.2).

7.4.2 Commonwealth offsetting

Under the EPBC Act, offsets are not required where the impacts of a proposed action are not thought to be significant.

As a guide, offset requirements under the EPBC Act require that 90% of the offset requirements must be met through direct offsets. A conservation gain is the benefit that a direct offset delivers to the protected matter which maintains or increases its viability or reduces any threats of damage, destruction or extinction. A conservation gain may be achieved by:

- Improving existing habitat for the protected matter
- Creating new habitat for the protected matter
- Reducing threats to the protected matter
- Increasing the values of a heritage place
- Averting the loss of a protected matter or its habitat that is under threat

It is considered that there would be no reasonable way to avoid the clearing of vegetation to facilitate the expansion of the quarry.

The proposed expansion is unlikely to have a significant effect on Swamp Sclerophyll forest EEC, due to the relatively small amount of this community that would be removed as a result of the proposed expansion, and the relatively large extent of similar vegetation types that occur within the study locality (refer to the assessment of significance in section 6.11.1 and Appendix E).

7.4.3 State and local offsetting

OEH or Richmond Valley Council do not have an official offsetting policy, so it is suggested that a suitable offset proposal be negotiated with RVC and the applicant, if required.

Alternatively, the offsetting could be arranged under the NSW BioBanking Scheme whereby credits of an appropriate vegetation community could be purchased to offset the residual loss required as part of the development. As an alternative to purchasing credits, a biobanking site could be established on or nearby the property in order to compensate for the necessary loss required by the development. Further details regarding BioBanking can be provided if required.

8. Conclusions

One endangered ecological community, Swamp Sclerophyll Forest on Coastal Floodplain, and one threatened fauna species, the Koala, were recorded during the field surveys at the subject site. In addition, potential habitat was available for at least seven other threatened fauna species that were assessed as being highly likely to occur, but were not detected during surveys.

The subject site contains an existing operational sand quarry, and has been subject to a range of impacts for over 100 years. The expansion of the quarry is not likely to involve any activities that vary from those currently employed on site (although the intensity of the operation will increase). As such, many potential impacts that would typically be associated with a new sand quarry development would have previously been realised.

The primary impact associated with the proposed expansion is the clearing of 1.3 ha of native vegetation. This would reduce the area of the modified Pink Bloodwood - Red Mahogany Open Forest and Paperbark Swamp Forest vegetation types, which are both considered to be consistent with the description of the EEC Swamp Sclerophyll forest, by approximately 1.3 ha. This would also reduce the area of habitat available within the subject site for threatened species. As there is an unavoidable residual impact, offsetting is likely to require further consideration in consultation with RVC.

Potential indirect impacts, such as habitat degradation have previously occurred, or degrading processes are presently in operation, at the site. Potential environmental impacts associated with quarry operations are to be managed by implementation of controls detailed within an EMP for the operation of the quarry. The EMP would also include controls to manage any potential indirect impacts upon Broadwater and Bundjalung National Parks.

Assessments of significance were undertaken for species recorded or that were considered highly likely to occur within the subject site against State and Commonwealth guidelines. The outcome of these assessments was that the proposed expansion would be unlikely to have a significant impact upon species, populations or endangered ecological communities or their habitats.

It is expected that with implementation of the management measures proposed a 'maintain or improve' outcome for the biodiversity values of the site could be achieved in the medium to long term.

The assessments completed and reported in this document have met the Director General's Requirements (refer section 3.1).

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Appendices

Appendix A – Likelihood of Occurrence Table

Likelihood of Occurrence Table

The likelihood of occurrence assessment determines the likelihood of conservation significant species, or species' habitat, occurring within the Study Area. The assessment involved a review of the desktop survey results (i.e. EPBC Act Protected Matters Report, BioNet extracts); relevant literature (e.g. Commonwealth Species Profile and Threats Database (SPRAT), field guides); and field survey results.

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

Likelihood	Definition
Known	Species or community known to occur within the site (i.e recorded during field survey)
High	Presence of potential high value habitat (e.g. breeding and foraging habitat; important movement corridors)
Moderate	Presence of potential medium value habitat (e.g. disturbed breeding conditions; constrained foraging habitat; movement corridors)
Low	Presence of potential low value habitat (e.g. disturbed conditions; isolated small habitat area; fragmented movement corridors)
Unlikely	No preferred habitat or corridors present

Matters considered in determining the likelihood of occurrence include:

- Known natural distributions including prior records (database searches) and site survey results.
- Geological/ soil preferences.
- Specific habitat requirements (e.g. aquatic environs, seasonal nectar resources, tree hollows etc).
- Climatic considerations (e.g. wet summers; snow fall).
- Home range size and habitat dependence.
- Topographical preferences (e.g. ridgetops, coastal headlands, midslopes, closed depressions).

Common Name Scientific Name	TSC Act Status	EPBC Act Status	Species Distribution and Habitat	Nature of Record	Likelihood of Occurrence Within Project Area
Lowland Rainforest of Subtropical Australia		CE	This community occurs on basalt and alluvial soils, usually above 300 m above sea level. The community is generally ≥20-30 m closed forest dominated by bangalow palm (<i>Archontophoenix cunninghamiana</i>) or cabbage palm (<i>Livistona australis</i>) with weeping satin ash/lilly pilli (<i>Syzygium floribundum</i>) in the riparian areas. It is a very diverse community	Community may occur within the area (PMST 2014)	Unlikely
FLORA					
<i>Acronychia littoralis</i> Scented Acronychia		En	This small tree grows on sand in humid, high rainfall areas. It occurs in transition zones between littoral rainforest and swamp sclerophyll forest and margins of littoral forest. Associated species include <i>Lophostemon confertus</i> , <i>Banksia integrifolia</i> , <i>Callitris columellaris</i> , <i>Araucaria cunninghamii</i> , <i>Eucalyptus intermedia</i> and <i>Melaleuca quinquenervia</i> . .	Species or species habitat likely to occur within area (PMST 2014)	Low
<i>Allocasuarina defungens</i> Dwarf Heath Casuarina		En	Dwarf Heath Casuarina grows mainly in tall heath on sand, but can also occur on clay soils and sandstone. The species also extends onto exposed nearby-coastal hills or headlands adjacent to sandplains. Confined to the north coast region of NSW , between Raymond Terrace and Port Macquarie. There are 32 sites recorded from six general localities over a geographic range of about 40 km.	Species or species habitat likely to occur within area (PMST 2014)	Unlikely
<i>Arthraxon hispidus</i> Hairy-joint Grass		Vu	Moisture and shade-loving grass, found in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps.	Species or species habitat likely to occur within area (PMST 2014)	Low
<i>Baloghia marmorata</i> Marbled Baloghia		Vu	Jointed Baloghia is found in subtropical rainforest on soils derived from basalt.	Species or species habitat may occur within area (PMST 2014)	Unlikely

Common Name Scientific Name	TSC Act Status	EPBC Act Status	Species Distribution and Habitat	Nature of Record	Likelihood of Occurrence Within Project Area
<i>Belvisia mucronata</i> Needle-leaf Fern	En		Grows on tress or rocks in dry rainforest or along creeks in moist open forests	Previously recorded in locality (OEH 2014)	Unlikely
<i>Cryptocarya foetida</i> Stinking Cryptocarya		Vu	Grows in dry rainforest on steep basalt boulder slopes on soil that is scarce but relatively high in nutrients and very well-drained.	Species or species habitat known to occur within area (PMST 2014)	Unlikely
<i>Cryptostylis hunteriana</i> Leafless Tongue-orchid		Vu	Little is known about the ecology of this species and it does not appear to have well defined habitat preferences. It is known from a range of communities, including swamp-heath and woodland.	Species or species habitat may occur within area (PMST 2014)	Low
<i>Cyperus aquatilis</i> Water Nutgrass	En		In NSW this species is known only from a few sites north from Grafton where it grows in ephemerally wet sites such as roadside ditches and seepage areas from small cliffs, in sandstone areas.	Previously recorded in locality (OEH 2014)	Low
<i>Dendrobium melaleucaphilum</i> Spider Orchid	En		Grows frequently on <i>Melaleuca styphelioides</i> , less commonly on rainforest trees or on rocks in coastal districts	Previously recorded in locality (OEH 2014)	Unlikely
<i>Desmodium acanthocladum</i> Thorny Pea	Vu	Vu	Occurs in dry rainforest and fringes of riverine subtropical rainforest	Species or species habitat likely to occur within area (PMST 2014)	Unlikely
<i>Endiandra hayesii</i> Rusty Rose Walnut		Vu	Occurs in sheltered moist gullies in lowland subtropical and warm temperate rainforest on alluvium or basaltic soils	Species or species habitat likely to occur within area (PMST 2014)	Unlikely
<i>Floydia praealta</i> Ball Nut		Vu	Occurs in riverine and subtropical rainforest, usually on soils derived from basalt	Species or species habitat likely to occur within area (PMST 2014)	Unlikely
<i>Gossia fragrantissima</i> Sweet Myrtle	En	En	This multi-stem shrub grows in dry subtropical and riverine rainforest	Species or species habitat likely to occur within area (PMST 2014)	Unlikely

Common Name Scientific Name	TSC Act Status	EPBC Act Status	Species Distribution and Habitat	Nature of Record	Likelihood of Occurrence Within Project Area
<i>Marsdenia longiloba</i> <i>Slender Marsdenia</i>	En	Vu	Grows in subtropical and warm temperate rainforest, lowland moist and eucalypt forest adjoining rainforest. It is also occasionally found in areas with rocky outcropping.	Species or species habitat may occur within area (PMST 2014)	Unlikely
<i>Oberonia complanata</i> Yellow-flowered King of the Fairies	En		This epiphytic species grows on trees and rocks in littoral rainforest, subtropical rainforest, dry rainforest, wet or dry eucalypt forests, dunes, stream-side areas, swampy forests and mangroves.	Previously recorded in locality (OEH 2014)	Unlikely
<i>Oberonia titania</i> Red-flowered King of the Fairies	En		This species occurs in littoral and subtropical rainforest and paperbark swamps, but it can also occur in eucalypt-forested gorges and in mangroves	Previously recorded in locality (OEH 2014)	Unlikely
<i>Ochrosia moorei</i> <i>Southern Ochrosia</i>		En	Southern Ochrosia is found in riverine and lowland subtropical rainforest	Species or species habitat likely to occur within area (PMST 2014)	Unlikely
<i>Owenia cepiodora</i> Onionwood		Vu	Occurs in subtropical and dry rainforest on or near soils derived from basalt	Species or species habitat likely to occur within area (PMST 2014)	Unlikely
<i>Persicaria elatior</i> <i>Knotweed</i>		Vu	Grows in damp places including stream sides and lakes. It is also occasionally found in swamp forest or associated with disturbance.	Species or species habitat likely to occur within area (PMST 2014)	Low
<i>Phaius australis</i> Lesser Swamp-orchid	En	En	Found in swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas. Occurs in Queensland and north-east NSW as far south as Coffs Harbour.	Species or species habitat known to occur within area (PMST 2014)	Unlikely
<i>Rutidosia heterogama</i> Heath Winklewort	Vu	Vu	This species grows in heath on sandy soils and moist areas in open forest. It has also been recorded growing within disturbed roadsides.	Species or species habitat likely to occur within area (PMST 2014)	Moderate
<i>Streblus pendulinus</i> Siah's Backbone		En	Siah's Backbone is found in warmer rainforests, chiefly along watercourses	Species or species habitat likely to occur within area (PMST 2014)	Unlikely
<i>Syzygium hodgkinsoniae</i>	Vu		Usually found in riverine and subtropical rainforest on rich alluvial or	Previously recorded in	Unlikely

Common Name Scientific Name	TSC Act Status	EPBC Act Status	Species Distribution and Habitat	Nature of Record	Likelihood of Occurrence Within Project Area
Red Lilly Pilly			basaltic soils	locality (OEH 2014)	

Note: All species distribution and habitat information was adapted from the Office of Environment and Heritage webpage - Threatened Species, Species Populations and Ecological Communities of NSW, URL: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/home_species.aspx, unless referenced otherwise.

Key – Vu = Vulnerable, En = Endangered, CE = Critically Endangered

Assessment of the Likelihood of Occurrence of Threatened and / or Migratory Fauna

List excludes those species that are exclusively marine, such as sharks, whales, turtles, sawfish, etc., as no marine environment forms part of the site.

Common Name Scientific Name	TSC Act Status	EPBC Act Status	Species Distribution and Habitat	Nature of Record	Likelihood of occurrence
Reptiles					
<i>Coeranoscincus reticulatus</i> Three-toed Snake-tooth Skink	Vu	Vu	This species inhabits rainforest and occasionally moist eucalypt forest on loamy or sandy soils. It lives in loose soil, leaf litter and rotting logs and feeds on earthworms and beetle grubs (OEH 2014)	Species is known to occur within the area (OEH 2014)	Moderate – towards the northeast of the site
Amphibians					
<i>Litoria aurea</i> Green and Golden Bell Frog	En	Vu	The Green and Golden Bell Frog inhabits marshes, dams, and stream-sides, particular containing bulrushes (<i>Typha</i> sp.) or spikerushes (<i>Eleocharis</i> spp.). Open waterbodies with no <i>Gambusia holbrooki</i> and a grassy area nearby are preferred. May inhabit highly disturbed sites (OEH 2014).	Species or species habitat may occur within area (PMST 2014) Species is known to occur within the area (OEH 2014)	Moderate
<i>Litoria olomburensis</i> Wallum Sedge Frog	Vu	Vu	This species is limited to paperbark swamps and sedge swamps of the coastal 'wallum' country which is lowland heath ecosystem dominated by <i>Banksia</i> species and acidic waterbodies. Olombgurra Frogs are usually found amongst sedges and rushes in coastal wetlands (OEH 2014).	Species or species habitat known to occur within area (PMST 2014, OEH 2014)	Low – no sedges observed in wetlands on site
<i>Crinia tinnula</i> Wallum Froglet	Vu		Wallum Froglets are found in a wide range of habitats, usually associated with acidic swamps on coastal sand plains. They typically occur in sedgeland and wet heathlands. They can also be found along drainage lines within other vegetation communities and disturbed areas, and occasionally in swamp sclerophyll forests (OEH 2014).	Species and/or species habitat known to occur within area (OEH 2014)	High
Fish					
<i>Nannoperca oxleyana</i> Oxleyan Pygmy Perch		En	Oxleyan Pygmy Perch mostly occur in swamps, creeks and lakes of coastal 'wallum' (Banksia-dominated coastal heath). These waters are usually acidic, with low salinity and low conductivity, and are often darkly stained. They seem to prefer slow-moving or still waters with plenty of shelter in the form of dense aquatic vegetation (e.g. sedges) or undercut, root-filled banks fringed with submerged riparian (river bank) vegetation.	Species and/or species habitat known to occur within area (PMST 2014; DPI 2014)	High – some still pools towards the northeast of the site

Common Name Scientific Name	TSC Act Status	EPBC Act Status	Species Distribution and Habitat	Nature of Record	Likelihood of occurrence
Birds					
<i>Amaurornis moluccana</i> Pale-vented Bush-hen	Vu		The Pale-vented Bush-hen inhabits tall dense understorey or ground-layer vegetation on the margins of freshwater streams and natural or artificial wetlands, usually within or bordering rainforest, rainforest remnants or forests. Also occur in secondary forest growth, rank grass or reeds, thickets of weeds, such as <i>Lantana (Lantana camara)</i>, and pastures, crops or other farmland, such as crops of sugar cane, and grassy or weedy fields, or urban gardens where they border forest and streams or wetlands, such as farm dams. Can also occur in and around mangroves, though rarely do so, if at all, in NSW. Key elements of their habitat are dense undergrowth 2 to 4 metres tall and within 300 metres of water (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Low
<i>Anthochaera phrygia</i> Regent Honeyeater		En	Patchy distribution mainly confined to two main breeding areas in NSW (Capertee Valley and Bundarra-Barraba the locality) and surrounding fragmented woodlands. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-Oak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes.	Species or species habitat known to occur within area (PMST 2014)	Low
<i>Botaurus poiciloptilus</i> Australasian Bittern	En	En	Occurs along the coast, in floodplain wetlands. Mainly associated with densely vegetated freshwater wetlands, less frequently with estuaries and tidal wetlands (Marchant & Higgins 1990).	Species or species habitat known to occur within area (PMST 2014)	Moderate
<i>Calyptrorhynchus lathamii</i> Glossy Black-cockatoo	Vu		Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (<i>Allocasuarina littoralis</i>) and Forest Sheoak (<i>A. torulosa</i>) are important foods (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Low
<i>Carterornis leucotis</i> White-eared Monarch	Vu		In NSW, White-eared Monarchs occurs in rainforest, especially drier types, such as littoral rainforest, as well as wet and dry sclerophyll forests, swamp forest and regrowth forest. They appear to prefer the ecotone between rainforest and other open vegetation types or the edges of rainforest, such as along roads.	Species or species habitat known to occur within area (OEH 2014)	Moderate

Common Name Scientific Name	TSC Act Status	EPBC Act Status	Species Distribution and Habitat	Nature of Record	Likelihood of occurrence
<i>Circus assimilis</i> Spotted Harrier	Vu		Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Moderate
<i>Coracina lineata</i> Barred Cuckoo-shrike	Vu		Rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses. They are usually seen in pairs or small flocks foraging among foliage of trees for insects and fruit. They are active birds, frequently moving from tree to tree (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Moderate
<i>Cyclopsitta diophthalma coxeni</i> Coxen's Fig-Parrot		En	Usually recorded from drier rainforests and adjacent wetter eucalypt forest but rarely seen due to its small size and cryptic habits. Also found in the wetter lowland rainforests that are now largely cleared in NSW (OEH 2014).	Species or species habitat may occur within area (PMST 2014)	Low
<i>Ephippiorhynchus asiaticus</i> Black-necked Stork	En		Black-necked Storks are mainly found on shallow, permanent, freshwater terrestrial wetlands, and surrounding marginal vegetation, including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands. They also forage within or around estuaries and along intertidal shorelines, such as saltmarshes, mudflats and sandflats, and mangrove vegetation (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Low – water bodies on site are all deep
<i>Erythrorhynchus radiatus</i> Red Goshawk	CE	Vu	Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, <i>Melaleuca</i> swamp forest and riparian <i>Eucalyptus</i> forest of coastal rivers (OEH 2014).	Species or species habitat known to occur within area (PMST 2014; OEH 2014)	High
<i>Esacus magnirostris</i> Beach Stone-curlew	En		Beach Stone-curlews are found exclusively along the coast, on a wide range of beaches, islands, reefs and in estuaries, and may often be seen at the edges of or near mangroves. They forage in the intertidal zone of beaches and estuaries, on islands, flats, banks and spits of sand, mud, gravel or rock, and among mangroves. Beach Stone-curlews breed above the littoral zone, at the backs of beaches, or on sandbanks and islands, among low vegetation of grass, scattered shrubs or low trees; also among open mangroves (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Low

Common Name Scientific Name	TSC Act Status	EPBC Act Status	Species Distribution and Habitat	Nature of Record	Likelihood of occurrence
<i>Glossopsitta pusilla</i> Little Lorikeet	Vu		Forages primarily in the canopy of open <i>Eucalyptus</i> forest and woodland, yet also finds food in <i>Angophora</i> , <i>Melaleuca</i> and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Moderate
<i>Grus rubicunda</i> Brolga	Vu		Though Brolgas often feed in dry grassland or ploughed paddocks or even desert claypans, they are dependent on wetlands too, especially shallow swamps, where they will forage with their head entirely submerged (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Moderate
<i>Haematopus longirostris</i> Pied Oystercatcher	En		Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. The chisel-like bill is used to pry open or break into shells of oysters and other shellfish (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Low
<i>Hieraaetus morphnoides</i> Little Eagle	Vu		Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Moderate
<i>Lathamus discolor</i> Swift Parrot		En	Migrates to the Australian south-east mainland between March and October. Favoured feed trees include winter flowering species such as Swamp Mahogany <i>Eucalyptus robusta</i> , Spotted Gum <i>Corymbia maculata</i> , Red Bloodwood <i>C. gummifera</i> , Mugga Ironbark <i>E. sideroxyton</i> , and White Box <i>E. albens</i> (OEH 2014).	Species or species habitat likely to occur within area (PMST 2014; OEH 2014)	Low
<i>Limicola falcinellus</i> Broad-billed Sandpiper	Vu		Broad-billed Sandpipers favour sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons. Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Low
<i>Lopholctinia isura</i> Square-tailed Kite	Vu		Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Moderate
<i>Pandion cristatus</i> Eastern Osprey	Vu		Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Low

Common Name Scientific Name	TSC Act Status	EPBC Act Status	Species Distribution and Habitat	Nature of Record	Likelihood of occurrence
<i>Pezoporus wallicus wallicus</i> Eastern Ground Parrot	Vu		The Ground Parrot occurs in high rainfall coastal and near coastal low heathlands and sedgelands, generally below one metre in height and very dense (up to 90% projected foliage cover). These habitats provide a high abundance and diversity of food, adequate cover and suitable roosting and nesting opportunities for the Ground Parrot, which spends most of its time on or near the ground. When flushed, birds fly strongly and rapidly for up to several hundred metres, at a metre or less above the ground (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Moderate – particularly to the north east of the site, and adjacent areas.
<i>Pomastotomus temporalis temporalis</i> Grey-crowned Babbler (eastern subspecies)	Vu		Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Moderate
<i>Ptilinopus magnificus</i> Wompoo Fruit Dove	Vu		Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests. Feeds on a diverse range of tree and vine fruits and is locally nomadic - following ripening fruit. Thought to be an effective medium to long-distance vector for seed dispersal (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Low
<i>Rostratula australis</i> Australian Painted Snipe	En		Inhabits inland and coastal shallow freshwater wetlands (Smith 1991). Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (OEH 2014).	Species or species habitat likely to occur within area (PMST 2014; OEH 2014)	Low
<i>Tyto longimembris</i> Eastern Grass Owl	Vu		Eastern Grass Owls are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Low
<i>Tyto novaehollandiae</i> Masked Owl	Vu		Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Moderate
Mammals					
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	Vu	Vu	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (<i>Petrochelidon ariel</i>), frequenting low to mid-elevation dry open forest and woodland close to these features. Found in well-timbered areas containing gullies (OEH 2014).	Species or species habitat may occur within area (PMST 2014; OEH 2014)	Low roosting habitat availability

Common Name Scientific Name	TSC Act Status	EPBC Act Status	Species Distribution and Habitat	Nature of Record	Likelihood of occurrence
<i>Chalinolobus nigrogriseus</i> Hoary Wattled Bat	Vu		In NSW the Hoary Wattled Bat occurs in dry open eucalypt forests, favouring forests dominated by Spotted Gum, boxes and ironbarks, and heathy coastal forests where Red Bloodwood and Scribbly Gum are common. Because it flies fast below the canopy level, forests with naturally sparse understorey layers may provide the best habitat (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Observed
<i>Dasyurus maculatus maculatus</i> Spotted-tailed Quoll (SE Mainland Population)		En	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. Usually traverse their large home range along densely vegetated creek lines.	Species or species habitat known to occur within area (PMST 2014)	Moderate
<i>Miniopterus australis</i> Little Bentwing-bat	Vu		Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, <i>Melaleuca</i> swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common Bentwing-bat and, in winter, the two species may form mixed clusters. In NSW the largest maternity colony is in close association with a large maternity colony of Eastern Bentwing-bats (<i>Miniopterus schreibersii</i>) and appears to depend on the large colony to provide the high temperatures needed to rear its young (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Observed
<i>Miniopterus schreibersii oceanensis</i> Eastern Bentwing-bat	Vu		This species occurs along the east and north-west coasts of Australia. They primarily roost in caves, but also use derelict mines, stormwater tunnels, buildings and other structures. They form discrete populations centred on a maternity cave that is used annually in spring and summer. This species hunts in forested areas, catching moths and other flying insects above the tree tops.	Species or species habitat known to occur within the area (OEH 2014)	Observed
<i>Myotis macropus</i> Southern Myotis	Vu		Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Moderate

Common Name Scientific Name	TSC Act Status	EPBC Act Status	Species Distribution and Habitat	Nature of Record	Likelihood of occurrence
<i>Petaurus norfolkensis</i> Squirrel Glider	Vu		Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey. Live in family groups of a single adult male one or more adult females and offspring. Require abundant tree hollows for refuge and nest sites (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Low
<i>Nyctophilus bifax</i> Eastern Long-eared Bat	Vu		Lowland subtropical rainforest and wet and swamp eucalypt forest, extending into adjacent moist eucalypt forest. Coastal rainforest and patches of coastal scrub are particularly favoured. Roosts in tree hollows, the hanging foliage of palms, in dense clumps of foliage of rainforest trees, under bark and in shallow depressions on trunks and branches, among epiphytes, in the roots of strangler figs, among dead fronds of tree ferns and less often in buildings (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Low
<i>Phascogale tapoatafa</i> Brush-tailed Phascogale	Vu		Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest. Agile climber foraging preferentially in rough barked trees of 25 cm DBH or greater. Feeds mostly on arthropods but will also eat other invertebrates, nectar and sometimes small vertebrates (OEH 2014).	Species or species habitat known to occur within area (OEH 2014) Recorded on site	High
<i>Phascogale cinereus</i> Koala (combined populations of Qld, NSW & the ACT)	Vu	Vu	Has a fragmented distribution throughout eastern Australia. Limited to areas of preferred feed trees in eucalypt woodlands and forests. Home range varies depending on the quality of habitat, ranging from less than 2 ha to several hundred hectares in size.	Species or species habitat known to occur within area (PMST 2014; OEH 2014)	High – possible scat and scratches observed to the south of the site
<i>Planigale maculata</i> Common Planigale	Vu		Common Planigales inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Low
<i>Pseudomys novaehollandiae</i> New Holland Mouse		Vu	Occurs in disjunct, coastal populations from Tasmania to Queensland. In NSW inhabits a variety of coastal habitats including heathland, woodland, dry sclerophyll forest with a dense shrub layer and vegetated sand dunes (Wilson and Bradtke 1999). Populations may recolonise/increase in size in regenerating native vegetation after wildfire, clearing and sandmining. Presence strongly correlated with understorey vegetation density, and high floristic diversity in regenerating heath (Lock and Wilson 1999).	Species or species habitat known to occur within area (PMST 2014) Species or species habitat known to occur within area (OEH 2014)	Moderate

Common Name Scientific Name	TSC Act Status	EPBC Act Status	Species Distribution and Habitat	Nature of Record	Likelihood of occurrence
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	Vu	Vu	Found within 200 km of the eastern coast of Australia. Occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps generally located within 20 km of a regular food source and are commonly found in gullies, close to water and in vegetation with a dense canopy. Travel up to 50 km to forage and feed on the nectar and pollen of Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines.	Species or species habitat known to occur within area (PMST 2014)	High
<i>Saccolaimus flaviventris</i> Yellow-bellied Sheath-tail-bat	Vu		Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	High
<i>Scoteanax rueppellii</i> Greater Broad-nosed Bat	Vu		Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	Moderate – most common in tall forests
<i>Syconycteris australis</i> Common Blossom-bat	Vu		Common Blossom-bats often roost in littoral rainforest and feed on nectar and pollen from flowers in adjacent heathland and paperbark swamps. They have also been recorded in a range of other vegetation communities, such as subtropical rainforest, wet sclerophyll forest and other coastal forests (OEH 2014).	Species or species habitat known to occur within area (OEH 2014)	High
<i>Xeromys myoides</i> Water Mouse		Vu	Water mouse habitat consists of mangroves and the associated saltmarsh, sedgelands, clay pans, heathlands and freshwater wetlands. The main habitat difference at each location is the littoral, supralittoral and terrestrial vegetation which differs in structure and composition (OEH 2014).	Species or species habitat likely to occur within area (PMST 2014;)	Low
Listed Migratory Species					
<i>Apus pacificus</i> Fork-tailed Swift		Mi	CAMBA, JAMBA, ROKAMBA Occupies low to very low airspace over varied habitat, rainforest to semi-desert; most active just ahead of summer storm fronts. Occurs in flocks rarely 1 or 2 individuals. Range covers all of Australia. Hawks for insects, at times very high, and sometimes in mixed flocks with the larger White-throated Needle-tail (Morcombe, 2004).	Species or species habitat likely to occur within area (PMST 2014; OEH 2014)	Low
Migratory Terrestrial species					

Common Name Scientific Name	TSC Act Status	EPBC Act Status	Species Distribution and Habitat	Nature of Record	Likelihood of occurrence
White-bellied Sea-Eagle (<i>Haliaeetus leucogaster</i>)		Mi	CAMBA The White-bellied Sea-Eagle is found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea). Birds have been recorded in (or flying over) a variety of terrestrial habitats (Marchant & Higgins 1993) (OEH 2014).	Species or species habitat likely to occur within area (PMST 2014)	Low
White-throated Needletail (<i>Hirundapus caudacutus</i>)		Mi	CAMBA, JAMBA, ROKAMBA White-throated Needletails often occur in large numbers over eastern and northern Australia. White-throated Needletails are aerial birds and for a time it was commonly believed that they did not land while in Australia. It has now been observed that birds will roost in trees (Morcombe, 2004). Although they occur over most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland. They also commonly occur over heathland, but less often over treeless areas, such as grassland or swamps. When flying above farmland, they are more often recorded above partly cleared pasture, plantations or remnant vegetation at the edge of paddocks.	Species or species habitat likely to occur within area (PMST 2014)	Moderate
<i>Merops ornatus</i> Rainbow Bee-eater		Mi	This species is widespread in Australia, except in desert areas, and breeds throughout most of its range. The Rainbow Bee-eater is most often found in open forests, woodlands and shrublands, and cleared areas, usually near water. It will be found on farmland with remnant vegetation and in orchards and vineyards. It will use disturbed sites such as quarries, cuttings and mines to build its nesting tunnels (Morcombe, 2004).	Species or species habitat known to occur within area (PMST 2014)	Moderate
<i>Monarcha melanopsis</i> Black-faced Monarch		Mi/Ma	The Black-faced Monarch mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest (OEH 2014).	Species or species habitat known to occur within area (PMST 2014)	Low
<i>Monarcha trivirgatus</i> Spectacled Monarch		Mi	Its natural habitats are subtropical or tropical moist lowland forests, subtropical or tropical mangrove forests, and subtropical or tropical moist montane forests.	Species or species habitat likely to occur within area (PMST 2014)	Low

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Satin Flycatcher (<i>Myiagra cyanoleuca</i>)		Mi	The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. It is typically found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests	Species or species habitat likely to occur within area (PMST 2014)	Low
Rufous Fantail (<i>Rhipidura rufifrons</i>)		Mi	Inhabits wet sclerophyll forests often in gullies dominated by Tallow-wood (<i>Eucalyptus microcorys</i>) and others with a dense shrubby understorey often including ferns.	Species or species habitat likely to occur within area (PMST 2014)	Low
Migratory Wetlands Species					
<i>Ardea alba</i> Great Egret		Mi	This species is common throughout Australia, with the exception of the most arid areas. Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands (Morcombe, 2004).	Species or species habitat likely to occur within area (PMST 2014)	Moderate
<i>Ardea ibis</i> Cattle Egret		Mi	This species is most widespread in south-eastern Australia from Bundaberg, Queensland to Port Augusta, South Australia. The Cattle Egret is found in grasslands, woodlands and wetlands, and is not common in arid areas. It also uses pastures and croplands, especially where drainage is poor. Will also forage at garbage dumps, and is often seen with cattle and other stock (Morcombe, 2004).	Species or species habitat likely to occur within area (PMST 2014)	Moderate
<i>Gallinago hardwickii</i> Latham's Snipe		Mi	Latham's Snipe is a non-breeding migrant to the south east of Australia. They are seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration. They also use crops and pasture (Morcombe, 2004).	Species or species habitat likely to occur within area (PMST 2014)	Moderate
<i>Numenius minutus</i> Little Curlew		Mi	When resting during the heat of day, the Little Curlew congregates around pools, river beds and water-filled tidal channels, and shallow water at edges of billabongs. The species prefers pools with bare dry mud (including mudbanks in shallow water) and they do not use pools if they are totally dry, flooded or heavily vegetated (Higgins & Davies 1996) (PMST 2014).	Species or species habitat likely to occur within area (PMST 2014)	Low
<i>Rostratula benghalensis (sensu lato)</i> Painted Snipe		Mi	This species occurs across Australia, the areas of most sensitivity to the species are those wetlands where the birds frequently occur and are known to breed. The Australian Painted Snipe is usually found in shallow inland wetlands, either freshwater or brackish, that are either permanently or temporarily filled. It is a cryptic bird that is hard to see	Species or species habitat likely to occur within area (PMST 2014)	Low

Common Name Scientific Name	TSC Act Status	EPBC Act Status	Species Distribution and Habitat	Nature of Record	Likelihood of occurrence
			and often overlooked. It nests on the ground amongst tall reed-like vegetation near water, and feeds near the water's edge and on mudflats.		
Listed Marine Species					
<i>Anseranas semipalmata</i> Magpie Goose		Ma	Mainly found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges. Equally at home in aquatic or terrestrial habitats; often seen walking and grazing on land; feeds on grasses, bulbs and rhizomes. Activities are centred on wetlands, mainly those on floodplains of rivers and large shallow wetlands formed by run-off; breeding can occur in both summer and winter dominated rainfall areas and is strongly influenced by water level; most breeding now occurs in monsoonal areas; nests are formed in trees over deep water; breeding is unlikely in south-eastern NSW. Often seen in trios or flocks on shallow wetlands, dry ephemeral swamps, wet grasslands and floodplains; roosts in tall vegetation (OEH 2014).	Species or species habitat known to occur within area (PMST 2014)	Low
<i>Pandion haliaetus</i> Osprey		Ma	Eastern Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. Eastern Ospreys occur sympatrically and sometimes interact with White-bellied Sea-Eagles (PMST 2014).	Species or species habitat may occur within area (PMST 2014)	Low

Note: All species distribution and habitat information was adapted from the Office of Environment and Heritage webpage - Threatened Species, Species Populations and Ecological Communities of NSW, URL: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/home_species.aspx, unless referenced otherwise.

Appendix B – Protected Matters Search Results



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: 24/03/14 15:35:49

[Summary](#)

[Details](#)

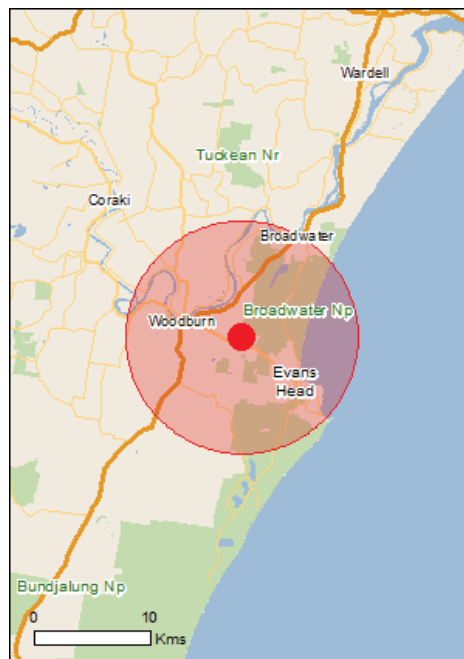
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

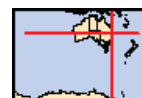
[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	64
Listed Migratory Species:	46

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As [heritage values](#) of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

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.

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:	2
Commonwealth Heritage Places:	None
Listed Marine Species:	73
Whales and Other Cetaceans:	13
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.

Place on the RNE:	7
State and Territory Reserves:	3
Regional Forest Agreements:	1
Invasive Species:	39
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 may occur within area

Listed Threatened Species [\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		
Anthochaera phrygia		
Regent Honeyeater [82338]	Endangered	Species or species habitat known 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
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

Name	Status	Type of Presence
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	habitat may occur within area Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat known to occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely 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 habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Pterodroma leucoptera leucoptera Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma neglecta neglecta Kermadec Petrel (western) [64450]	Vulnerable	Foraging, feeding or related behaviour 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	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour 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
Thalassarche melanophris impavida Campbell Albatross [82449]	Vulnerable	Species or species habitat may occur within area
Fish		
Epinephelus daemeli Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Nannoperca oxleyana Oxleyan Pygmy Perch [64468]	Endangered	Species or species habitat known to occur within area
Frogs		

Name	Status	Type of Presence
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat may occur within area
Litoria olongburensis Wallum Sedge Frog [1821]	Vulnerable	Species or species habitat known to occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may 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
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	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 known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrko [66]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Acronychia littoralis Scented Acronychia [8582]	Endangered	Species or species habitat likely to occur within area
Allocasuarina defungens Dwarf Heath Casuarina [21924]	Endangered	Species or species habitat likely to occur within area
Arthraxon hispidus Hairy-joint Grass [9338]	Vulnerable	Species or species habitat likely to occur within area
Baloghia marmorata Marbled Baloghia, Jointed Baloghia [8463]	Vulnerable	Species or species habitat may occur within area
Cryptocarya foetida Stinking Cryptocarya, Stinking Laurel [11976]	Vulnerable	Species or species habitat known to occur within area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Desmodium acanthocladum Thorny Pea [17972]	Vulnerable	Species or species habitat likely to occur within area
Endiandra hayesii Rusty Rose Walnut, Velvet Laurel [13866]	Vulnerable	Species or species habitat likely to occur within area
Floydia praealta Ball Nut, Possum Nut, Big Nut, Beefwood [15762]	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
Marsdenia longiloba Clear Milkvine [2794]	Vulnerable	Species or species habitat may occur within area
Ochrosia moorei Southern Ochrosia [11350]	Endangered	Species or species habitat likely to occur within area
Owenia cepiodora Onionwood, Bog Onion, Onion Cedar [11344]	Vulnerable	Species or species habitat likely to occur within area
Persicaria elatior Knotweed [5831]	Vulnerable	Species or species habitat likely to occur within area
Phaius australis Lesser Swamp-orchid [5872]	Endangered	Species or species habitat known to occur within area
Rutidosia heterogama Heath Wrinklewort [13132]	Vulnerable	Species or species habitat likely to occur within area
Streblus pendulinus Siah's Backbone, Sia's Backbone, Isaac Wood [21618]	Endangered	Species or species habitat likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding 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	Congregation or aggregation known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding likely to occur within area
Sharks		
Carcharias taurus (east coast population) Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	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
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may 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
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Puffinus leucomelas Streaked Shearwater [66541]		Species or species habitat may occur within area
Sterna albifrons Little Tern [813]		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

Name	Threatened	Type of Presence
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*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding 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	Congregation or aggregation known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species

Name	Threatened	Type of Presence
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		habitat may occur within area 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 known 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]		Roosting may occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting 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 - Defence Housing Authority Commonwealth Land - Telstra Corporation Limited		
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		

Name	Threatened	Type of Presence
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
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may 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]		Roosting may occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to 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 habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species

Name	Threatened	Type of Presence
Merops ornatus Rainbow Bee-eater [670]		habitat may occur within area 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 known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour 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
Sterna albifrons Little Tern [813]		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*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Fish		
Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
Campichthys tryoni Tryon's Pipefish [66193]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys ocellatus Orange-spotted Pipefish, Ocellated Pipefish [66203]		Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
Hippichthys heptagonus Madura Pipefish, Reticulated Freshwater Pipefish [66229]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus kelloggi Kellogg's Seahorse, Great Seahorse [66723]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Micrognathus andersonii Anderson's Pipefish, Shortnose Pipefish [66253]		Species or species habitat may occur within area
Micrognathus brevirostris thorntail Pipefish, Thorn-tailed Pipefish [66254]		Species or species habitat may occur within area
Microphis manadensis Manado Pipefish, Manado River Pipefish [66258]		Species or species habitat may occur within area
Solegnathus dunckeri Duncker's Pipehorse [66271]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Solenostomus paegnius Rough-snout Ghost Pipefish [68425]		Species or species habitat may occur within area
Solenostomus paradoxus Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding 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	Congregation or aggregation known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding likely to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area
Whales and other Cetaceans		
[Resource Information]		
Name	Status	Type of Presence
Mammals		

Name	Status	Type of Presence
Balaenoptera acutorostrata Minke Whale [33]	Endangered	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]		Species or species habitat may occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]	Vulnerable	Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Places on the RNE	[Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Richmond River (Casino to Broadwater)	NSW	Indicative Place
Broadwater National Park (1978 boundary)	NSW	Registered
Jerusalem Creek Area	NSW	Registered
Indigenous		
Goanna Headland Area	NSW	Registered
Schnapper Point Area	NSW	Registered

Name	State	Status
Historic		
Catholic Church	NSW	Indicative Place
Riverview	NSW	Indicative Place

State and Territory Reserves [\[Resource Information \]](#)

Name	State
Broadwater	NSW
Bundjalung	NSW
Minyumai	NSW

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 Resources 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

[Sturnus vulgaris](#)

Common Starling [389]

Species or species habitat likely to occur within area

Frogs

[Bufo marinus](#)

Cane Toad [1772]

Species or species habitat likely to occur within area

[Rhinella marina](#)

Cane Toad [83218]

Species or species habitat likely to occur within area

Mammals

Name	Status	Type of Presence
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
Feral deer Feral deer species in Australia [85733]		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
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 plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species 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
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
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 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
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
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Coordinates

-29.08348 153.38702

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

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.

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Appendix C - Flora Species List

Family	Exotic	Scientific Name	Common Name
Adiantaceae		<i>Cheilanthes sieberi subsp. sieberi</i>	Rock Fern
Amaranthaceae		<i>Amaranthus spp.</i>	Amaranth
Amaranthaceae	*	<i>Alternanthera pungens</i>	Khaki Weed
Apiaceae		<i>Trachymene incisa</i>	Trachymene
Apiaceae		<i>Hydrocotyle verticillata</i>	Shield Pennywort
Apiaceae		<i>Centella asiatica</i>	Indian Pennywort
Apocynaceae		<i>Parsonia straminea</i>	Common Silkpod
Arecaceae		<i>Livistona australis</i>	Cabbage Palm
Asteraceae	*	<i>Hypochaeris radicata</i>	Catsear
Asteraceae	*	<i>Ageratum houstonianum</i>	
Asteraceae	*	<i>Cirsium vulgare</i>	Spear Thistle
Asteraceae	*	<i>Senecio madagascariensis</i>	Fireweed
Asteraceae	*	<i>Bidens pilosa</i>	Cobbler's Pegs
Asteraceae	*	<i>Aster subulatus</i>	Wild Aster
Asteraceae		<i>Vernonia cinerea var. cinerea</i>	
Asteraceae	*	<i>Sonchus oleraceus</i>	Common Sowthistle
Asteraceae		<i>Euchiton sphaericus</i>	Star Cudweed
Asteraceae	*	<i>Gamochaeta americana</i>	Cudweed
Campanulaceae		<i>Wahlenbergia spp.</i>	Bluebell
Caryophyllaceae		<i>Spergularia marina</i>	Lesser Sea-spurrey
Clusiaceae		<i>Hypericum gramineum</i>	Small St John's Wort
Convolvulaceae		<i>Dichondra repens</i>	Kidney Weed
Cupressaceae		<i>Callitris columellaris</i>	
Cyperaceae		<i>Cyperus polystachyos</i>	
Cyperaceae		<i>Gahnia sieberiana</i>	Red-fruit Saw-sedge
Cyperaceae		<i>Caustis recurvata</i>	
Cyperaceae		<i>Fimbristylis spp.</i>	
Cyperaceae		<i>Baumea juncea</i>	
Cyperaceae		<i>Lepidosperma filiforme</i>	
Cyperaceae		<i>Fimbristylis velata</i>	
Cyperaceae		<i>Cyperus leiocaulon</i>	
Cyperaceae		<i>Cyperus difformis</i>	Dirty Dora
Cyperaceae		<i>Baumea articulata</i>	Jointed Twig-rush
Cyperaceae		<i>Gahnia aspera</i>	Rough Saw-sedge
Cyperaceae		<i>Cyperus concinnus</i>	Trim Flat-sedge
Cyperaceae	*	<i>Cyperus sesquiflorus</i>	
Dennstaedtiaceae		<i>Pteridium esculentum</i>	Bracken
Droseraceae		<i>Drosera spatulata</i>	
Ericaceae		<i>Leucopogon lanceolatus var. gracilis</i>	
Ericaceae		<i>Monotoca scoparia</i>	
Ericaceae		<i>Leucopogon leptospermoides</i>	
Ericaceae		<i>Monotoca elliptica</i>	Tree Broom-heath
Ericaceae		<i>Epacris pulchella</i>	Wallum Heath

Family	Exotic	Scientific Name	Common Name
Euphorbiaceae	*	<i>Chamaesyce hirta</i>	Asthma Plant
Fabaceae (Faboideae)		<i>Glycine clandestina</i>	Twining glycine
Fabaceae (Faboideae)	*	<i>Trifolium repens</i>	White Clover
Fabaceae (Faboideae)		<i>Dillwynia spp.</i>	
Fabaceae (Faboideae)		<i>Aotus ericoides</i>	
Fabaceae (Faboideae)		<i>Desmodium rhytidophyllum</i>	
Fabaceae (Faboideae)		<i>Kennedia rubicunda</i>	Dusky Coral Pea
Fabaceae (Faboideae)		<i>Hardenbergia violacea</i>	False Sarsaparilla
Fabaceae (Faboideae)		<i>Pultenaea villosa</i>	Hairy Bush-pea
Fabaceae (Mimosoideae)		<i>Acacia longifolia subsp. sophorae</i>	Coastal Wattle
Fabaceae (Mimosoideae)		<i>Acacia aulacocarpa</i>	Salwood
Fabaceae (Mimosoideae)		<i>Acacia ulicifolia</i>	Prickly Moses
Fabaceae (Mimosoideae)	*	<i>Acacia saligna</i>	Golden Wreath Wattle
Gleicheniaceae		<i>Gleichenia dicarpa</i>	Pouched Coral Fern
Goodeniaceae		<i>Goodenia pinnatifida</i>	Scrambles Eggs
Juncaceae		<i>Juncus usitatus</i>	
Juncaceae		<i>Juncus spp.</i>	A Rush
Juncaceae		<i>Juncus continuus</i>	
Juncaceae		<i>Juncus mollis</i>	Knotted rush
Juncaceae		<i>Luzula flaccida</i>	Woodrush
Lamiaceae	*	<i>Mentha spp.</i>	
Lauraceae		<i>Cassytha filiformis</i>	
Lobeliaceae		<i>Pratia purpurascens</i>	Whiteroot
Lomandraceae		<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
Luzuriagaceae		<i>Geitonoplesium cymosum</i>	Scrambling Lily
Malvaceae	*	<i>Modiola caroliniana</i>	Red-flowered Mallow
Menispermaceae		<i>Stephania japonica</i>	Snake vine
Myrsinaceae	*	<i>Anagallis arvensis</i>	Scarlet Pimpernel
Myrtaceae	*	<i>Corymbia torelliana</i>	Cadaghi
Myrtaceae		<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark
Myrtaceae		<i>Leptospermum polygalifolium subsp. cismontanum</i>	
Myrtaceae		<i>Melaleuca nodosa</i>	
Myrtaceae		<i>Leptospermum trinervium</i>	Slender Tea-tree
Myrtaceae		<i>Melaleuca squamea</i>	Swamp Honey-myrtle
Myrtaceae		<i>Callistemon salignus</i>	Willow Bottlebrush
Myrtaceae		<i>Eucalyptus tereticornis</i>	Forest Red Gum

Family	Exotic	Scientific Name	Common Name
Myrtaceae		<i>Corymbia intermedia</i>	Pink Bloodwood
Myrtaceae		<i>Eucalyptus resinifera</i>	Red Mahogany
Myrtaceae		<i>Leptospermum whitei</i>	
Myrtaceae		<i>Acmena smithii</i>	Lilly Pilly
Myrtaceae		<i>Eucalyptus robusta</i>	Swamp Mahogany
Myrtaceae		<i>Melaleuca thymifolia</i>	Thyme Honey-myrtle
Myrtaceae		<i>Leptospermum liversidgei</i>	Olive Tea-tree
Myrtaceae		<i>Lophostemon suaveolens</i>	Swamp Mahogany, Swamp Turpentine
Myrtaceae		<i>Eucalyptus bancroftii</i>	Orange Gum
Nymphaeaceae	*	<i>Nymphaea caerulea subsp. zanzibarensis</i>	Cape Waterlily
Orchidaceae		<i>Spiranthes australis</i>	Ladies' Tresses
Orchidaceae		<i>Dendrobium spp.</i>	
Oxalidaceae		<i>Oxalis exilis</i>	
Philydraceae		<i>Philydrum lanuginosum</i>	Frogsmouth
Phormiaceae		<i>Dianella caerulea</i>	Blue Flax-lily
Phyllanthaceae		<i>Poranthera microphylla</i>	Small Poranthera
Phyllanthaceae		<i>Glochidion ferdinandi</i>	Cheese Tree
Pinaceae	*	<i>Pinus radiata</i>	Radiata Pine
Plantaginaceae	*	<i>Plantago lanceolata</i>	Lamb's Tongues
Poaceae	*	<i>Andropogon virginicus</i>	Whisky Grass
Poaceae	*	<i>Axonopus fissifolius</i>	Narrow-leaved Carpet Grass
Poaceae		<i>Cynodon dactylon</i>	Common Couch
Poaceae		<i>Paspalum distichum</i>	Water Couch
Poaceae	*	<i>Setaria pumila</i>	Pale Pigeon Grass
Poaceae		<i>Imperata cylindrica</i>	Blady Grass
Poaceae		<i>Entolasia stricta</i>	Wiry Panic
Poaceae	*	<i>Paspalum urvillei</i>	Vasey Grass
Poaceae		<i>Eragrostis brownii</i>	Brown's Lovegrass
Poaceae		<i>Oplismenus aemulus</i>	
Poaceae		<i>Cymbopogon refractus</i>	Barbed Wire Grass
Poaceae		<i>Echinopogon ovatus</i>	Forest Hedgehog Grass
Poaceae	*	<i>Digitaria violascens</i>	
Poaceae	*	<i>Agrostis capillaris</i>	Browntop Bent
Poaceae	*	<i>Stenotaphrum secundatum</i>	Buffalo Grass
Poaceae	*	<i>Eleusine indica</i>	Crowsfoot Grass
Poaceae		<i>Themeda australis</i>	Kangaroo Grass
Poaceae	*	<i>Paspalum dilatatum</i>	Paspalum
Poaceae		<i>Microlaena stipoides</i>	Weeping Grass
Polygonaceae		<i>Persicaria decipiens</i>	Slender Knotweed
Portulacaceae		<i>Portulaca oleracea</i>	Pigweed
Proteaceae		<i>Banksia ericifolia</i>	Heath-leaved Banksia
Proteaceae		<i>Banksia aemula</i>	Wallum Banksia

Family	Exotic	Scientific Name	Common Name
Proteaceae		<i>Banksia oblongifolia</i>	Fern-leaved Banksia
Restionaceae		<i>Baloskion tetraphyllum</i>	
Restionaceae		<i>Eurychorda complanata</i>	
Restionaceae		<i>Hypolaena fastigiata</i>	
Restionaceae		<i>Leptocarpus tenax</i>	
Rhamnaceae		<i>Alphitonia excelsa</i>	Red Ash
Rubiaceae		<i>Pomax umbellata</i>	Pomax
Selaginellaceae		<i>Selaginella uliginosa</i>	Swamp Selaginella
Solanaceae	*	<i>Solanum nigrum</i>	Black-berry Nightshade
Solanaceae	*	<i>Solanum mauritianum</i>	Wild Tobacco Bush
Verbenaceae	*	<i>Verbena bonariensis</i>	Purpletop
Violaceae		<i>Hybanthus stellarioides</i>	
Violaceae		<i>Viola hederacea</i>	Ivy-leaved Violet
Xanthorrhoeaceae		<i>Xanthorrhoea fulva</i>	

Appendix D - Fauna Species List

Scientific Name	Common Name	Threatened Status	Observation Method
Birds			
<i>Struthidea cinerea</i>	Apostle Birds		Visual
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe		Visual
<i>Cracticus tibicen</i>	Australian Magpie		Visual
<i>Pelecanus conspicillatus</i>	Australian Pelican		Visual
<i>Corvus coronoides</i>	Australian Raven		Visual
<i>Chenonetta jubata</i>	Australian Wood Duck		Visual
<i>Coracina novaehollandiae</i>	Black-Faced Cuckoo-Shrike		Visual
<i>Entomyzon cyanotis</i>	Blue-Faced Honeyeater		Visual
<i>Lichmera indistincta</i>	Brown Honeyeater		Visual
<i>Climacteris picumnus</i>	Brown Treecreeper	V	Visual
<i>Platycercus elegans</i>	Crimson Rosella		Visual
<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill		Visual
<i>Eolophus roseicapilla</i>	Galah		Visual
<i>Rhipidura fuliginosa</i>	Grey Fantail		Visual
<i>Meliphaga lewinii</i>	Lewin's Honeyeater		Visual
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant		Visual
<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant		Visual
<i>Anthochaera chrysoptera</i>	Little Wattlebird		Visual
<i>Vanellus miles</i>	Masked Lapwing		Visual
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater		Visual
<i>Philemon corniculatus</i>	Noisy Friarbird		Visual
<i>Cracticus nigrogularis</i>	Pied Butcherbird		Visual
<i>Strepera graculina</i>	Pied Currawong		Visual
<i>Grallina cyanoleuca</i>	Pied Mudlark		Visual
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet		Visual
<i>Myiagra inquieta</i>	Restless Flycatcher		Visual
<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater		Visual
<i>Zosterops lateralis</i>	Silvereye		Visual
<i>Pardalotus striatus</i>	Striated Pardalote		Visual
<i>Malurus cyaneus</i>	Superb Fairywren		Visual
<i>Hirundo neoxena</i>	Welcome Swallow		Visual
<i>Sericornis frontalis</i>	White-Browed Scrubwren		Visual
<i>Rhipidura leucophrys</i>	Willy Wagtail		Visual
<i>Calyptorhynchus funereus</i>	Yellow-Tailed Black-Cockatoo		Visual / audio
Amphibians			
<i>Bufo marinus</i>	Cane Toad		Visual
<i>Crinia parinsignifera</i>	Eastern Sign-Bearing Froglet		Audio
<i>Litoria fallax</i>	Eastern Dwarf Tree Frog		Audio
Mammals			
<i>Pteropus alecto</i>	Black Flying Fox		Visual
<i>Trichosurus vulpecula</i>	Brush Tailed Possum		Visual

Scientific Name	Common Name	Threatened Status	Observation Method
<i>Bos primigenius</i>	Cattle*		Visual
<i>Canis lupus familiaris</i>	Dog*		Tracks
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bent-wing Bat	V	Anabat (Probable)
<i>Vespadelus pumilus</i>	Eastern Forest Bat		Anabat
<i>Macropus giganteus</i>	Eastern Grey Kangaroo		Visual
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat		Anabat (Probable)
<i>Chalinolobus nigrogriseus</i>	Hoary Wattled Bat	V	Anabat (Probable)
<i>Phascolarctos cinereus</i>	Koala	V	Scat / scratches
<i>Vespadelus darlingtoni</i>	Large Forest Bat		Anabat
<i>Miniopterus australis</i>	Little Bent-wing bat	V	Anabat
<i>Lepus curpaeums</i>	Rabbit*		Digs / scats
<i>Wallabia bicolor</i>	Swamp Wallaby		Visual
<i>Vespadelus regulus</i>	Southern Forest Bat		Anabat (Probable)
<i>Tadarida australis</i>	White-striped free-tailed bat		Anabat

V=vulnerable status under the TSC Act;

'Probable' indicates an indefinite identification from the Anabat monitor;

* indicates an introduced or domestic species

Appendix E - Assessment of significance for species listed on the TSC Act

Assessments of significance for State-listed threatened biota

Assessments of Significance (Seven-Part Tests) have been undertaken in accordance with the *Threatened species assessment guidelines: The assessment of significance* (OEH 2007) to identify the significance of impacts of the proposed expansion on threatened species and endangered ecological communities listed on Schedules 1, 1A and 2 of the NSW *Threatened Species Conservation Act 1995* (TSC Act) that were recorded or are considered likely to occur in the proposal site and that have not been assessed for significance under the EPBC Act.

Endangered Ecological Communities

- *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.*

Threatened flora

- *Rutidosis heterogama* (Heath Wrinklewort)

Threatened fauna

- *Crinia tinnula* (Wallum Froglet)
- *Nannoperca oxleyana* (Oxleyan Pygmy Perch)
- *Erythrorchis radiatus* (Red Goshawk)
- *Chalinolobus nigrogriseus* (Hoary Wattled Bat)
- *Miniopterus australis* (Little Bentwing-bat)
- *Miniopterus schreibersii oceanensis* (Eastern Bent-wing Bat)
- *Phascogale tapatoafa* (Brush-tailed Phascogale)
- *Phascolarctos cinereus* (Koala)
- *Petaurus poliocephalus* (Grey-headed Flying-fox)
- *Saccolaimus flaviventris* (Yellow-bellied Sheath-tail-bat)
- *Syconycteris australis* (Common Blossom-bat)

ENDANGERED ECOLOGICAL COMMUNITIES

Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions ('Swamp Sclerophyll Forest')

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable to endangered ecological communities.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable to endangered ecological communities.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Pink Bloodwood –Red Mahogany Open forest and Swamp Paperbark Forest occurs in low lying areas to the east of the existing quarry. These vegetation communities are synonymous with Swamp Sclerophyll Forest EEC.

Construction of the proposed expansion requires the removal of around 1.3 ha of modified Swamp Sclerophyll Forest.

Based on GIS analysis of EcoLogical (2005) mapping there is extant area of 24,799 ha of Paperbark swamp forest within the region. The proposed expansion would therefore result in a decrease in less than 0.005 percent of this EEC within the North Coast region.

The vegetation to be cleared on the site has been impacted by previous sand mining activities, clearing activities, past and agricultural activities and the presence of invasive weeds.

Due to the minor impact of the proposal on Swamp Sclerophyll Forest within the region and the already modified nature of the vegetation to be removed the proposal is unlikely to have an adverse effect on the extent of Swamp Sclerophyll Forest or place its local occurrence at risk of extinction.

(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

The proposed expansion has the potential to affect the composition of the Swamp Sclerophyll Forest adjacent to the area by introducing weed propagules into the area during construction and during operation. However, provided weed control measures are implemented during and after construction, weed infestation would be controlled and the composition of the vegetation would not be substantially altered. Weed control measures would be detailed in an environmental management plan (EMP) for the site.

Provided mitigation measures are implemented, the proposed expansion would not adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

d) In relation to the habitat of a threatened species, population or ecological community:

(i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed expansion requires the removal of about 1.3 ha of Modified Swamp Sclerophyll Forest.

The proposal also has the potential to indirectly impact areas of adjacent EEC through construction erosion and sedimentation, and edge effects such as invasion from weeds. Implementation of mitigation measures outlined in the Flora and Fauna Impact Assessment would protect adjacent areas of EECs and decrease the chance of indirect impacts to Swamp Sclerophyll Forest, including construction erosion and sedimentation controls.

(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Removal of vegetation as part of the proposed expansion would further fragment Swamp Sclerophyll Forest which occurs in an already fragmented landscape due to historic clearing of this EEC for existing quarry operations and rural development.

Within the subject site, vegetation proposed to be removed has been highly modified and consist of several small patches of scattered trees. These trees have been fragmented from nearby vegetation due to past land clearing. Clearing of this EEC during construction would further fragment this vegetation by widening the gap between the patches by about 100 metres. This would cause this patch to become further isolated from other areas of this EEC.

The existing patch of Swamp Sclerophyll Forest occurs in an already fragmented landscape due to historic clearing of this EEC for existing quarry operations and rural development. The clearing required for the proposed expansion would slightly increase the isolation of this patch of Swamp Sclerophyll Forest.

(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The area of Swamp Sclerophyll Forest to be impacted has been significantly modified through past clearing and subsequent invasion by perennial exotic grasses.

Impacts on this EEC are limited by the relatively small area of vegetation to be removed in comparison to the area that would remain within the locality. This vegetation is therefore unlikely to be important for the long term survival of the community in the locality.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

There is no critical habitat listed for Swamp Sclerophyll Forest under Part 3 Division 1 of the TSC Act

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is no recovery plan or threat abatement plan for Swamp Sclerophyll Forest EEC. OEH is currently developing a targeted approach for managing ecological communities in NSW. In the interim, the following management actions have been identified for this community:

- Undertake research to determine minimum fire frequency.
- Collate existing information on vegetation mapping and associated data for this EEC and identify gaps in knowledge. Conduct targeted field surveys and ground truthing to fill data gaps and clarify condition of remnants.
- Prepare identification and impact assessment guidelines and distribute to consent and determining authorities.
- Use mechanisms such as Voluntary Conservation Agreements to promote the protection of this EEC on private land.
- Liaise with landholders and undertake and promote programs that ameliorate threats such as grazing and human disturbance.

- Enhance the capacity of persons involved in the assessment of impacts on this EEC to ensure the best informed decisions are made.
- Undertake weed control for Bitou Bush and Boneseed at priority sites in accordance with the approved Threat Abatement Plan and associated PAS actions.
- Identify and prioritise other specific threats and undertake appropriate on-ground site management strategies where required.
- Investigate the ecology of Swamp sclerophyll forest species with particular emphasis on the importance of drying and wetting cycles in maintaining ecosystem health.
- Determine location, species composition and threats to remaining remnants to assist with prioritising restoration works.
- Collect seed for NSW Seedbank. Develop collection program in collaboration with BGT - all known provenances (conservation collection).

Investigate seed viability, germination, dormancy and longevity (in natural environment and in storage).

In line with mitigation measures outlined in the report, the proposed expansion would protect adjacent areas of EEC within a proposed offset site to the south of the proposed development. Furthermore weed management procedures would be implemented and construction erosion and sedimentation controls would be applied to prevent impacts on areas of Swamp Sclerophyll Forest adjoining the site.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

A threatening process is defined under Part 1 of the TSC Act, as "a process that threatens, or may have the capability to threaten the survival or evolutionary development of species, populations or ecological communities". Key threatening processes are listed under Schedule 3 of the Act and discussed in section 6.8 of this report.

Construction of the proposal would result in the operation of one key threatening process, namely 'clearing of native vegetation' (OEH, 2014e). However, as noted above, this clearing is relatively minor and is not likely to render the local occurrence of this EEC extinct.

Conclusion

The clearing of 1.3 ha of modified Swamp Sclerophyll Forest is expected to have a minimal impact on the EEC within the locality. There are about 24,499 ha of this EEC within the North Coast region (Ecological 2005). Therefore the removal of a small area of this community is unlikely to have a significant impact on this EEC in the regional context. Mitigation measures outlined in the Flora and Fauna Impact Assessment would protect adjacent areas of EECs and decrease the chance of indirect impacts to Swamp Sclerophyll Forest.

It is therefore considered unlikely that the proposed expansion would have a significant impact on Swamp Sclerophyll Forest EEC and as such a species impact statement would not be required.

THREATENED FLORA

***Rutidosia heterogama* (Heath Wrinklewort)**

Rutidosia heterogama (Heath Wrinklewort) is a small perennial plant in the Asteraceae family. The species is listed as vulnerable under both the TSC and EPBC Acts. Within NSW the species has been recorded from Cessnock to Kurri Kurri with isolated populations also known from the Central Coast north from Wyong to Newcastle. There are also populations between Wooli and Evans Head in Yaraygir and Bundjalung National Parks (OEH 2014).

Assessment of Significance for the Heath Wrinklewort

- a) ***In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;***

No population of this species has been recorded on site and no evidence of the species was observed during the recent field survey. The closest record of this species is approximately 4 km from the site within the Bundjalung National Park.

The proposed expansion will result in the loss of a small amount of potential habitat in the form of disturbance to approximately 0.2 ha of heath vegetation. Given the abundant adjacent corresponding vegetation community within the neighbouring Broadwater National Park, it is considered that the proposed expansion is not likely to have an adverse effect on the lifecycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

- b) ***In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;***

This is not an endangered population; therefore this question does not apply.

- c) ***In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***

is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

The Heath Wrinklewort is not an endangered or critically endangered ecological community. This question does not apply to this species.

- d) ***In relation to the habitat of a threatened species, population or ecological community:***

- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and***

An area estimated to be approximately 0.2 ha of coastal heath will be cleared from the site. It is possible that this area may comprise appropriate habitat for Heath Wrinklewort. Given the extent of the adjacent Broadwater National Park and similar available habitat, it is considered that the extent of the loss is not significant.

- (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and***

The area that will be cleared is currently partially isolated from the adjacent Broadwater National Park because of an asset protection zone cleared fence line. It is considered that the removal of this area will not increase the fragmentation of habitat or isolate any other areas.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

The project will result in the removal of up to 0.2 ha of potential habitat for Heath Wrinklewort. Given the small area that is likely to be disturbed and the availability of similar habitat in the adjacent national park, this potential habitat is not likely to be significant for the long term survival of this species.

According to the Threatened Species database (OEH 2014), this species and/or its habitat is known to occur in the locality. There are three records (OEH 2014) approximately 4 km from the study area. However, given the large amount of available similar habitat within the locality, the importance of the habitat to be removed to the long-term survival of any local population is considered low.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

There is no critical habitat listed for this species on the register of critical habitat.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan;

No recovery or threat abatement plan has been prepared for Heath Wrinklewort although six priority actions are listed for the species within the priority action statement. The proposed action contradicts a number of these threat abatement actions.

A targeted strategy for managing this species has been developed under the Saving Our Species program. Under this strategy Heath Wrinklewort has been assigned to the 'keep-watch species' management stream. There are no management actions proposed under this management stream.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

A threatening process is defined under Part 1 of the TSC Act, as "a process that threatens, or may have the capability to threaten the survival or evolutionary development of species, populations or ecological communities". Key threatening processes are listed under Schedule 3 of the Act and discussed in section 6.8 of this report.

Construction of the proposal would result in the operation of one key threatening process, namely 'clearing of native vegetation' (OEH, 2014e). However, as noted above, this clearing is relatively minor and is not likely to render the local occurrence of this species extinct.

Conclusion

The proposal would result in the removal of up to 0.2 hectares of potential habitat for Heath Wrinklewort. The removal of this habitat is unlikely to have a significant impact on the species.

THREATENED FAUNA

Crinia tinnula (Wallum Froglet)

Wallum Froglets are found in a wide range of habitats, usually associated with acidic swamps on coastal sand plains. They typically occur in sedgelands and wet heathlands. They can also be found along drainage lines within other vegetation communities and disturbed areas, and occasionally in swamp sclerophyll forests. The species breeds in swamps with permanent water as well as shallow ephemeral pools and drainage ditches. Breeding is thought to peak in the colder months, but can occur throughout the year following rain. Wallum Froglets shelter under leaf litter, vegetation, other debris or in burrows of other species. Shelter sites are wet or very damp and often located near the water's edge. Males may call throughout the year and at any time of day, peaking following rain (OEH 2014).

Assessment of Significance for the Wallum Froglet

- a) ***In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;***

No population of this species has been recorded on site and no evidence of the species was observed during the recent field survey. Some appropriate habitat for the Wallum Froglet is present within the study area, to the north east. The proposed expansion will result in the loss of some potential habitat in the form of disturbance to heath ecosystem with ponds. Given the abundant adjacent corresponding vegetation community within the neighbouring Broadwater National Park, it is considered that the proposed expansion is not likely to have an adverse effect on the lifecycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

- b) ***In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;***

This is not an endangered population; therefore this question does not apply.

- c) ***In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***

is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

The Wallum Froglet is not an endangered or critically endangered ecological community. This question does not apply to this species.

- d) ***In relation to the habitat of a threatened species, population or ecological community:***

- (i) ***the extent to which habitat is likely to be removed or modified as a result of the action proposed, and***

An area estimated to be no more than 720 m² of partially cleared lowland heath containing some *Banksia* species will be cleared from the area to the north of the large lake. It is possible that this area may comprise appropriate habitat or contain ephemeral ponds which are appropriate for use by this species. The artificial drainage channels and other water storages within the study area may also provide breeding habitat for this species. Given the extent of the adjacent Broadwater National Park and similar available habitat, it is considered that the extent of the loss is not significant.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The area that will be cleared is currently partially isolated from the adjacent Broadwater National Park because of an asset protection zone cleared fence line. It is considered that the removal of this area will not increase the fragmentation of habitat or isolate any other areas.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Clearing of vegetation may involve the removal of heath vegetation and ephemeral ponds. Given that there is no known population of the species within the locality and the availability of similar habitat in the adjacent national park, potential habitat for this species is not likely to be permanently modified as a result of the proposed activities, nor will it become fragmented or isolated from other potential habitat of this species.

According to the Threatened Species database (OEH 2014), this species and/or its habitat is known to occur in the locality. There are two records (OEH 2014) within one kilometre of the study area, to the north and east. However, given the large amount of available similar habitat within the locality, the importance of the habitat to be removed to the long-term survival of any local population is considered low.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

There is no critical habitat listed for this species or similar species on the register of critical habitat.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan;

A targeted strategy for managing this species has been developed under the *Saving our Species* program, Landscape species management stream (OEH 2014).

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Threats to this species are generally at the landscape / catchment scale and include sea level rise, climate change, shifts in water chemistry and urban development impacts.

Clearing of native vegetation

Clearing of native vegetation and alteration to natural ground level can be considered urban development impacts and are a threatening process to this species.

Conclusion

The removal of native vegetation as part of this proposal is not likely to have a significant effect upon the Wallum Froglet given the lack of a known population within the locality and the large amount of similar habitat in adjacent Broadwater National Park. Based on consideration of the above factors it is concluded that the proposed expansion is unlikely to have a significant impact on the Wallum Froglet under s5A of the EP&A Act.

Nannoperca oxleyana (Oxleyan Pygmy Perch)

Oxleyan Pygmy Perch mostly occur in swamps, creeks and lakes of coastal 'wallum' (Banksia-dominated coastal heath). These waters are usually acidic, with low salinity and low conductivity, and are often darkly stained. They seem to prefer slow-moving or still waters with plenty of shelter in the form of dense aquatic vegetation (e.g. sedges) or undercut, root-filled banks fringed with submerged riparian (river bank) vegetation.

Assessment of Significance for the Wallum Froglet

- a) *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;***

No population of this species has been recorded on site and no evidence of the species was observed during the recent field survey. Some appropriate habitat for the Oxleyan Pygmy Perch is present within the study area, to the north east, however this is unlikely to be impacted by the proposal. Given the abundant adjacent corresponding vegetation community within the neighbouring Broadwater and Bundjalung National Park, it is considered that the proposed expansion is not likely to have an adverse effect on the lifecycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

- b) *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;***

This is not an endangered population; therefore this question does not apply.

- c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***

is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

The Oxleyan Pygmy Perch is not an endangered or critically endangered ecological community. This question does not apply to this species.

- d) *In relation to the habitat of a threatened species, population or ecological community:***

- (i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and***

An area estimated to be no more than 720 m² of partially cleared lowland heath containing some *Banksia* species will be cleared from the area to the north of the large lake. The artificial drainage channels and other water storages within the study area may provide habitat for this species. Given the extent of the adjacent Broadwater and Bundjalung National Parks with similar habitat, it is considered that the extent of the loss is not significant.

- (ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and***

The area that will be cleared is currently partially isolated from the adjacent National Parks because of an asset protection zone cleared fence line. It is considered that the removal of this area will not increase the fragmentation of habitat or isolate any other areas.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Given that there is no known population of the species within the study area and the availability of similar and more suitable habitat in the adjacent national park, potential habitat for this species is not likely to be permanently modified as a result of the proposed activities, nor will it become fragmented or isolated from other potential habitat of this species.

According to the DPI Records Viewer database (Figure 3), there are many records within one kilometre of the study area. However, given the large amount of available similar habitat within the locality, the importance of the habitat to be removed to the long-term survival of any local population is considered low.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

There is no critical habitat listed for this species or similar species on the register of critical habitat.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan;

The Recovery Plan for this species contains 17 objectives to be achieved in three program areas including research, compliance and management.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Threats to this species are listed in the Recovery Plan as:

- Habitat degradation and loss
- Introduced fish species
- Collection and aquarium keeping.

Conclusion

The disturbance to some small holes and shallow open drainage lines as part of this proposal is not considered likely to have a significant impact upon the Oxleyan Pygmy Perch given the lack of a known population within the locality and the large amount of similar habitat in adjacent National Parks. Based on consideration of the above factors it is concluded that the proposed expansion is unlikely to have a significant impact on the Oxleyan Pygmy Perch under s5A of the EP&A Act.

Erythroriorchis radiatus (Red Goshawk)

This species is listed as Critically Endangered under the TSC Act. It is known to inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and they are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, *Melaleuca* swamp forest and riparian *Eucalyptus* forest of coastal rivers (OEH 2014).

Assessment of Significance for the Red Goshawk

- a) ***In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;***

No Red Goshawks were observed within the subject site during the current investigation.

Additionally, there are no known populations of this species within this study area.

Consequently, it is unlikely that there is a viable local population of the Red Goshawk within the site.

The proposed expansion is not likely to have an adverse effect on the lifecycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

- b) ***In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;***

This is not an endangered population; therefore this question does not apply.

- c) ***In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***

- ***is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or***
- ***is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;***

The Red Goshawk is not an endangered or critically endangered ecological community. This question does not apply to this species.

- d) ***In relation to the habitat of a threatened species, population or ecological community:***

- (i) ***the extent to which habitat is likely to be removed or modified as a result of the action proposed, and***

Vegetation will be cleared as part of the proposed construction. Up to 22 trees with hollows may be cleared as a result of the proposed expansion. However, there is an abundance of suitable habitat in adjacent areas.

- (ii) ***whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and***

Given the already fragmented and predominantly cleared nature of much of the subject site, no increase in isolation or fragmentation is likely to result from the proposed clearing to facilitate the construction.

- (iii) ***the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;***

Given that there is no known population of the species within the locality, potential habitat for this species is not likely to be permanently modified as a result of the proposed activities, nor will it become fragmented or isolated from other potential habitat of this species.

According to the Threatened Species database (OEH 2014), this species is not known to occur in the locality but its habitat is predicted to occur.

e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);*

There is no critical habitat listed for these species or similar species on the register of critical habitat.

f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan;*

There are five current priority actions identified to assist the recovery of this species. These are mostly based on further research and increasing community awareness. The proposed expansion is not inconsistent with OEH's priority actions or recovery strategies.

g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

There are currently 35 key threatening processes (KTPs) listed under the *TSC Act*. Those that will occur as part of the proposed action include:

Clearing of native vegetation

The proposed action includes the removal of native vegetation, thus a listed KTP will occur as part of the proposal.

Conclusion

The removal of native vegetation as part of this proposal is not likely to have a significant effect under s5A of the EP&A Act upon the Red Goshawk given the proposed management protocols associated with clearing, lack of an identified population in the locality and the large amount of similar scattered mature eucalypt and grassland habitat in nearby agricultural areas.

***Miniopterus australis* (Little Bentwing-bat), *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat), *Chalinolobus nigrogriseus* (Hoary Wattled Bat)**

The Little Bent-wing Bat is listed as vulnerable under the TSC Act. It is known to inhabit moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, *Melaleuca* swamps, dense coastal forests and banksia scrub. It is generally found in well-timbered areas. They roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains culverts, bridges and sometimes buildings during the day. At night they forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites and only five nursery sites / maternity colonies are known in Australia (OEH 2014).

The Eastern Bent-wing Bat occurs along the east and north-west coasts of Australia. They primarily roost in caves, but also use derelict mines, stormwater tunnels, buildings and other structures. They form discrete populations centred on a maternity cave that is used annually in spring and summer. This species hunts in forested areas, catching moths and other flying insects above the tree tops (OEH 2014).

In NSW the Hoary Wattled Bat occurs in dry open eucalypt forests, favouring forests dominated by Spotted Gum, boxes and ironbarks, and heathy coastal forests where Red Bloodwood and Scribbly Gum are common. Because it flies fast below the canopy level, forests with naturally sparse understorey layers may provide the best habitat (OEH 2014).

Assessment of Significance for these microbat species

- a) ***In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;***

Microbats were observed within the subject site during the current investigation. There is, however, no known population of this species within this study area. It is likely that the site was being utilised as forage for the species. Given that this species can roost in tree hollows, it is possible that there may be scattered individuals present within the study area from time to time. It is unlikely that there is a viable population of these species within the study area.

The proposed expansion is not likely to have an adverse effect on the lifecycle of these species such that a viable population is likely to be placed at risk of extinction.

- b) ***In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;***

This is not an endangered population; therefore this question does not apply.

- c) ***In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***

- ***is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or***
- ***is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;***

These microbat species are not an endangered or critically endangered ecological community. This question does not apply.

- d) ***In relation to the habitat of a threatened species, population or ecological community:***

- (i) ***the extent to which habitat is likely to be removed or modified as a result of the action proposed, and***

Vegetation will be cleared as part of the proposed construction. Up to 22 trees with hollows are likely to be cleared for the proposed quarry extension. However, there is an abundance of suitable habitat in adjacent areas.

- (ii) ***whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and***

Given the already fragmented and predominantly cleared nature of much of the subject site, no increase in isolation or fragmentation is likely to result from the proposed clearing for the construction.

- (iii) ***the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;***

Given that there is no known population of the species within the locality, and that there is an abundance of potential habitat for this species in adjacent National Parks, the amount of vegetation which provides potential habitat for this species is not considered important, nor will it become fragmented or isolated from other potential habitat of this species.

- e) ***Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);***

There is no critical habitat listed for these species or similar species on the register of critical habitat.

- f) ***Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan;***

These species have been assigned to the Site-managed species management stream under the *Saving our Species* program. The proposed expansion is not consistent with OEH's recovery strategy which identifies site-based management objectives.

- g) ***Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.***

There are currently 35 key threatening processes (KTPs) listed under the TSC Act. Those that will occur as part of the proposed action include:

Clearing of native vegetation

The proposed action includes the removal of native vegetation, thus a listed KTP will occur as part of the proposal.

Conclusion

The removal of native vegetation as part of this proposal is not likely to have a significant effect under s5A of the EP&A Act upon the Little Bentwing-bat, the Eastern Bentwing-bat or the Hoary Wattled Bat given the large amount of similar scattered mature eucalypt and National Park in nearby areas.

Phascogale tapoatafa (Brush-tailed Phascogale)

Brush-tailed Phascogales are tree-dwelling, carnivorous marsupials. They prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. They also inhabit heath, swamps, rainforest and wet sclerophyll forest. This species is an agile climber, foraging preferentially in rough barked trees of 25 cm DBH or greater. They feed mostly on arthropods but will also eat other invertebrates, nectar and sometimes small vertebrates. They nest and shelter in tree hollows with entrances 2.5-4 cm wide and use many different hollows over a short time span. They are known to utilise exclusive large territories of approximately 20-40 ha (female) and 100 ha (male) (OEH 2014).

Assessment of Significance for the Brush-tailed Phascogale

- a) ***In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;***

The proposed expansion will result in the loss of some potential habitat in the form of hollow-bearing trees. No known populations were identified within this study area although the OEH database indicates that a record for this species has been made on the property. It is possible that there is a local population that utilises habitat within the study area. It is not known if the proposed expansion is likely to have an adverse effect on the lifecycle of this species such that a viable population of the species is likely to be placed at risk of local extinction. Given the abundance of similar habitat available in adjacent areas to the west, south and east of the record point (OEH 2014), it is considered unlikely that the proposed expansion will have an adverse effect on the lifecycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

- b) ***In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;***

This is not an endangered population; therefore this question does not apply.

- c) ***In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***

is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

The Brush-tailed Phascogale is not an endangered or critically endangered ecological community. This question does not apply to this species.

- d) ***In relation to the habitat of a threatened species, population or ecological community:***

- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and***

The proposed action will cause the removal of up to 22 hollow-bearing trees. This represents foraging and nesting habitat for this species. Retention of these hollows in the offset area may reduce the impacts.

- (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and***

The development area is dominated by scattered mature eucalypts in an agricultural landscape. Clearing the isolated trees is not likely to further isolate or fragment areas of habitat in an already scattered and fragmented area.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Clearing is likely to involve the removal of trees including those preferred by the Brush-tailed Phascogale. A detailed inventory of the trees to be removed has not been completed as part of this study.

Given the abundance of similar habitat trees in adjacent areas, the removal of some potential habitat for this species is not likely to represent a threat to the survival of the species or population, nor will the nature of the proposal cause the area to become more fragmented or isolated from other potential habitat of this species.

e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);*

There is no critical habitat listed for these species or similar species on the register of critical habitat.

f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan;*

A targeted strategy for managing this species has been developed under the *Saving our Species* program, Landscape species management stream (OEH 2014).

g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

This species is distributed across relatively large areas and is subject to threatening processes that generally act at the landscape scale (e.g. habitat loss or degradation) rather than at distinct, definable locations.

Loss of hollow bearing trees

The proposed action includes the removal of up to 22 hollow bearing trees which is a recognised key threatening process.

Clearing of native vegetation

The proposed action includes the removal of native vegetation, another key threatening process that will occur as part of the proposal.

Conclusion

The removal of native vegetation as part of this proposal is not likely to have a significant effect upon the Brush-tailed Phascogale given the large amount of similar scattered mature eucalypt habitat in nearby agricultural areas and Broadwater National Park. With regards to the removal of hollow bearing trees, the impact is not considered likely to cause a significant effect on the Brush-tailed Phascogale given the size of the range for this species and the available similar habitat in adjacent areas. Based on consideration of the above factors it is concluded that the proposed expansion is unlikely to have a significant effect on the Brush-tailed Phascogale under s5A of the EP&A Act.

Pteropus poliocephalus (Grey-headed Flying-fox), Saccolaimus flaviventris (Yellow-bellied Sheathtail-bat) and Syconycteris australis (Common Blossom-bat)

Grey-headed Flying foxes are found within 200 km of the eastern coast of Australia. They occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps generally located within 20 km of a regular food source and are commonly found in gullies, close to water and in vegetation with a dense canopy. Travel up to 50 km to forage and feed on the nectar and pollen of Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. OEH database indicates records in Broadwater National Park to the north of the study area (OEH 2014).

The Yellow-bellied Sheathtail-bat forages across a range of habitats including those with and without trees, from wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert. This species roosts in tree hollows and buildings and in areas where trees are scarce or absent, and has been known to utilise mammal burrows. This species has been recorded three kilometres to the east of the study area (OEH 2014).

Common Blossom-bats are small nectar-eating bats that often roost in littoral rainforest and feed on nectar and pollen from flowers in adjacent heathland and paperbark swamps. They have also been recorded in other coastal vegetation communities. This species has been recorded in the Broadwater National Park within two kilometres of the study area (OEH 2014).

Assessment of Significance for these species

- a) ***In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;***

Pteropus alecto (Black Flying-fox) were observed during the site survey, however none of these listed species were observed. No roosts or camps were observed. The proposed expansion may impact on foraging habitat for all these species. No known populations were identified within this study area. The proposed expansion is not likely to have an adverse effect on the lifecycle of the listed species such that a viable population of the species is likely to be placed at risk of extinction.

- b) ***In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;***

These species are not an endangered population; therefore this question does not apply.

- c) ***In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***

is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

These species are not an endangered or critically endangered ecological community. This question does not apply to this species.

- d) ***In relation to the habitat of a threatened species, population or ecological community:***

- (i) ***the extent to which habitat is likely to be removed or modified as a result of the action proposed, and***

The removal of vegetation may result in the reduction of available vegetation for foraging. However given the abundance of vegetation in adjacent areas and National parks nearby, it is not likely that the extent of removal would be significant to these species.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The proposal is unlikely to further fragment habitat for these species given the predominantly cleared agricultural area.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Vegetation removal will include removal of potential foraging habitat for these species. There is no known camp for the Grey-headed Flying-fox within the locality of the proposed development. Given the large amount of available similar habitat within the locality, the importance of the habitat to be removed to the long-term survival of any local population is considered moderate.

Given the location of the proposed development adjacent to existing habitat within the Broadwater National Park, the remaining habitat will not become further fragmented or isolated from other potential habitat of this species.

According to the Threatened Species database (OEH 2014), these species are known to occur in the locality and have been recorded within 2.5 km of the study area.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

There is no critical habitat listed for these species or similar species on the register of critical habitat.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan;

This species is distributed across relatively large areas and is subject to threatening processes that generally act at the landscape scale (e.g. habitat loss or degradation) rather than at distinct, definable locations.

The proposed expansion is likely to remove hollow-bearing trees as part of the requirements for the quarry expansion.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Loss of hollow bearing trees (HBT)

The proposed action includes the removal of up to 22 hollow bearing trees so therefore it involves the operation of a KTP.

Clearing of native vegetation

The proposed action includes the removal of native vegetation, thus a listed KTP will occur as part of the proposal.

Conclusion

The removal of native vegetation from within this proposal is not likely to have a result in a significant effect upon these species given the large amount of similar habitat in nearby areas. In regards to the removal of hollow bearing trees, the impact is not considered to cause a significant effect on these species due to the presence of other HBTs in the locality. Based on consideration of the above factors it is concluded that the proposed expansion is unlikely to have a significant effect on the Grey-headed Flying-fox, Yellow-bellied Sheath-tail-bat or the Common Blossom Bat under s5A of the EP&A Act.

Koala (*Phascolarctos cinereus*)

The Koala is 'known' to occur within the locality (OEH 2013). The Koala has a fragmented distribution, with some populations west of the Great Dividing Range in NSW. Their home range varies greatly from two ha to several hundred ha in size. Koalas inhabit eucalypt woodlands and forests feeding on the foliage of more than 70 eucalypt species and 30 non-eucalypt species. Known feed trees for this species include *Eucalyptus tereticornis* which is a constituent species of the vegetation to be cleared.

Assessment of Significance for the Koala

- a) ***In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;***

Evidence of Koala was observed during the site survey in the form of scats or scratches on potential feed trees in the area adjacent to the clearing area. The proposed expansion is likely to impact on foraging habitat. No known populations were identified within this study area. It is not known if the proposed expansion is likely to have an adverse effect on the lifecycle of this species such that a viable population of the species is likely to be placed at risk of extinction. Given the linear nature of the proposed clearing, it may be that the impact on any resident population would be negligible, with an allowance for the species to still cross and connect with adjacent vegetation communities.

- b) ***In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;***

This is not an endangered population; therefore this question does not apply.

- c) ***In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***

is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

This species is not an endangered or critically endangered ecological community. This question does not apply to this species.

- d) ***In relation to the habitat of a threatened species, population or ecological community:***

- (i) ***the extent to which habitat is likely to be removed or modified as a result of the action proposed, and***

Foraging habitat and refugia will be impacted as a result of the proposed expansion through the clearing of native vegetation including eucalypts.

- (ii) ***whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and***

The proposal is unlikely to further fragment habitat for this species given the predominantly cleared agricultural area.

- (iii) ***the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;***

Vegetation removal will include removal of foraging habitat for this species. Given the large amount of available similar habitat within the locality, the importance of the habitat to be removed to the long-term survival of any local population is considered moderate. However,

consideration of cumulative impacts on this species may indicate that removal of any habitat is a factor contributing to the decline in numbers of this species across its range.

Potential habitat for this species may be permanently modified as a result of the proposed activities, however, an increase in the level of fragmentation is not likely to result given the nature of the proposed expansion within a partially cleared agricultural paddock. The clearing is unlikely to further isolate any individuals or populations within the proposed alignment.

e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);*

There is no critical habitat listed for these species or similar species on the register of critical habitat.

f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan;*

Management for this species has received funding through the *Saving our Species* as part of the Iconic Species Project.

The Recovery Plan for the Koala (DECC 2008) indicates that priority actions focus on implementation of the objectives of SEPP 44 and the National Koala Conservation Strategy for the conservation of koalas and their habitat in NSW.

The proposed expansion is likely to remove foraging trees as part of the requirements for the development, and as such is not wholly consistent with OEH's priority actions or recovery strategies.

g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

There are currently 35 key threatening processes (KTPs) listed under the *TSC Act*. Those that will occur as part of the proposed action include:

Clearing of native vegetation

The proposed action includes the removal of native vegetation, thus a listed KTP will occur as part of the proposal.

Conclusion

The removal of native vegetation as part of this proposal is not likely to have a significant effect under s5A of the EP&A Act upon the Koala given the large amount of similar eucalypt habitat in nearby areas and the linear nature of the impact in a largely modified agricultural landscape.

Appendix F - Assessment of significance for species listed on the EPBC Act

Assessment of Significance (EPBC Act)

The following EPBC listed threatened species have been identified as having potential to occur in the locality and field surveys have confirmed either their presence within the study area or the presence of suitable habitat in the study area, with a moderate or high assessment of impact.

- *Rutidosia heterogama* (Heath Wrinklewort) – Listed as Vulnerable
- *Phascolarctos cinereus* (Koala) – Listed as Vulnerable
- *Erythrotriorchis radiatus* (Red Goshawk) – Listed as Vulnerable (Critically endangered under TSC Act NSW)
- *Nannoperca oxleyana* (Oxleyan Pygmy Perch) – Listed as Endangered

An assessment of the significance of the impact from the proposed project on this species is included in this section.

None of the other EPBC listed threatened or migratory species were considered likely to occur or to be significantly affected by the proposal for some or all of the following reasons:

- Potential habitat does not occur on or near the study area
- Potential habitat is unlikely to be significantly impacted
- Minimal potential to occur on study area due to:
 - o Disturbance history
 - o Isolation from other suitable habitats
 - o Insufficient extent of habitats in remnants
 - o Habitat loss due to the proposal represents a relatively small contraction of a suitable fraction of a larger potential range

It is not considered likely that there will be a significant impact on any of these species as a result of the proposed activities.

Significant Impact Criteria for Critically Endangered and Endangered Species

An action is likely to have a significant impact on a **critically endangered** or **endangered** species if there is a real chance or possibility that it will:

- a) *lead to a long-term decrease in the size of a population*
- b) *reduce the area of occupancy of the species*
- c) *fragment an existing population into two or more populations*
- d) *adversely affect habitat critical to the survival of a species*
- e) *disrupt the breeding cycle of a population*
- f) *modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*
- g) *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*
- h) *introduce disease that may cause the species to decline, or • interfere with the recovery of the species.*

Nannoperca oxleyana (Oxleyan Pygmy Perch)

Oxleyan pygmy perch are a small freshwater fish endemic to the coastal region of eastern Australia. They have specific habitat requirements which are threatened by coastal development and competition from the introduced *Gambusia holbrooki*. They are listed as endangered under both the TSC and EPBC Acts (NSW DPI 2007).

Oxleyan pygmy perch mostly occur in swamps, creeks and lakes of coastal 'wallum' (Banksia-dominated coastal heath). The water is usually acidic, with low salinity and are often darkly stained. They prefer slow-moving or still waters with plenty of shelter from dense aquatic vegetation such as sedges or undercut root-filled banks fringed with submerged riparian vegetation. They mainly feed on small aquatic fauna such as insects, diatoms and crustaceans.

Part of their recovery plan for this species is to protect remaining areas of habitat from disturbance or degradation, preventing sedimentation and impacts on water quality.

Oxleyan Pygmy Perch mostly occur in swamps, creeks and lakes of coastal 'wallum' (Banksia-dominated coastal heath). These waters are usually acidic, with low salinity and low conductivity, and are often darkly stained.

They seem to prefer slow-moving or still waters with plenty of shelter in the form of dense aquatic vegetation (e.g. sedges) or undercut, root-filled banks fringed with submerged riparian (river bank) vegetation (DPI 2014).

a) *lead to a long-term decrease in the size of a population*

While the effects of clearing the small (approx. 720 m²) area of heath vegetation on sand in which pools with tannin-stained water are present is cumulative across the landscape, it is not considered that the impact of clearing for the proposed development will lead directly to a long-term decrease in the size of a population associated with the locality.

It is possible that the reduction in number of suitable acidic pools will reduce the size of any population that is present within the locality and their ability to disperse.

b) *reduce the area of occupancy of the species*

Given that the species was not observed nor were any signs of this species observed during site surveys, and given that there is limited suitable habitat, in terms of appropriately vegetated

pools, for the species present within the study area, the impacts of the proposed development are not considered likely to reduce the area of occupancy of this species.

c) *fragment an existing population into two or more populations*

No population of this species was observed within the study area so it is not considered likely that the proposed action would fragment an existing population into two or more populations any further than it already is within the study area.

Given that the majority of the study area has already been impacted by land clearing and agricultural landuse practices, additional significant fragmentation is not considered significant.

d) *adversely affect habitat critical to the survival of a species*

If it were present in the study area, this species would occur within isolated pools, as no natural watercourses occur. There are likely to be a greater abundance of suitable pools, streams and other waterbodies within the adjacent Broadwater National Park. Whilst potential habitat will be affected, it is not considered likely that the habitat that will be removed could be considered habitat that is critical to the survival of the species.

e) *disrupt the breeding cycle of a population*

Clearing of low heath including ephemeral pools will involve some risk of disturbance to this species, if it is present within the area to be cleared. It is suggested that the clearing be timed to avoid prime breeding periods for this species within the locality and that pre-clearance surveys be undertaken by suitably qualified aquatic fauna specialists.

f) *modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

Habitat is likely to be modified, removed and decreased as a result of the proposed action, however, it is considered unlikely that the species will decline as a result of this given the availability of similar habitat within the immediate vicinity of the habitat that will be cleared.

g) *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

The proposed action is not likely to result in the establishment of an invasive species that would harm the endangered species or their habitat. Stormwater flow from the proposed quarry expansion is towards the south, away from the Broadwater National Park. Given this fact, it is considered unlikely that the proposed development would result in an invasive species being introduced into the fish's habitat. Gambusia are a threatening species, however, it is unlikely that the proposed development would increase the abundance of Gambusia within the study area.

h) *introduce disease that may cause the species to decline, or*

The proposed action is not likely to introduce disease that may cause the species to decline.

i) *interfere with the recovery of the species.*

Given that there is no known population of this species within the subject site, the proposed action is not likely to interfere with the recovery of the species.

Conclusion

The proposed action is not likely to have a significant impact on *Nannoperca oxleyana* (Oxleyan Pygmy Perch).

Erythrorchis radiatus (Red Goshawk)

Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, *Melaleuca* swamp forest and riparian *Eucalyptus* forest of coastal rivers (OEH 2014). This species is listed as critically endangered under the NSW *Threatened Species Conservation Act 1995*.

The OEH database indicates one record for this species located within one kilometre of the study area to the south east in Broadwater National Park and near the Evans River.

a) lead to a long-term decrease in the size of a population

While the effect of clearing is cumulative across the landscape, it is not considered that the impact of clearing for the proposed development will lead to a long-term decrease in the size of a population of this species associated with the locality. Red Goshawks have large home ranges (up to 120 km² in the Northern Territory) and feed on medium-large birds. Given the abundance of similar habitat within the locality and in the broader region that forms part of their range, the proposed project is not likely to lead to a long-term decrease in the size of a population that may be present within the locality.

b) reduce the area of occupancy of the species

Given that the Red Goshawk has a large range, it is unlikely that the clearing as part of the proposed activities will significantly reduce the area of occupancy of the species. Suitable habitat for this species is present within the locality and the broader region.

c) fragment an existing population into two or more populations

There is no known population within the vicinity of the study area. The proposed development is unlikely to bring about the fragmentation of a population.

d) adversely affect habitat critical to the survival of a species

It is not considered likely that the habitat that will be removed could be considered habitat that is critical to the survival of the species.

e) disrupt the breeding cycle of a population

Clearing of native vegetation may involve some risk of disturbance for this species. Pre-clearance inspections of trees will avoid this.

f) modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

It is considered unlikely that the species will decline as a result of the proposed development given the availability of similar habitat within the immediate vicinity. It is unlikely that the proposal will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the Red Goshawk species is likely to decline further.

g) result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

The proposed development is not likely to result in the establishment of an invasive species that would harm the endangered species or their habitat.

h) introduce disease that may cause the species to decline, or

The proposed action is not likely to introduce disease that may cause the species to decline.

i) interfere with the recovery of the species.

The proposed action is not likely to interfere with the recovery of the species if the amount of clearing is minimised.

Conclusion

The proposed action is unlikely to have a significant impact on the habitat of the *Erythrotriorchis radiatus* (Red Goshawk) and thereby on the species.

Significant Impact Criteria for Vulnerable Species

The guidelines to the assessment of significance define an action as likely to have significant impact on a **vulnerable** species if it will:

- a) Lead to a long term decrease in the size of an important population of a species;*
- b) Reduce the area of occupancy of an important population;*
- c) Fragment an existing important population into two or more populations;*
- d) Adversely affect habitat critical to the survival of a species;*
- e) Disrupt the breeding cycle of an important population;*
- f) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;*
- g) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;*
- h) Introduce disease that may cause the species to decline; or*
- i) Interfere with the recovery of the species.*

a) Lead to a long term decrease in the size of an important population of a species;

An 'important population' of a vulnerable species is defined by DEWHA (2009) as '...a population that is necessary for the species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species' range'

***Rutidosia heterogama* (Heath Wrinklewort)**

Rutidosia heterogama (Heath Wrinklewort) is a small perennial plant in the Asteraceae family. The species is listed as vulnerable under both the TSC and EPBC Acts. Within NSW the species has been recorded from Cessnock to Kurri Kurri with isolated populations also known from the Central Coast north from Wyong to Newcastle. There are also populations between Wooli and Evans Head in Yaraygir and Bundjalung National Parks (OEH 2014).

a) *Will the activity lead to a long term decrease in the size of an important population of a species*

The plant species Heath Wrinklewort (*Rutidosia heterogama*), although not identified within the study area, is known to occur within the nearby Bundjalung National Park. This population is considered to be an important population as it is identified in approved Conservation Advice for the species and is a population that would maintain the genetic diversity of the species.

This population is located approximately 4 km from the study area. It is likely that if this species were to occur within the site that it would be considered to be part of this important population.

b) *Will the activity reduce the area of occupancy of an important population*

The proposal would reduce the area of potential occupancy of this species by approximately 0.2 ha.

c) *Will the activity fragment an existing important population into two or more populations*

The area of potential habitat that would be impacted occurs in an already fragmented landscape. It is therefore not likely to result in the fragmentation or isolation of habitats.

d) *Will the activity adversely affect habitat critical to the survival of a species*

There is no listed critical habitat for the Heath Wrinklewort.

e) *Will the activity disrupt the breeding cycle of an important population*

The Heath Wrinklewort predominantly flowers in Autumn, with seeds dispersed by wind. According to the approved conservation advice, the species appears to require soil disturbance for successful recruitment. Given that no important population of this species has been identified within the study area, the proposed expansion is unlikely to disrupt the breeding cycle.

f) *Will the activity modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

Given the size of the area proposed to be removed in the context of the adjacent National Park vegetation, it is unlikely that this species' habitat will be impacted to the extent that it is likely to decline.

g) *Will the activity result in invasive species that are harmful to a threatened species becoming established in a threatened species habitat*

Weed species are currently actively controlled and will be maintained utilising existing practices. Methods utilised should be sympathetic towards the potential for impacts upon native species. The proposed expansion is unlikely to result in establishment of harmful invasive species in this species habitat.

h) *Will the activity introduce disease that may cause the species to decline*

The risk of disease introduction as a result of the proposed activities is considered low and appropriate hygiene measures will be employed such that the risk of the introduction of diseases is minimised.

i) *Will the activity interfere substantially with the recovery of a species*

The clearing and potential operational impacts associated with the proposed expansion are not expected to substantially interfere with the recovery of the Heath Wrinklewort.

Phascolarctos cinereus (Koala)

The Koala is listed as Vulnerable under the EPBC Act. It is a medium to large arboreal marsupial that occurs in eastern Australia. It has a fragmented distribution, limited to areas of preferred feed trees in eucalypt woodlands and forests. The home range of Koalas varies depending on the quality of habitat, ranging from less than 2 ha to several hundred ha in size.

Koalas are common on the east coast of NSW. There is one record of Koala within approximately one kilometre of the study area to the east (OEH 2014).

a) lead to a long-term decrease in the size of a population

While the impact of clearing trees is cumulative across the landscape, it is not considered that the impact of clearing for the proposed action will lead to a long-term decrease in the size of a population associated with the locality. The Koala prefers eucalypts (especially *Eucalyptus tereticornis* and *E. resinifera*) that occur within the study area. The reduction in food trees may lead to a long-term decrease in the size of the local population, however the nature of the proposed clearing will result in the loss of some open woodland, the removal of some paddock trees. Given the abundance of similar trees within the adjacent areas that are to be retained and within the neighbouring Broadwater National Park, the removal of trees as part of this proposed project is not likely to lead to a long-term decrease in the size of a population that may be present within the locality.

b) reduce the area of occupancy of the species

Given that Koala feeds on eucalypt leaves from certain species that do occur across the study area and into adjacent areas, it is unlikely that the clearing as part of the proposed activities will significantly reduce the area of occupancy of the species. There is suitable alternative habitat for the species present within the study area and in the locality.

c) fragment an existing population into two or more populations

There is no known population of Koala within the vicinity of the study area. The proposed development is unlikely to bring about the fragmentation of a population.

d) adversely affect habitat critical to the survival of a species

It is not considered likely that the habitat that will be removed could be considered habitat that is critical to the survival of the species.

e) disrupt the breeding cycle of a population

Clearing of native vegetation will involve some risk of disturbance for this species. A fauna spotter catcher will be required to inspect all vegetation immediately prior to the clearing operation so as to avoid impacting Koala in the study area.

f) modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Habitat will be modified, removed and decreased as a result of the proposed development, however, it is considered unlikely that the species will decline as a result of this given the availability of similar habitat within the immediate vicinity. It is unlikely that the proposal will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the Koala species is likely to decline further.

g) result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

The proposed development is not likely to result in the establishment of an invasive species that would harm the endangered species or their habitat.

h) introduce disease that may cause the species to decline, or

The proposed action is not likely to introduce disease that may cause the species to decline.

i) interfere with the recovery of the species.

The proposed action is not likely to interfere with the recovery of the species if the amount of clearing is minimised.

Conclusion

The proposed action is unlikely to have a significant impact on the habitat of the *Phascolarctos cinereus* (Koala) and thereby on the species.

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Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
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Appendix H – Traffic Impact Assessment



Rixa Quarries

Proposed Expansion of Doonbah Quarry, Evans Head Woodburn-Evans Head Road, Doonbah Traffic Impact Assessment

November 2014

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Appendices

Appendix A – Traffic Data

Appendix B – Crash Data

1. Introduction

1.1 Project overview

GHD has been engaged by Rixa Quarries Pty Ltd (Rixa) to prepare an Environmental Impact Statement (EIS) for the proposed expansion of the Doonbah Quarry ('the quarry'), an existing sand quarry located at Lot 2 DP 1040274 on Woodburn Evans Head Road, Doonbah, NSW (the 'subject site'). The location of the quarry is shown in Figure 1 and is within the Richmond Valley Council (RVC) Local Government Area (LGA). The quarry would be operated under a 'profit a prendre' (royalty) arrangement with the owner of the property.

Quarry operations at the site date back to 1961. In 1997, the quarry was granted approval to extract up to 35,715 m³ (approximately 57,000 tonnes) per annum (DA 128/95). The quarry has now exhausted the resources available under this approval.

The proposal is to expand the existing quarry to have an extraction rate of up to 490,000 tonnes per annum. The primary purpose of the quarry would be to supply sand to the current and proposed Pacific Highway upgrade works, and for supply to local councils and contractors. The quarry is well located to service the Pacific Highway upgrade works between Woolgoolga and Ballina which is to take place over a timeframe of approximately 5 years.

To provide the required material, the extraction area of the quarry would need to be expanded from 6.28 ha to approximately 18.3 ha, with a depth of 15 metres below ground level or -12 metres Australian Height Datum (AHD). It is estimated that the quarry would have an available resource of 4,000,000 tonnes which would allow extraction for a period of between 20 and 30 years, depending on demand.

1.2 Purpose of this report

This traffic impact assessment has been prepared by GHD Pty Ltd (GHD) on behalf of Rixa Quarries Pty Ltd for the expansion of the existing Doonbah Quarry (referred to in this report as 'the proposal'). This assessment has been prepared to form a part of an Environmental Impact Statement (EIS) for the proposal.

1.3 Scope

The study area for this traffic and access assessment encompasses the local road network around Doonbah Quarry, Doonbah NSW.

This assessment has been prepared to address specific requirements, including the Director General's Requirements from the Department of Planning and Infrastructure (DP&I) (now Department of Planning and Environment), and key issues raised by statutory agencies through formal correspondence.

The requirements relevant to this assessment, along with a reference to the relevant sections of this report, are provided below.

Table 1 **Assessment requirements**

Source	Requirement	Section of this report
Director General's Requirements (Traffic and Transport)	An assessment of potential traffic impacts on the capacity, efficiency and safety of the road network including a Road Safety Audit on the proposed route.	3.1.5 4
	A description of proposed measures to maintain and/or improve the capacity, efficiency and safety of the road network in the surrounding area over the life of the project.	5
Roads and Maritime Services	A detailed traffic study should include:	
	Impact of existing and proposed development on the road network	4
	Existing and proposed access conditions	2.3 4.2 4.3
	Intersection sight distances	4.3.2
	Proposed improvements for road intersections	4.3.1
	Cumulative traffic impact	4.1
	Detail of servicing and parking arrangements	4.7
	Impact on School zone	4.5
	Impact on transport	4.5
	Consideration for pedestrians and cyclists	4.5
	Impact of road traffic noise and dust	4.6
	Clauses 104 of the SEPP (Infrastructure)	4.9
	Details of contributions	Refer to separate documentation

2. Existing conditions

A plan of the study area is shown in Figure 1. Key roads in the surrounding area include the Woodburn Evans Head Road, and Alfred Street.

2.1 Woodburn Evans Head Road

Woodburn Evans Head Road is a classified road owned by Richmond Valley Council, but maintained by the NSW Roads and Maritime Services. It is a two-way single carriageway road and provides access from the Pacific Highway and the township of Woodburn to Evans Head, running generally east-west. The road has an 80km/h speed limit, recently reduced from 100 km/h.

The roadway is approximately 7.5m wide, generally with grassed verges and table drains and no road shoulders.

2.2 Alfred Street

Alfred Street is the western extension of Woodburn Evans Head Road, and connects to the Pacific Highway in the town of Woodburn. The intersection with the Pacific Highway is a T-intersection, with a channelised right turn and auxiliary left turn lane provided. There are no acceleration lanes on either departure, although traffic speeds on the Pacific Highway through Woodburn are relatively low. Traffic exiting Alfred Street is controlled by a give way sign.

Alfred Street is signposted at 50km/h and provides direct property access for residential properties. The road is generally level and has a straight alignment between the Pacific Highway and Grafton Street. One travel lane is provided in each direction, with approximate lane widths of 3 metres.

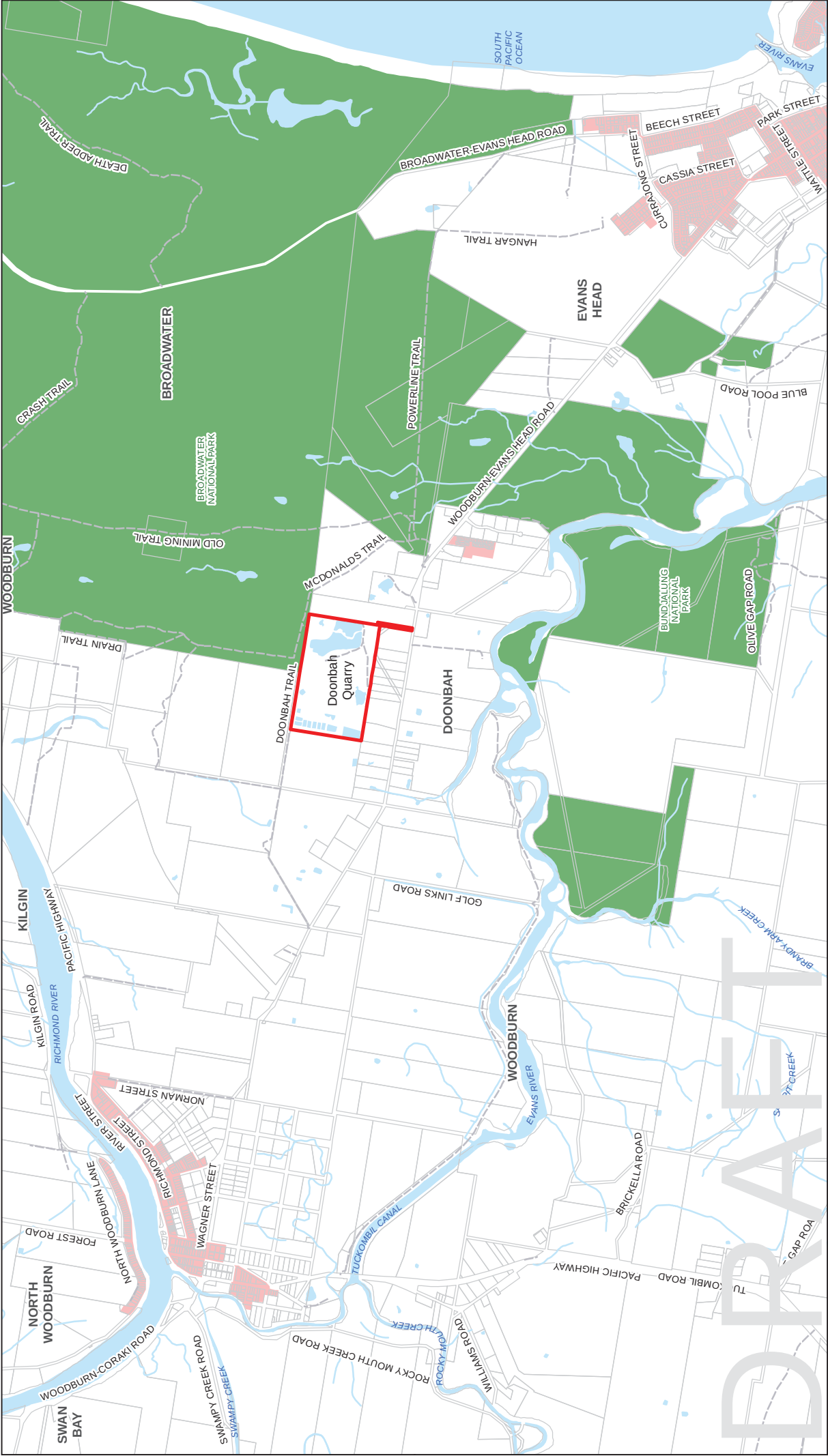
South of the Grafton Street intersection, Alfred Street curves to the east and intersects with Wagner Road. East of this intersection, Alfred Street becomes Woodburn Evans Head Road.

An alternate, but less direct, route between the Pacific Highway and Woodburn Evans Head Road is available via Whyratta Street, Woodburn Street and Wagner Street.

2.3 Doonbah Quarry access

The access to the existing Doonbah Quarry is located on Woodburn Evans Head Road, approximately 4.4 kilometres east of Wagner Street. This access is directly opposite a private driveway. The westbound lane has been widened to allow a vehicle to bypass another vehicle waiting to turn right into the site (see Figure 2).

The access road is 6.5 metres wide at the intersection, with a wide splay. A gate restricts access into the site (see Figure 3). The access road is sealed for approximately 80m from Woodburn Evans Head Road.



Paper Size A4

0 250 500 750 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

LEGEND

- Doonbah Quarry
- Track
- Watercourse
- Waterbody
- Cadastre
- Built Up Area
- National Park

Rixa Quarries Pty Ltd
Doonbah Quarry
Traffic Impact Assessment

GHD

Job Number 22-17200
Revision A
Date 07 Apr 2014

Study Area

Figure 1



Figure 2 Existing Site Access, looking west



Figure 3 Site Access Road and Gate

2.4 Daily traffic volumes

2.4.1 Woodburn Evans Head Road

Richmond Valley Council provided traffic data for Woodburn Evans Head Road. This data is shown in Table 2 and full data is included in Appendix A.

Table 2 Woodburn Evans Head Road Traffic Data

Year	Location	Average Daily Traffic Volume ¹	%HV	85 th percentile speed	Peak Hour (2-way)
2013	East of quarry	2,691	7.0%	86.8 km/h	255
2013	West of quarry	2,675	4.9%	86.4 km/h	255

The 85th percentile speed is the speed which is not exceeded by 85% of vehicles. The high 85th percentile speed, relative to the posted speed limit of 80km/h, is most likely influenced by the recent reduction in the speed limit from 100 km/h, with drivers taking some time to adjust to the changed conditions.

2.4.1 Doonbah Quarry

The traffic accessing the existing quarry varies considerably based on demand. Under the current extraction rates, the number of heavy vehicles accessing the site generally ranges from one to ten per day (2-20 vehicle movements).

2.5 Crash history

Crash history has been provided from Roads and Maritime for Alfred Street-Woodburn Evans Head Road from the Pacific Highway to Wallum Drive, east of the quarry. This data is inclusive of October 2008 to September 2013 and is included in Appendix B.

In the data period, there were a total of 16 crashes with five resulting in injury and none resulting in fatalities. Seven of the crashes were located at or near intersections and driveways and half of the total crashes were off road, hit object on either a curve or straight. There were no crashes in the vicinity of the quarry access.

2.6 Other transport modes

2.6.1 Buses

Northern Rivers Bus Lines operates public bus services between Evans Head and Ballina, and Evans Head and Lismore. There are 5 daily services from Evans Head, and 6 returning to Evans Head. There are also daily school bus services that use Woodburn Evans Head Road.

2.6.2 Cyclists

There is no provision for cyclists on Woodburn Evans Head Road.

2.6.3 Pedestrians

There is no provision for pedestrians on Woodburn Evans Head Road.

¹ Average Daily Traffic (ADT) volume is the average volume of traffic recorded at a point each day over a specific period. Note that AADT (Annual Average Daily Traffic) requires a 12-month count, or an understanding of seasonal variations in traffic volumes across the year.

3. Proposed development

3.1 Operational characteristics

3.1.1 Extraction rate

It is estimated that the remaining sand resource to be extracted at the site would yield approximately two million tonnes. However it is difficult to accurately estimate the annual extraction rate of material from the quarry which may be required to service the demand from the Pacific Highway upgrade works. It is proposed to extract and process up to 490,000 tonnes per annum, although this rate of extraction is expected to be uncommon. It is more likely that the annual extraction rate during the upgrade of the Pacific Highway would be around 300,000 to 350,000 tonnes per annum. After the highway upgrade is complete, the annual extraction rate is anticipated to reduce to about 100,000 tonnes per annum.

Based on the assessment of the underpinning demand, and after allowing for downtime from wet weather, etc it is realistic to expect the quarry to operate for 40 weeks a year. A maximum daily extraction and haul rate of about 2,250 tonnes is expected, with an average daily win and haul rate of about 1,600 tonnes. The average daily win and haul rate would reduce significantly following the completion of the highway upgrade.

3.1.2 Operation workforce

During operation, it is likely that there would be a maximum of five employees or plant operators on the site at any one time. This would yield a daily workforce traffic generation in the order of 10 vehicle trips per day (vtpd). It is assumed the majority of the workforce would arrive between 6:30 am and 7:30 am and depart generally between 4:00 pm and 6:30 pm.

3.1.3 Operation tasks

The typical tasks requiring heavy vehicle movements during operation are:-

- Export of material for customer orders
- Import of rock, topsoil or landscaping products for blending.

3.1.4 Operation hours

The quarry is expected to operate for 40 weeks per year. This allows for equipment breakdowns and wet weather.

The hours of operation would depend on demand, with some periods of high activity and other times when activity is limited to the occasional loading of haulage trucks. The proposed hours of operation are:

- Weekdays - 7.00am - 6.00pm
- Saturdays - 8.00am - 1.00pm
- Saturday afternoons and Sundays – maintenance only
- Public holidays - No work

3.1.5 Proposed equipment

Table 3 lists the plant and equipment that would operate on site.

Table 3 Proposal equipment

Item	Number on site	Frequency of use	Description of use
Excavator (35 tonne)	2	20-90%	Excavating material and stockpiling. Used constantly during initial excavation and then less frequently, once the dredge is operating.
Dredge	1	20-90%	Main form of extraction.
Screen	1	90%	Aggregate production.
Front-end Loader	1	80%	Loading material onto the haul trucks.
Haul Trucks	Up to 70 loaded trips per day (140 daily truck movements)	-	Delivery of materials to customers.
Water Cart (15,000L)	1	0-60%	Watering haul roads and excavation areas, as required.
Light vehicles	10 vehicles per day	-	Employee vehicles.
Water Pump	1	50%	To supply water cart.
Generator	1	90%	Supply power to the screen.
Hand tools	Numerous	10%	General activities.

3.1.6 Operation phase traffic volumes

The traffic generated by the proposal will vary based on material demand.

At its peak, the quarry is expected to win and haul about 2,250 tonnes of material per day. An average rate of production would be approximately 1,600 tonnes per day.

Truck and dog trailer combinations, with a capacity of approximately 32 tonnes, would be used. The peak rate of truck activity would be approximately 70 trucks day (140 daily truck movements). The number of movements may be reduced through the use of back-loading, with some trucks bringing in blending material as well as taking export material out, rather than separate trucks required for each task. The use of haulage vehicles to return to site with imported blending material will, where feasible, reduce the number of truck movements.

4. Impact assessment

4.1 Cumulative traffic impacts

At its peak, the quarry would be expected to generate 140 truck movements per day, and 10 staff movements. Current levels of activity are around 20 truck movements per day.

As a result of the proposal, daily traffic volumes on Woodburn Evans Head Road would be expected to increase from the existing average of 2691 vehicles per day to some 2821 vehicles per day. This level of activity would represent an increase of some 5% on the current traffic volumes on Woodburn Evans Head Road. The proportion of heavy vehicles on Woodburn Evans Head Road would increase from 7% currently to approximately 11%, as shown in Table 4.

Table 4 Impacts on Traffic Volumes: Woodburn Evans Head Road

Scenario	Total Vehicles	Light Vehicles	Heavy Vehicles	% HV
Existing	2691	2501	190	7%
Less current quarry activities	20		20	
Plus Proposal	150	10	140	
Future	2821	2511	310	11%

4.2 Access road

The existing access road is relatively narrow (see Figure 4) and does not allow for inbound and outbound vehicles to pass each other without leaving the formed roadway. With the proposed increase in truck activity, there will be increased potential for trucks to meet each other on the access roadway. This could result in degradation of the road edges, and deterioration of the roadway surface.

It is recommended that the access road be upgraded to provide suitable passing bays at regular intervals. The location of the passing bays should consider the available sight distances between them, or provision may need to be made for driver communication via 2-way radio.

Sealing of the access roadway may be necessary to manage dust generation during dry weather. Alternatively a regime of regular watering may be appropriate.



Figure 4 Existing Site Access Road

4.3 Access intersection

4.3.1 Intersection configuration

Haulage trucks would enter and exit the site using the existing access onto Woodburn Evans Head Road. It is expected that almost all truck movements will be to and from the west (Pacific Highway), with left turns into the site and right turns out onto Woodburn Evans Head Road.

The likely traffic volumes at this intersection can be estimated, and compared with design warrants in the Austroads Guide to Road Design Part 4A.

It is expected that the peak design hour would contain approximately 10% of truck movements into and out of the quarry (7 trucks turning in, 7 trucks turning out). Traffic count data provided by Richmond Valley Council for Woodburn Evans Head Road indicates a 2-way peak hourly volume of up to 260 vehicles. Figure 5 shows the warrants for turn treatments based on traffic volumes.

The left turn into the quarry access, with approximately 7 trucks per hour turning in, and an affected volume of 150 vehicles per hour on Woodburn Evans Head Road (assumed peak direction one-way flow), requires a basic left turn (BAL) treatment. The right turn into the quarry access would have only a very small volume of turning trucks, and would also require only a basic right turn (BAR) treatment. These treatments are illustrated in Figure 6.

Even with background growth in traffic volumes on the Woodburn Evans Head Road, or with an increase in the volume of truck activity at the quarry, this type of intersection is likely to be suitable for many years to come.

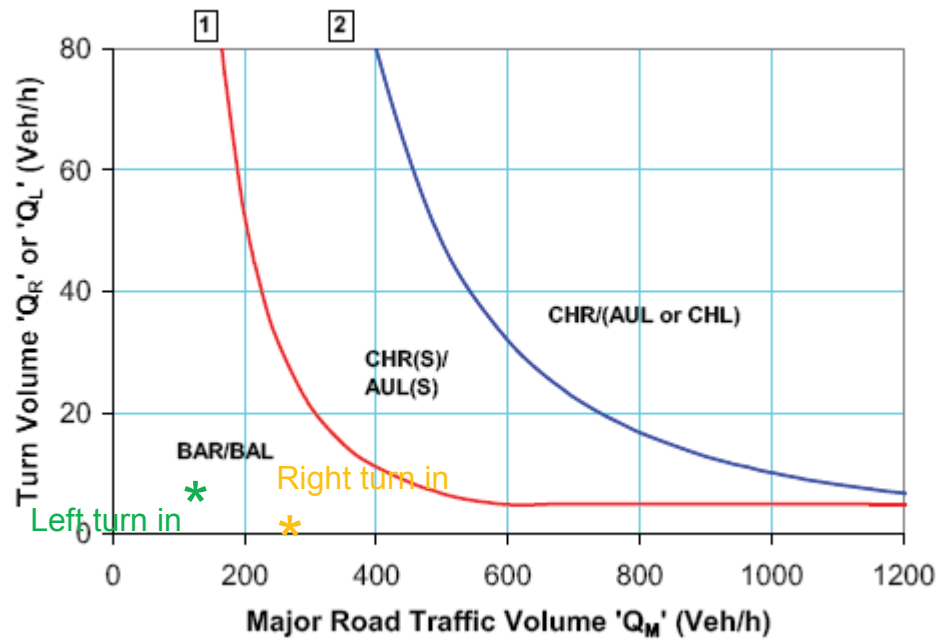


Figure 5 Austroads Warrants for turn treatments on the major road at unsignalised intersections

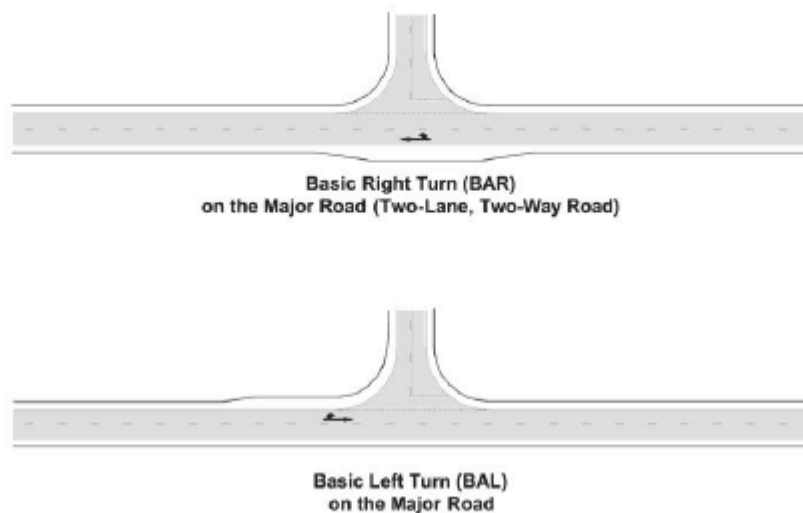


Figure 6 Austroads Rural Basic BA turn treatments

The existing access intersection already has a BAR treatment provided, with a widened westbound lane. Given the low volume of traffic expected to turn right into the quarry, this treatment is considered satisfactory for ongoing operations.

There is currently no widening of the eastbound lane on approach to the intersection. It is appropriate for some widening to be provided at this location, to allow left-turning trucks to begin the movement out of the eastbound through lane earlier than is currently possible. The extent of widening that is feasible will need to consider requirements for drainage, and provision for other existing services including a water main and Telstra cabling. Figure 7 shows the area to be widened, west of the access.



Figure 7 Looking West from Site Access

4.3.2 Sight distance assessment

The intersection of the quarry access with the Woodburn Evans Head Road is located on a straight and flat section of road. The requirements for sight distance are specified in the Austroads Guide to Road Design Part 4A. For an 80km/h speed environment, the sight distance requirement is 114m. However as noted in Section 2.4, existing speeds on Woodburn Evans Head Road are generally higher than the speed limit, with an 85th percentile speed of 85-86km/h. The sight distance required for a 90km/h speed environment is 151m (or 139m with an improved driver reaction time).

Sight lines are good in both directions, and significantly exceed these requirements as shown in Figure 7 and Figure 8.



Figure 8 Looking East from Site Access

4.4 Haulage route

Haulage of quarry materials would primarily be between the site and the Pacific Highway via Woodburn Evans Head Road, for distribution onto the wider network. Precise routes will depend on the location of works utilising quarry outputs. For the purpose of this assessment, the following comments can be made about the safety performance of the Woodburn Evans Head Road route:

- In general, Woodburn Evans Head Road is considered to provide a safe road environment for the haulage activities. Whilst the road pavement is relatively narrow, the 80km/h speed limit (recently reduced from 100km/h) has somewhat mitigated the risks associated with the narrow pavement.
- The alignment of Woodburn Evans Head Road, being flat and predominantly straight or with large-radius curves, provides drivers with good forward sight distance to be aware of any potential obstructions or other issues. There are relatively few objects in the clear zone adjacent to the roadway, apart from drainage culverts at driveways which are a common feature on this type of road. Four of the 16 crashes recorded on Alfred Street and Woodburn Evans Head Road (see Section 2.5) involved a vehicle impacting with a drain or culvert.
- The volume of traffic on Woodburn Evans Head Road, with a 2-way peak volume of 260 vehicles per hour, also results in a reduced risk level associated with 2-vehicle collisions.
- The crash history is not indicative of any particular safety deficiencies at specific locations, and the nature and frequency of crashes is likely to be typical of similar road types elsewhere.

On this basis, it is unlikely that a formal road safety audit process will identify any major issues with this section of road. However, if required by Council, a Road Safety Audit of the proposed haulage route should be completed prior to commencement of haulage activities.

It is noted that there is the potential for a 'rat run' through Woodburn, as described in Section 2.1. The use of this route by haulage vehicles may create a hazard on narrow residential streets adjacent to Woodburn Primary School. It is recommended that haulage vehicle drivers be directed to use only Alfred Street to travel between the Pacific Highway and Woodburn Evans Head Road.

4.5 Impact on Vulnerable Road Users

The quarry site is remote from any source of vulnerable road user (pedestrians and cyclists) activity. As noted in Section 2.6, there are no specific facilities for pedestrians or cyclists on Woodburn Evans Head Road. However given the relatively low traffic volumes on the road, the scale of traffic increase expected, and the physical characteristics of the road that provide for good forward sight distance, there is not expected to be any deterioration in safety for pedestrians or cyclists. Similarly, there will be no direct impact on any existing bus stops, or bus services.

Schools, with associated school zones, are located in Woodburn and Evans Head. It is recommended that trucks en route to or from the quarry should avoid travelling through the school zone on Woodburn Street (Woodburn Primary School). There may be an increase in traffic travelling through the school zone on the Pacific Highway side of the school, but this remains the most appropriate route for this traffic.

Haulage activity is unlikely to impact directly on the school zone outside the Evans Head school.

4.6 Road Traffic Noise and Dust

A separate Air and Noise assessment has been completed for this proposal.

The access road is sealed for approximately 80m from Woodburn Evans Head Road. This will minimise any impacts of dust on traffic on Woodburn Evans Head Road.

A 10km/h speed limit which applies to the access road will minimise dust production by traffic entering and leaving the quarry.

4.7 On-Site Traffic Management

The quarry area will be accessed via the access road, with a weighbridge proposed at the entry to the quarry area. A site office and amenities block will be located nearby. At this location, there is expected to be sufficient space for the manoeuvring and parking of staff vehicles, and other site vehicles as required.

Traffic movement within the quarry will depend on the area being excavated at the time. Vehicle access paths will be established to suit the specific activities being undertaken.

4.8 Construction Impact Assessment

It is anticipated that traffic activity associated with construction of the proposal will be less than activity during operation of the proposal. Therefore no specific assessment of construction impacts has been undertaken.

4.9 State Environment Planning Policy (Infrastructure) 2007

Clause 104 of the SEPP for Infrastructure requires that, amongst other things, the consent authority (in this case, Richmond Valley Council) advise the RTA (now RMS) of the application, and take into account any response received from RMS on the proposal when determining the application. The consent authority is also required to take into consideration:

- the efficiency of movement of people and freight to and from the site and the extent of multi-purpose trips
 - see Sections 3.1.5, 4.1 and 4.4
- the potential to minimise the need for travel by car and to maximise movement of freight in containers or bulk freight by rail,
 - access by rail is not available for this development
- any potential traffic safety, road congestion or parking implications of the development.
 - See Sections 4.1, 4.4, 4.5 and 4.7

5. Recommendations

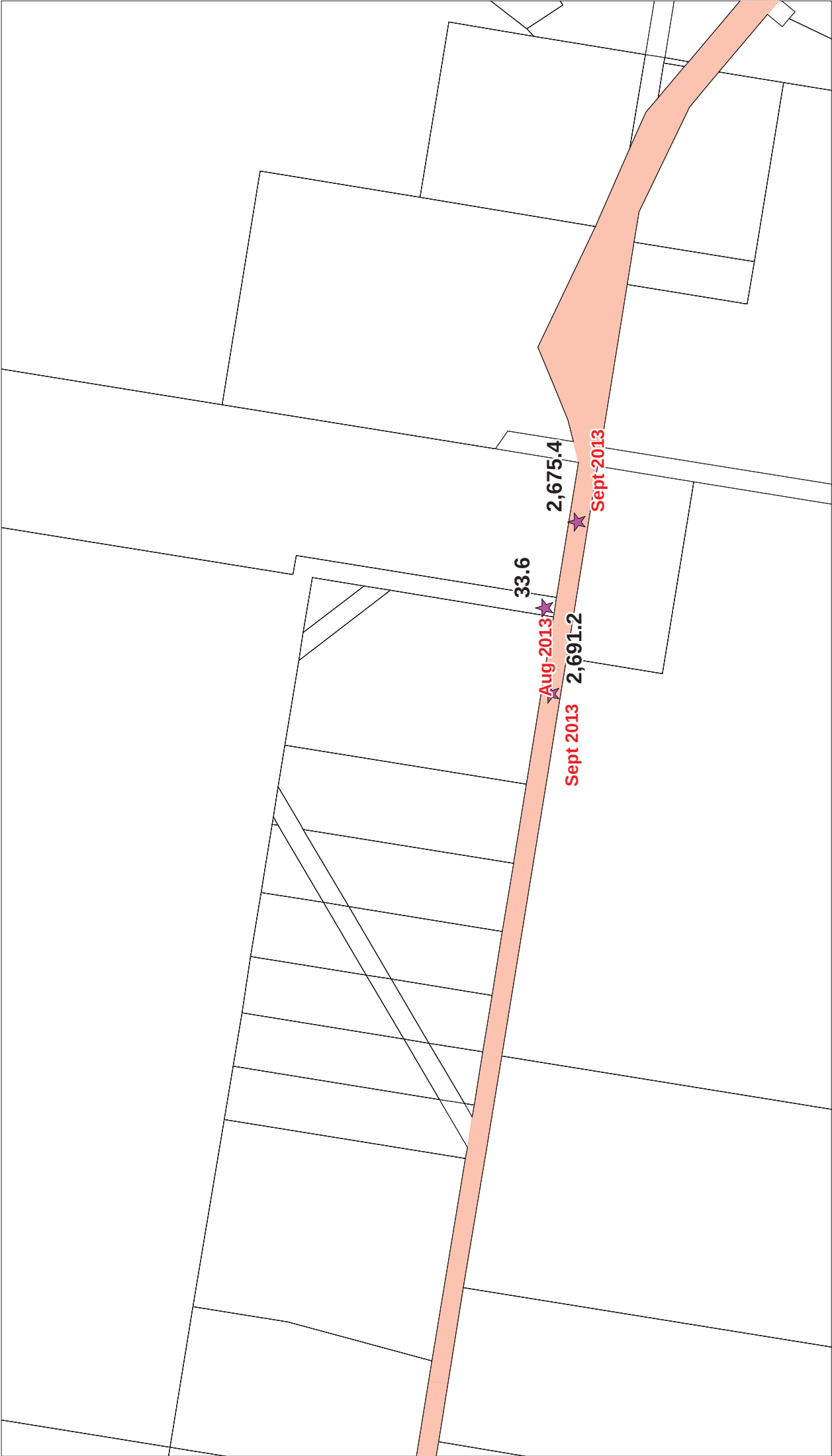
To minimise potential impacts to traffic and access due to the proposal, the following measures are recommended:

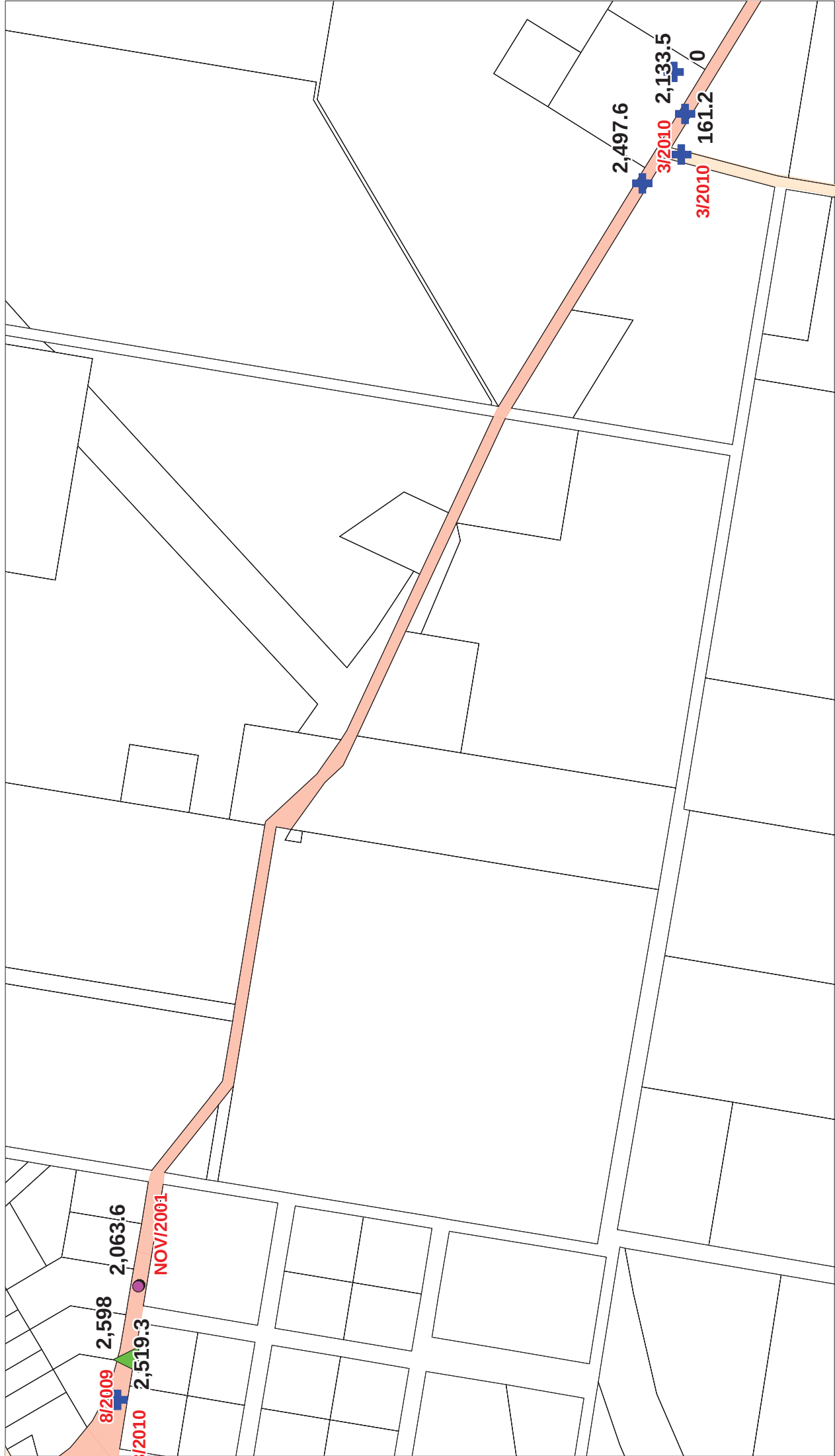
- Subject to detailed survey, upgrade of the existing quarry access intersection to provide a BAL-type treatment for left turns into the site (see Section 4.3.1).
- Passing bays should be provided on the quarry access road to minimise potential conflict between inbound and outbound traffic, and to minimise damage to the road edge (see Section 4.2).
- A 10km/h speed limit is to be maintained on the access road to the quarry to minimise dust production by traffic entering and leaving the quarry see Section 4.6).
- Heavy vehicle access between the Pacific Highway and the quarry should be via Alfred Street. Haulage trucks should not use the route via Woodburn Street and Wagner Street, to avoid impacts on the Woodburn Primary School and the surrounding residential area (see Section 4.4).
- As a result of the proposal, no potential road safety issues were identified and it is considered a Road Safety Audit is not warranted at this stage (see Section 4.4).
- Where practicable, haulage vehicles should be backloaded to carry loads on both inward and outward journeys, to minimise vehicle movements (see Section 3.1.6).

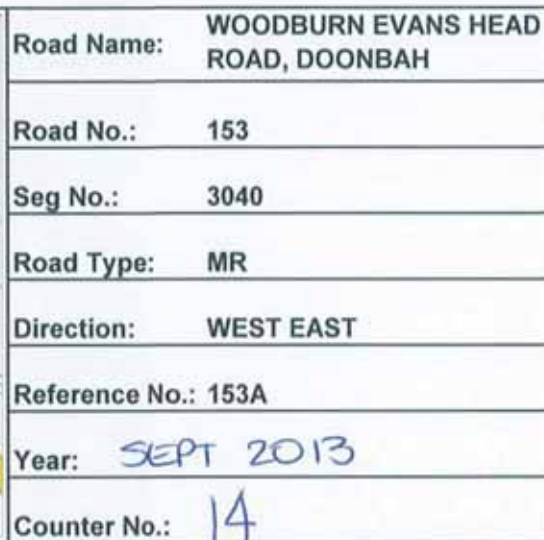
Subject to these recommendations, the proposed development is supported on traffic grounds.

Appendices

Appendix A – Traffic Data







G:\Works\Traffic Counts\Maps\2013\MR153\153A Woodburn Evans Head Road Doonbah 020913.xls

Richmond Valley Council Weekly Vehicle Counts

WeeklyVehicle-88 -- English (ENA)

Datasets:

Site: [153A] Near 495 Woodburn Evans Head Road, Doonbah
Direction: 6 - West bound A>B, East bound B>A. Lane: 0
Survey Duration: 14:34 Friday, 30 August 2013 => 8:38 Thursday, 19 December 2013
Zone:
File: 153A Woodburn Evans Head Road Doonbah 19Dec2013.EC0 (Plus)
Identifier: P935D5NT MC56-L4 [MC55] (c)Microcom 19Sep03
Algorithm: Factory default (v3.21 - 15322)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range: 10 - 160 km/h.
Direction: North, East, South, West (bound)
Separation: All - (Headway)
Name: Default Profile
Scheme: Vehicle classification (AustRoads94)
Units: Metric (meter, kilometer, m/s, km/h, kg, tonne)
In profile: Vehicles = 110340 / 127479 (86.56%)

Weekly Vehicle Counts

WeeklyVehicle-88

Site: 153A.0.0WE
Description: Near 495 Woodburn Evans Head Road, Doonbah
Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

	Mon 02 Sep	Tue 03 Sep	Wed 04 Sep	Thu 05 Sep	Fri 06 Sep	Sat 07 Sep	Sun 08 Sep	Averages 1 - 5	1 - 7
Hour									
0000-0100	*		2	4	2	9	13	2.3	6.
0100-0200	*	1	8	1	2	4	3	2.5	3.3
0200-0300	*	3	1	2	2	5	2	3.2	3.3
0300-0400	*	6	3	8	4	3	1	5.3	4.1
0400-0500	*	8	6	5	16	5	1	8.5	7.2
0500-0600	*	43	43	47	52	33	14	47.5	39.3
0600-0700	*	108	116	122	95	52	38	110.3	88.3
0700-0800	*	181	198	194	167	76	72	185.3	148.1
0800-0900	*	255<	273<	214	231<	192	178	243.3<	212.2
0900-1000	*	219	192	220<	222	214	194	213.3	210.2
1000-1100	*	194	204	184	176	270<	274<	183.3	212.7<
1100-1200	*	178	178	175	213	240	271	185.3	209.1
1200-1300	*	161	188	176	193	188	254<	175.3	196.3
1300-1400	*	194	152	172	200	205<	247	177.3	193.3
1400-1500	*	178	203	196	193	195	228	187.3	192.2
1500-1600	*	244<	237	223	250<	193	177	246.3	220.3
1600-1700	*	246	272<	244<	234	172	172	247.5<	222.3<
1700-1800	*	222	212	196	198	158	155	194.3	181.3
1800-1900	*	117	134	108	121	110	80	119.3	109.1
1900-2000	*	53	63	45	59	46	45	55.3	51.4
2000-2100	*	48	56	43	46	50	23	47.3	43.3
2100-2200	*	31	36	24	39	34	14	30.3	28.1
2200-2300	*	12	17	23	25	33	14	19.3	20.4
2300-2400	*	11	6	5	18	24	4	15.3	13.3
Totals									
0700-1900	*	2352	2488	2256	2374	2143	2231	1350.3	2312.1
0600-2200	*	2529	2733	2490	2615	2342	2359	2593.3	2514.2
0600-0000	*	1734	2762	2515	2658	2424	2364	1621.3	2546.3
0000-0000	*	1620	2920	2596	2786	1494	2412	2091.3	2610.1
AM Peak	*	1410	1800	1906	1800	1010	774		
	*	235	273	220	231	270	274		
PM Peak	*	1574	1616	1601	1500	1319	1707		
	*	244	212	244	280	295	204		

* - No data.

Weekly Vehicle Counts

WeeklyVehicle-88
Site: 153A.0.0WE

Description: Near 495 Woodburn Evans Head Road, Doonbah

Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013

Scheme: Vehicle classification (AustRoads94)

Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

	Mon 09 Sep	Tue 10 Sep	Wed 11 Sep	Thu 12 Sep	Fri 13 Sep	Sat 14 Sep	Sun 15 Sep	Averages 1 - 5	1 - 7
Hour									
0000-0100	2	2	4	4	3	16	13	3.0	6.1
0100-0200	1	4	4	6	1	5	9	2.2	4.1
0200-0300	1	1	1	1	2	2	1	1.4	1.4
0300-0400	2	3	6	6	5	3	2	4.1	5.1
0400-0500	10	8	6	8	10	5	8	8.0	8.1
0500-0600	22	44	70	58	53	28	13	35.6	45.9
0600-0700	111	206	139	126	133	59	41	111.2	98.7
0700-0800	178	149	177	215	170	59	77	136.6	157.9
0800-0900	220<	254<	269<	253<	256<	164	126	250.4<	220.3<
0900-1000	203	229	212	247	250	173	206	224.2	217.7
1000-1100	182	164	179	211	196	258<	197	186.4	199.1
1100-1200	187	174	184	185	207	206	267<	187.4	208.6
1200-1300	191	155	178	134	154	217	231	195.4	195.1
1300-1400	175	149	190	182	181	212<	250<	176.1	191.7
1400-1500	167	199	181	200	203	164	247	190.1	197.3
1500-1600	220<	241<	227	267	262<	132	205	243.4<	224.9<
1600-1700	214	219	235<	283<	253	158	173	240.6	219.3
1700-1800	207	209	220	200	205	104	108	207.3	179.7
1800-1900	55	168	181	112	117	93	91	121.6	113.1
1900-2000	48	60	61	48	67	47	47	54.8	52.0
2000-2100	31	57	39	40	40	32	36	41.4	39.8
2100-2200	23	67	29	34	40	42	16	38.6	35.0
2200-2300	9	13	72	17	22	30	8	16.4	17.0
2300-2400	4	8	5	10	21	10	3	9.4	9.9

Totals

0700-1900	2219	2345	2378	2759	2491	2055	2177	2474.2	2321.9
0600-2200	1433	2838	2624	2637	2722	2135	2319	2400.2	2543.6
0600-0000	1445	2858	2651	2664	2765	2294	2331	2416.0	2511.7
0000-0000	2519	2719	2742	2948	2833	2345	234	2753.4	2641.7

AM Peak	135.1	301	380.1	3500	3800	1100	110.1		
	221	256	269	253	256	268	267		

PM Peak	150	181	1800	1800	1500	1310	1300		
	221	241	338	293	302	212	250		

* - No data.

Weekly Vehicle Counts

WeeklyVehicle-88

Site: 153A.0.0WE
 Description: Near 495 Woodburn Evans Head Road, Doonbah
 Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
 Scheme: Vehicle classification (AustRoads94)
 Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

	Mon 16 Sep	Tue 17 Sep	Wed 18 Sep	Thu 19 Sep	Fri 20 Sep	Sat 21 Sep	Sun 22 Sep	Averages 1 - 5	1 - 7
Hour									
0000-0100	4	2	4	4	4	13	17	3.4	7.0
0100-0200	3	3	2	1	3	10	12	2.4	4.9
0200-0300	3	3	3	3	2	1	4	3.1	3.0
0300-0400	3	4	4	3	6	2	7	6.3	5.1
0400-0500	11	3	6	11	12	11	13	7.4	8.0
0500-0600	44	35	34	51	51	23	23	47.5	42.7
0600-0700	114	97	113	125	105	69	38	105.2	92.8
0700-0800	219	144	204	169	160	39	61	185.1	154.0
0800-0900	245<	257<	252<	249<	255<	146	124	251.6<	215.3
0900-1000	212	213	217	244	253	260	198	227.7	227.3<
1000-1100	205	174	177	196	218	267<	240<	194.3	211.6
1100-1200	174	177	165	191	201	235	238	179.6	195.0
1200-1300	160	150	161	215	199	227<	245	185.8	210.4
1300-1400	163	162	174	154	213	220	229	179.2	192.1
1400-1500	166	162	153	177	205	224	251<	171.3	197.6
1500-1600	204	248<	234<	230<	280<	195	235	240.0<	233.3<
1600-1700	208<	219	221	225	235	188	174	223.6	211.1
1700-1800	184	144	135	162	194	168	145	162.6	173.7
1800-1900	74	126	116	123	144	92	101	119.1	112.4
1900-2000	51	67	74	74	59	62	53	63.0	61.1
2000-2100	24	37	35	41	60	63	44	39.4	42.6
2100-2200	14	31	32	23	40	15	24	29.4	29.4
2200-2300	11	13	19	12	29	24	10	19.2	15.6
2300-2400	3	9	4	14	11	22	9	8.6	10.6
Totals									
0700-1900	2137	2141	2301	2383	2577	2312	1238	2340.2	1320.7
0600-2200	2333	2472	2555	2654	2841	2541	2379	2580.7	2045.9
0600-0000	2413	2421	2589	2655	2881	2547	2348	2608.1	2578.1
0000-0000	1471	1342	2635	2761	2959	2451	147	2699.6	2645.4
AM Peak	1811	1477	1811	1800	1400	1000	1000		
	248	257	252	249	255	267	240		
PM Peak	1811	1571	1574	1565	1500	1200	1400		
	213	245	234	230	280	224	251		

* - No data.

Weekly Vehicle Counts

WeeklyVehicle-88

Site: 153A.0.0WE
Description: Near 495 Woodburn Evans Head Road, Doonbah
Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

	Mon 23 Sep	Tue 24 Sep	Wed 25 Sep	Thu 26 Sep	Fri 27 Sep	Sat 28 Sep	Sun 29 Sep	Averages 1 - 5	1 - 7
Hour									
0000-0100	1	2	1	2	5	5	13	21.4	41.7
0100-0200	4	2	2	1	3	6	4	2.4	3.1
0200-0300	*	2	3	3	2	4	1	2.4	3.1
0300-0400	4	3	5	7	12	3	7	5.8	5.4
0400-0500	12	8	14	10	12	13	6	11.4	10.8
0500-0600	57	49	57	57	60	49	20	54.6	46.1
0600-0700	109	111	113	104	103	65	51	103.7	93.1
0700-0800	161	145	156	155	162	99	91	153.8	137.3
0800-0900	205	186	217	196	206	169	137	204.0	189.4
0900-1000	245<	225<	237	204	253<	215	212	233.6	226.4
1000-1100	142	213	242<	265<	245	246	260	242.6<	245.6<
1100-1200	211	199	199	212	216	250<	293<	207.4	225.7
1200-1300	187	200	212	255	220<	219<	230	210.6	221.1<
1300-1400	196	189	205	227	219	174	251	208.2	206.0
1400-1500	203	213	193	260<	216	198	253<	217.4	219.7
1500-1600	207	200	212	238	216	144	227	215.6	209.1
1600-1700	228<	222<	221<	240	207	196	233	223.6<	221.1
1700-1800	201	186	189	179	219	103	156	197.0	186.3
1800-1900	99	96	109	109	125	97	111	108.0	106.1
1900-2000	54	62	68	63	74	45	69	63.8	61.8
2000-2100	41	43	45	41	52	41	49	45.0	45.9
2100-2200	28	26	32	42	36	17	26	32.4	33.4
2200-2300	8	*	21	15	37	27	14	18.0	19.7
2300-2400	6	12	8	12	11	24	9	9.6	10.4
Totals									
0700-1900	1453	1294	1385	2344	2514	2145	2474	2430.1	2395.6
0600-2200	2662	2524	2644	2794	2769	2349	2669	2619.1	2630.4
0600-0000	2677	2545	2673	2821	2817	2419	2691	2706.6	2661.6
0000-0000	1755	2611	2755	2901	2968	2415	1741	2754.1	2733.7
AM Peak	1901	1874	1977	1900	1908	1110	1171		
	141	225	247	265	253	251	293		
PM Peak	1612	1600	1664	1400	1271	1210	1400		
	277	222	221	164	221	219	253		

* - No data.

Weekly Vehicle Counts

WeeklyVehicle-88

Site: 153A.0.0WE
Description: Near 495 Woodburn Evans Head Road, Doonbah
Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

	Mon 30 Sep	Tue 01 Oct	Wed 02 Oct	Thu 03 Oct	Fri 04 Oct	Sat 05 Oct	Sun 06 Oct	Averages 1 - 5	1 - 7
Hour									
0000-0100	3	1	4	3	4	13	19	4.2	7.4
0100-0200	1	3	3	4	4	3	1	3.1	4.3
0200-0300		2	1	2	2	3	2	1.6	2.6
0300-0400	13	4	4	4	4	9	3	6.1	6.0
0400-0500	11	3	10	5	13	4	13	8.4	10.4
0500-0600	43	22	33	61	33	39	32	37.4	34.3
0600-0700	33	103	109	123	36	49	34	106.4	96.3
0700-0800	134	123	141	157	144	113	123	149.3	144.3
0800-0900	191	214	194	213	190	168	204	203.3	190.7
0900-1000	107	216	189	221	121	231	268	214.3	224.3
1000-1100	232<	252<	247	230<	314<	230	282<	255.0<	259.0<
1100-1200	214	218	258<	223	227	287<	260	229.4	241.4
1200-1300	225<	194	249	231	140	267<	253	225.3	237.7
1300-1400	211	196	252	232	249	242	282<	226.0	236.3
1400-1500	213	250<	268<	223	254<	235	253	241.6<	242.7<
1500-1600	213	235	239	237<	241	213	196	233.4	223.7
1600-1700	233	243	239	226	216	191	164	223.4	211.7
1700-1800	131	124	227	202	213	173	92	211.4	199.3
1800-1900	141	103	101	123	139	139	71	113.3	111.3
1900-2000	56	31	33	33	34	38	49	36.4	35.6
2000-2100	27	33	44	46	32	33	31	40.4	43.7
2100-2200	26	20	39	24	47	43	27	36.4	31.4
2200-2300	17	19	17	21	33	29	8	21.3	21.7
2300-2400	7	11	3	3	11	21	13	3.1	10.4
Totals									
0700-1900	1353	2477	2624	2331	2642	2513	2438	2328.1	2312.3
0600-2200	2381	2679	2359	2781	2903	2711	2639	2760.6	2739.1
0600-0000	2413	2719	2381	2303	2943	2773	2660	2700.4	2710.1
0000-0000	2435	2394	2363	2391	3031	2843	2772	2722.2	2736.1
AM Peak	1133	1077	1103	1336	1043	1213	1233	1136	1092
	202	202	234	233	314	207	232		
PM Peak	1001	1413	1491	1311	1311	1213	1301	1307	1337
	202	233	233	234	234	237	232		

* - No data.

Weekly Vehicle Counts

WeeklyVehicle-88

Site: 153A.0.0WE
Description: Near 495 Woodburn Evans Head Road, Doonbah
Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

	Mon 07 Oct	Tue 08 Oct	Wed 09 Oct	Thu 10 Oct	Fri 11 Oct	Sat 12 Oct	Sun 13 Oct	Averages 1 - 5	1 - 7
Hour									
0000-0100	2	2	3	2	5	7	5	3.7	3.9
0100-0200	1	2	1	2	1	4	2	1.4	1.9
0200-0300	3	4	2	3	7	6	5	4.2	4.4
0300-0400	15	5	4	19	12	4	12	9.1	9.6
0400-0500	29	35	43	47	44	25	19	39.6	34.1
0500-0600	41	118	111	127	99	58	89	98.2	96.1
0600-0700	52	102	100	169	152	95	63	140.4	123.4
0700-0800	96	268<	248<	261<	238<	159	112	222.2	195.7
0800-0900	213	239	253	231	221	232	214	213.4	216.1
0900-1000	328<	237	181	205	203	261	236<	224.8<	231.6<
1000-1100	327	185	193	186	156	293<	230	204.2	220.7
1100-1200	311	158	159	145	141	222	222	202.8	208.3
1200-1300	309<	187	180	169	181	208<	177	172.4	199.4
1300-1400	294	171	219	131	178	194	193<	201.2	197.4
1400-1500	273	237<	248<	218	213	177	171	237.2<	219.1<
1500-1600	233	223	232	234<	214	147	145	224.1	204.1
1600-1700	183	213	206	223	220<	147	145	195.4	190.9
1700-1800	65	137	142	138	122	111	101	115.4	112.4
1800-1900	63	51	79	41	79	33	19	72.6	76.4
1900-2000	31	33	51	72	48	60	48	46.8	60.3
2000-2100	17	47	36	35	53	51	25	33.4	34.8
2100-2200	7	14	11	14	35	49	18	16.0	18.1
2200-2300	5	3	9	8	13	26	4	9.4	10.2
2300-2400	4	3	5	1	12	14	7	5.4	5.8

Totals

0700-1900	2443	2271	2065	2244	1186	2033	2149	2319.4	2265.6
0600-2200	2751	2627	2841	2589	2414	2481	2178	2596.2	2492.1
0600-0000	2159	1477	2555	2596	2541	2531	2179	2509.6	2549.3
0000-0000	2446	2616	2778	2790	1669	2659	1148	2726.2	2646.3

AM Peak

231	155	171	191	173	110	97
318	145	247	261	232	193	136

PM Peak

2213	1411	1403	1507	1600	1210	1135
214	137	245	134	263	218	143

* - No data.

MetroCount Traffic Executive Class Speed Matrix

ClassMatrix-91 -- English (ENA)

Datasets:

Site: [153A] Near 495 Woodburn Evans Head Road, Doonbah
Direction: 6 - West bound A>B, East bound B>A, Lane: 0
Survey Duration: 14:34 Friday, 30 August 2013 => 8:38 Thursday, 19 December 2013
Zone:
File: 153A Woodburn Evans Head Road Doonbah 19Dec2013.EC0 (Plus)
Identifier: P935D5NT MC56-L4 [MC55] (c)Microcom 19Sep03
Algorithm: Factory default (v3.21 - 15322)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range: 10 - 160 km/h.
Direction: North, East, South, West (bound)
Separation: All - (Headway)
Name: Default Profile
Scheme: Vehicle classification (AustRoads94)
Units: Metric (meter, kilometer, m/s, km/h, kg, tonne)
In profile: Vehicles = 110340 / 127479 (86.56%)

Richmond Valley Council Speed Statistics

SpeedStat-92 -- English (ENA)

Datasets:

Site: [153A] Near 495 Woodburn Evans Head Road, Doonbah
Direction: 6 - West bound A>B, East bound B>A. Lane: 0
Survey Duration: 14:34 Friday, 30 August 2013 => 8:38 Thursday, 19 December 2013
Zone:
File: 153A Woodburn Evans Head Road Doonbah 19Dec2013.EC0 (Plus)
Identifier: P935D5NT MC56-L4 [MC55] (c)Microcom 19Sep03
Algorithm: Factory default (v3.21 - 15322)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range: 10 - 160 km/h.
Direction: North, East, South, West (bound)
Separation: All - (Headway)
Name: Default Profile
Scheme: Vehicle classification (AustRoads94)
Units: Metric (meter, kilometer, m/s, km/h, kg, tonne)
In profile: Vehicles = 110340 / 127479 (86.56%)

Speed Statistics

SpeedStat-92

Site: 153A.0.0WE
Description: Near 495 Woodburn Evans Head Road, Doonbah
Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Scheme: Vehicle classification (AustRoads94)
Filter: CIs(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Vehicles = 110340

Posted speed limit = 80 km/h. Exceeding = 50924 (46.15%), Mean Exceeding = 86.33 km/h

Maximum = 157.2 km/h, Minimum = 11.1 km/h, Mean = 79.7 km/h

85% Speed = 86.8 km/h, 95% Speed = 93.6 km/h, Median = 79.2 km/h

20 km/h Pace = 69 - 89, Number in Pace = 92225 (83.58%)

Variance = 83.68. Standard Deviation = 9.15 km/h

Speed Bins

Speed	Bin	Below	Above	Energy	vMult	n * vMult
0 - 10	0	0	110340	0.00	0.00	0.00
10 - 20	50	50	110290	0.00	0.00	0.00
20 - 30	154	304	110036	99.7	0.00	0.00
30 - 40	518	620	109780	99.4	0.00	0.00
40 - 50	857	1227	109113	98.9	0.00	0.00
50 - 60	1070	2238	108104	98.0	0.00	0.00
60 - 70	3015	3241	102099	90.5	0.00	0.00
70 - 80	5117	5941	50924	46.2	0.00	0.00
80 - 90	4075	10018	10172	9.2	0.00	0.00
90 - 100	3159	10832	2013	1.8	0.00	0.00
100 - 110	1550	10987	461	0.4	0.00	0.00
110 - 120	317	11019	145	0.1	0.00	0.00
120 - 130	43	11027	60	0.1	0.00	0.00
130 - 140	39	11031	23	0.0	0.00	0.00
140 - 150	16	11033	7	0.0	0.00	0.00
150 - 160	5	11034	0	0.0	0.00	0.00
160 - 170	1	11034	0	0.0	0.00	0.00
170 - 180	0	11034	0	0.0	0.00	0.00
180 - 190	0	11034	0	0.0	0.00	0.00
190 - 200	0	11034	0	0.0	0.00	0.00

Total Speed Rating = 0.00

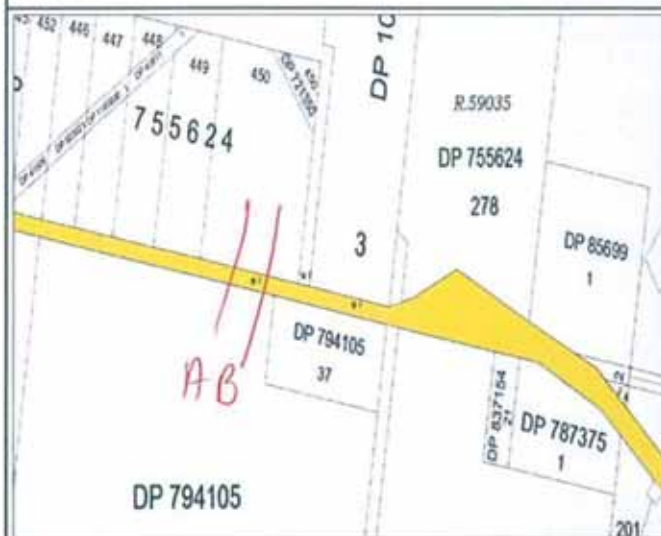
Total Moving Energy (Estimated) = 0.00

Speed limit fields

Limit	Below	Above
0 - 80 PSL	59416 53.6	50924 46.2



RICHMOND VALLEY COUNCIL TRAFFIC COUNT REPORT



Road Name:	WOODBURN EVANS HEAD ROAD, DOONBAH
Road No.:	153
Seg No.:	3040
Road Type:	MR
Direction:	WEST EAST
Reference No.:	153A
Year:	2/09/2013
Counter No.:	

Site Description:	NEAR 495 WOODBURN EVANS HEAD ROAD, DOONBAH (EAST OF QUARRY)
Date of Count:	3/9/2013 TO 30/9/2013
Number of Full Days of Count:	27 DAYS
Number of Vehicles:	71,809
Annual Average Daily Traffic Count (AADT): (No. of days / No. of Vehicles)	$71,809 \div 27$ 2659.59 AADT
Heavy Vehicles:	7.4%
85 Percentile Speed (km/h):	86.8 km/h 80km SIGN POSTED
Comments:	

Richmond Valley Council Weekly Vehicle Counts

WeeklyVehicle-81 -- English (ENA)

Datasets:

Site: [153A] Near 495 Woodburn Evans Head Road, Doonbah
Direction: 6 - West bound A>B, East bound B>A, Lane: 0
Survey Duration: 14:34 Friday, 30 August 2013 => 9:55 Monday, 30 September 2013
Zone:
File: 153A Woodburn Evans Head Rd Doonbah 30Sep2013.EC0 (Plus)
Identifier: P935D5NT MC56-L4 [MC55] (c)Microcom 19Sep03
Algorithm: Factory default (v3.21 - 15322)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 30 September 2013
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range: 10 - 160 km/h.
Direction: North, East, South, West (bound)
Separation: All - (Headway)
Name: Default Profile
Scheme: Vehicle classification (AustRoads94)
Units: Metric (meter, kilometer, m/s, km/h, kg, tonne)
In profile: Vehicles = 71809 / 74567 (96.30%)

Weekly Vehicle Counts

WeeklyVehicle-81

Site: 153A.0.0WE

Description: Near 495 Woodburn Evans Head Road, Doonbah

Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 30 September 2013

Scheme: Vehicle classification (AustRoads94)

Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Hour	02 Sep	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages	
									1 - 5	1 - 7
0000-0100	*	*	0	1	3	2	9	19	2.0	6.0
0100-0200	*	*	1	9	1	2	4	5	2.5	3.2
0200-0300	*	*	8	1	2	2	6	2	3.2	3.5
0300-0400	*	*	6	5	6	4	3	1	5.3	4.2
0400-0500	*	*	5	9	8	16	5	7	8.2	7.8
0500-0600	*	*	48	43	47	52	23	14	47.5	29.5
0600-0700	*	*	108	116	122	95	52	38	110.3	48.5
0700-0800	*	*	181	198	194	167	76	72	185.0	148.0
0800-0900	*	*	255<	273<	214	231<	192	108	243.3<	212.2
0900-1000	*	*	219	192	220<	222	214	194	213.2	210.2
1000-1100	*	*	188	204	184	176	270<	274<	183.0	212.7<
1100-1200	*	*	175	178	175	212	240	271	185.3	208.7
1200-1300	*	*	151	183	176	193	185	254<	175.8	190.3
1300-1400	*	*	154	182	172	200	205<	247	177.0	193.2
1400-1500	*	*	176	203	186	183	185	226	187.0	193.2
1500-1600	*	*	244<	237	229	250<	183	177	240.0	220.0
1600-1700	*	*	240	272<	244<	234	172	172	247.5<	222.3<
1700-1800	*	*	202	212	176	186	258	155	194.0	181.5
1800-1900	*	*	117	134	106	121	100	80	119.3	109.7
1900-2000	*	*	53	63	45	59	46	45	55.0	51.5
2000-2100	*	*	45	56	43	46	50	23	47.5	43.8
2100-2200	*	*	21	36	34	39	34	14	30.0	28.0
2200-2300	*	*	12	17	22	25	38	16	19.3	20.8
2300-2400	*	*	11	6	5	28	24	4	10.0	11.2
Totals										
0700-1900	*	*	2302	2468	2256	2376	2180	2236	2366.5	2362.0
0500-2200	*	*	2529	2739	2490	2615	2362	2350	2593.5	2514.8
0600-0000	*	*	2552	2762	2518	2658	2424	2364	2622.5	2546.2
0000-0000	*	*	2620	2825	2586	2736	2484	2412	2691.8	2610.5
AM Peak	*	*	0800	0400	0900	0800	1600	1000		
	*	*	255	272	229	221	270	274		
PM Peak	*	*	1500	1600	1600	1500	1300	1200		
	*	*	244	272	244	250	205	254		

* - No data.

Weekly Vehicle Counts

WeeklyVehicle-81

Site: 153A.0.0WE

Description: Near 495 Woodburn Evans Head Road, Doonbah

Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 30 September 2013

Scheme: Vehicle classification (AustRoads94)

Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages		
	09 Sep	10 Sep	11 Sep	12 Sep	13 Sep	14 Sep	15 Sep	1	5	7
0000-0100	2	2	4	4	3	18	13	3.0		6.6
0100-0200	1	2	4	6	1	5	4	4.8		4.0
0200-0300	2	1	1	1	1	2	1	1.4		1.4
0300-0400	6	7	6	6	5	3	2	6.0		5.0
0400-0500	11	8	6	8	10	5	9	8.1		8.1
0500-0600	52	44	70	59	53	28	15	55.6		45.9
0600-0700	132	106	109	126	103	59	41	111.2		93.7
0700-0800	182	189	177	215	170	89	77	186.6		157.0
0800-0900	220<	254<	269<	253<	256<	164	126	250.4<	220.3<	220.3<
0900-1000	203	229	212	247	250	178	205	228.2	217.7	217.7
1000-1100	182	164	179	211	196	258	197	186.4	198.1	198.1
1100-1200	187	174	184	185	207	256	231	187.4	208.6	208.6
1200-1300	181	155	176	234	182	207	231	185.6	195.1	195.1
1300-1400	178	149	190	182	181	212<	250<	176.0	191.7	191.7
1400-1500	167	199	181	200	203	184	247	190.0	197.3	197.3
1500-1600	220<	241<	227	267	262<	152	205	243.4<	224.9<	224.9<
1600-1700	214	219	235<	283<	253	158	173	240.8	219.3	219.3
1700-1800	200	209	225	200	205	104	108	207.8	178.7	178.7
1800-1900	85	163	131	112	117	93	91	121.6	113.1	113.1
1900-2000	48	60	61	48	57	67	47	54.8	52.6	52.6
2000-2100	31	57	39	40	40	32	38	41.4	39.6	39.6
2100-2200	23	67	29	54	40	42	16	38.6	35.9	35.9
2200-2300	8	13	22	17	22	30	9	16.4	17.3	17.3
2300-2400	4	7	5	10	21	19	3	9.4	9.9	9.9
Totals										
0700-1900	2219	2345	2386	2589	2480	2055	2177	2406.2	2321.2	2321.2
0600-2200	2423	2635	2624	2837	2720	2235	2319	2650.2	2543.6	2543.6
0600-0000	2445	2655	2651	2864	2765	2284	2331	2676.0	2570.7	2570.7
0000-0000	2519	2719	2742	2948	2839	2345	2380	2753.4	2641.7	2641.7
AM Peak	0800	0800	0800	0800	0800	1000	1100			
	220	254	269	253	256	256	167			
PM Peak	1500	1500	1600	1600	1500	1300	1300			
	220	241	235	282	262	212	250			

* - No data.

Weekly Vehicle Counts

WeeklyVehicle-81

Site: 153A.0.0WVE
 Description: Near 495 Woodburn Evans Head Road, Doonbah
 Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 30 September 2013
 Scheme: Vehicle classification (AustRoads94)
 Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages		
	16 Sep	17 Sep	18 Sep	19 Sep	20 Sep	21 Sep	22 Sep	1 - 5	1 - 7	
0000-0100	4	3	4	4	4	3	17	3.8	7.0	
0100-0200	3	3	3	1	3	10	12	2.3	6.9	
0200-0300	3	3	3	5	3	1	4	3.1	5.0	
0300-0400	4	4	6	9	6	12	9	6.8	8.2	
0400-0500	10	3	6	7	13	11	19	7.6	9.7	
0500-0600	49	35	54	50	51	26	20	47.8	40.7	
0600-0700	101	97	113	125	105	69	39	104.2	92.7	
0700-0800	209	184	204	169	160	97	61	185.2	154.9	
0800-0900	245<	257<	252<	249<	255<	146	124	251.6<	218.3	
0900-1000	212	210	217	244	253	260	195	227.2	227.3<	
1000-1100	205	175	177	196	218	267<	240<	194.8	211.6	
1100-1200	174	167	165	191	201	235	238	179.6	195.9	
1200-1300	183	150	181	215	199	227<	248	185.6	200.4	
1300-1400	163	160	174	184	213	220	229	175.2	192.1	
1400-1500	160	162	155	177	205	224	251<	171.8	190.6	
1500-1600	208	248<	234<	230<	280<	198	235	240.0<	233.3<	
1600-1700	208<	209	222	225	255	188	172	223.6	211.1	
1700-1800	154	188	195	182	194	158	145	182.6	173.7	
1800-1900	76	126	126	123	144	92	101	119.0	112.6	
1900-2000	51	57	74	74	59	62	53	63.0	61.4	
2000-2100	24	37	35	41	40	63	25	39.4	40.6	
2100-2200	16	30	33	29	40	35	24	29.4	29.4	
2200-2300	11	20	19	17	29	24	16	19.1	18.6	
2300-2400	3	9	8	14	11	22	9	8.6	10.6	
Totals	2197	2241	2301	2385	2573	2212	2239	1340.2	2321.7	
0700-1900	2389	2462	2555	2654	2841	2541	2379	1580.1	2545.9	
0600-0000	2403	2491	2580	2685	2881	2587	2396	1760.0	2575.0	
0000-0000	2481	2542	2655	2761	2959	2650	2479	2679.6	2645.4	
AM Peak	980	980	980	980	980	1000	1000			
PM Peak	160	150	150	150	150	120	140			

* - No data.

Weekly Vehicle Counts

WeeklyVehicle-81

Site: 153A.0.0WE
 Description: Near 495 Woodburn Evans Head Road, Doonbah
 Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 30 September 2013
 Scheme: Vehicle classification (AustRoads94)
 Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages	
	23 Sep	24 Sep	25 Sep	26 Sep	27 Sep	28 Sep	29 Sep	1 - 5	1 - 7
0000-0100	2	2	1	2	5	8	13	3.4	4.7
0100-0200	4	2	2	1	3	9	4	2.4	2.1
0200-0300	5	0	2	2	1	6	1	2.8	2.0
0300-0400	4	3	5	2	10	3	6	5.8	5.4
0400-0500	13	8	14	0	12	13	6	11.4	10.9
0500-0600	59	49	57	57	60	29	20	54.6	46.0
0600-0700	109	111	113	104	103	65	51	109.0	92.7
0700-0800	151	145	156	155	162	99	91	153.8	137.0
0800-0900	225	186	207	196	206	169	137	204.0	189.4
0900-1000	245<	225<	237	208	253<	295	212	233.6	226.4
1000-1100	242	219	242<	255	245	246	260	242.6<	245.6<
1100-1200	211	199	199	212	216	250<	293<	207.4	225.7
1200-1300	192	200	212	255	220<	219<	250	215.8	221.1<
1300-1400	198	189	208	227	219	164	251	206.2	208.0
1400-1500	203	215	193	260<	216	198	253<	217.4	219.7
1500-1600	227	200	212	238	216	144	227	218.6	209.1
1600-1700	228<	222<	221<	240	207	196	333	223.6<	221.0
1700-1800	212	186	189	179	219	163	156	197.0	186.3
1800-1900	99	98	109	199	125	92	111	108.0	106.1
1900-2000	54	62	66	63	74	45	69	63.8	61.9
2000-2100	41	43	48	41	52	47	49	45.0	45.9
2100-2200	25	26	33	42	36	47	26	32.2	33.4
2200-2300	9	8	21	15	37	27	14	18.0	18.7
2300-2400	6	11	8	12	11	24	8	9.6	11.4
Totals									
0700-1900	2433	2284	2385	2544	2504	2145	2474	2430.0	2295.6
0600-2200	2662	2526	2644	2794	2769	2349	2629	2679.0	2630.4
0600-0000	2677	2545	2673	2821	2817	2400	2691	2706.6	2660.6
0000-0000	2755	2611	2755	2901	2908	2465	2741	2786.0	2733.7
AM Peak	9900	9900	10000	10000	9900	11000	11000		
	245	225	267	265	253	250	293		
PM Peak	1600	1600	1600	1600	1200	1200	1600		
	228	224	221	260	220	219	253		

* - No data.

Richmond Valley Council

Class Speed Matrix

ClassMatrix-82 -- English (ENA)

Datasets:

Site: [153A] Near 495 Woodburn Evans Head Road, Doonbah
Direction: 6 - West bound A>B, East bound B>A. Lane: 0
Survey Duration: 14:34 Friday, 30 August 2013 => 9:55 Monday, 30 September 2013
Zone:
File: 153A Woodburn Evans Head Rd Doonbah 30Sep2013.EC0 (Plus)
Identifier: P935D5NT MC56-L4 [MC55] (c)Microcom 19Sep03
Algorithm: Factory default (v3.21 - 15322)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 30 September 2013
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range: 10 - 160 km/h.
Direction: North, East, South, West (bound)
Separation: All - (Headway)
Name: Default Profile
Scheme: Vehicle classification (AustRoads94)
Units: Metric (meter, kilometer, m/s, km/h, kg, tonne)
In profile: Vehicles = 71809 / 74567 (96.30%)

ClassMatrix-82

Desc

Filter time:

Scheme:

Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

[illegible]

Richmond Valley Council

Speed Statistics

SpeedStat-83 -- English (ENA)

Datasets:

Site: [153A] Near 495 Woodburn Evans Head Road, Doonbah
Direction: 6 - West bound A>B, East bound B>A, Lane: 0
Survey Duration: 14:34 Friday, 30 August 2013 => 9:55 Monday, 30 September 2013
Zone:
File: 153A Woodburn Evans Head Rd Doonbah 30Sep2013.EC0 (Plus)
Identifier: P935D5NT MC56-L4 [MC55] (c)Microcom 19Sep03
Algorithm: Factory default (v3.21 - 15322)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 30 September 2013
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range: 10 - 160 km/h.
Direction: North, East, South, West (bound)
Separation: All - (Headway)
Name: Default Profile
Scheme: Vehicle classification (AustRoads94)
Units: Metric (meter, kilometer, m/s, km/h, kg, tonne)
In profile: Vehicles = 71809 / 74567 (96.30%)

Speed Statistics

SpeedStat-83

Site: 153A.0.0WE
 Description: Near 495 Woodburn Evans Head Road, Doonbah
 Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 30 September 2013
 Scheme: Vehicle classification (AustRoads94)
 Filter: CIs(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Vehicles = 71809
 Posted speed limit = 80 km/h, Exceeding = 32800 (45.68%), Mean Exceeding = 86.32 km/h
 Maximum = 157.2 km/h, Minimum = 11.1 km/h, Mean = 79.5 km/h
 85% Speed = 86.8 km/h, 95% Speed = 93.6 km/h, Median = 79.2 km/h
 20 km/h Pace = 69 - 89, Number in Pace = 59701 (83.14%)
 Variance = 87.86, Standard Deviation = 9.37 km/h

Speed Bins

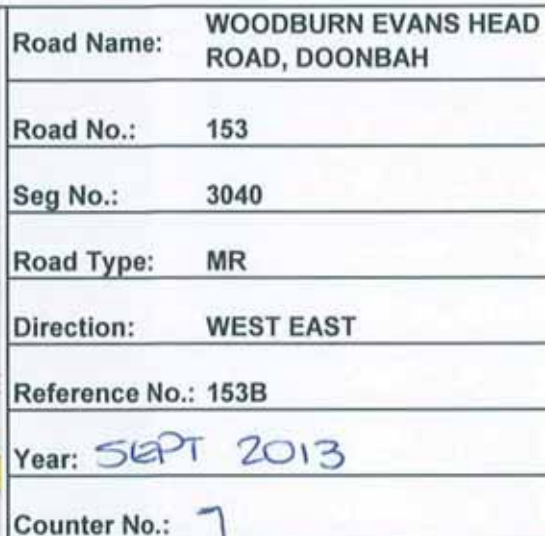
Speed	Bin	Below	Above	Energy	vMult	n * vMult
0 - 10	0	0	71809	0.00	0.00	0.00
10 - 20	38	38	71771	0.00	0.00	0.00
20 - 30	175	213	71196	0.00	0.00	0.00
30 - 40	231	444	71363	0.00	0.00	0.00
40 - 50	513	957	70450	0.00	0.00	0.00
50 - 60	922	1719	70090	0.00	0.00	0.00
60 - 70	1401	5770	66039	0.00	0.00	0.00
70 - 80	33339	39009	33800	0.00	0.00	0.00
80 - 90	26210	65019	6590	0.00	0.00	0.00
90 - 100	5335	70554	1255	0.00	0.00	0.00
100 - 110	960	71514	295	0.00	0.00	0.00
110 - 120	256	71710	99	0.00	0.00	0.00
120 - 130	35	71709	44	0.00	0.00	0.00
130 - 140	29	71793	19	0.00	0.00	0.00
140 - 150	11	71304	0	0.00	0.00	0.00
150 - 160	5	71809	0	0.00	0.00	0.00
160 - 170	0	71609	0	0.00	0.00	0.00
170 - 180	0	71809	0	0.00	0.00	0.00
180 - 190	0	71809	0	0.00	0.00	0.00
190 - 200	0	71809	0	0.00	0.00	0.00

Total Speed Rating = 0.00

Total Moving Energy (Estimated) = 0.00

Speed limit fields

Limit	Below	Above
0 - 40 (PSL)	49009	32800



G:\Works\Traffic Counts\Maps\2013\MR153\153B Woodburn Evans Head Road Doonbah 020913.xls

Richmond Valley Council Weekly Vehicle Counts

WeeklyVehicle-93 -- English (ENA)

Datasets:

Site: [153B] Near 500 Woodburn Evans Head Road, Doonbah
Direction: 6 - West bound A>B, East bound B>A. Lane: 0
Survey Duration: 14:37 Friday, 30 August 2013 => 19:44 Monday, 14 October 2013
Zone:
File: 153B Woodburn Evans Head Rd Doonbah 19Dec2013.EC0 (Plus)
Identifier: AB4100NR MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default (v3.21 - 15322)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range: 10 - 160 km/h.
Direction: North, East, South, West (bound)
Separation: All - (Headway)
Name: Default Profile
Scheme: Vehicle classification (AustRoads94)
Units: Metric (meter, kilometer, m/s, km/h, kg, tonne)
In profile: Vehicles = 109694 / 114365 (95.92%)

Weekly Vehicle Counts

WeeklyVehicle-93

Site: 153B.0.0WE
Description: Near 500 Woodburn Evans Head Road, Doonbah
Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Hour	Mon 02 Sep	Tue 03 Sep	Wed 04 Sep	Thu 05 Sep	Fri 06 Sep	Sat 07 Sep	Sun 08 Sep	Averages 1 - 5	1 - 7
0000-0100	*		2	4	2	9	19	2.0	6.3
0100-0200	*	1	6	1	2	4	9	2.5	3.2
0200-0300	*	8	1	2	2	6	2	3.3	3.1
0300-0400	*	4	6	6	4	3	1	5.5	4.3
0400-0500	*	4	4	8	14	5	4	6.3	7.2
0500-0600	*	17	43	46	51	33	14	46.8	39.7
0600-0700	*	127	118	122	96	64	38	110.3	98.7
0700-0800	*	176	195	191	165	75	40	181.5	148.2
0800-0900	*	247<	266<	211	226<	186	108	237.5<	207.3
0900-1000	*	212	198	213<	221	208	195	208.5	206.2
1000-1100	*	189	195	159	172	269<	267	178.3	208.5<
1100-1200	*	174	177	172	212	239	267<	193.3	206.3
1200-1300	*	144	182	177	190	181	252<	174.3	188.7
1300-1400	*	154	192	169	193	203<	245	174.5	191.3
1400-1500	*	171	203	182	196	193	222	185.3	191.5
1500-1600	*	240<	232	224	249<	194	186	238.3	219.2
1600-1700	*	231	268<	244<	233	173	174	244.0<	221.2<
1700-1800	*	216	209	171	189	156	151	191.5	178.3
1800-1900	*	118	134	105	123	111	78	120.3	109.3
1900-2000	*	53	64	44	59	46	45	65.0	51.3
2000-2100	*	45	56	43	46	50	23	47.5	43.3
2100-2200	*	27	39	24	39	34	14	35.3	28.3
2200-2300	*	12	17	23	25	38	10	19.3	20.3
2300-2400	*	21	6	5	18	25	4	14.5	11.5

Totals

0700-1900	*	2228	2431	2219	2356	2138	2214	2316.3	2273.2
0600-2200	*	2457	2794	2451	2596	2342	2324	2539.0	2485.7
0600-0000	*	2113	2727	2479	2639	2415	2346	2543.3	2513.7
0000-0000	*	2818	2799	2546	2714	2475	2395	2655.3	2581.2

AM Peak	*	81	1401	9900	6800	1000	1130		
	*	247	266	213	226	249	267		

PM Peak	*	153.7	161	1400	1500	1300	1100		
	*	247	266	244	249	213	267		

* - No data.

Weekly Vehicle Counts

WeeklyVehicle-93

Site: 153B.0.0WE
Description: Near 500 Woodburn Evans Head Road, Doonbah
Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

	Mon 09 Sep	Tue 10 Sep	Wed 11 Sep	Thu 12 Sep	Fri 13 Sep	Sat 14 Sep	Sun 15 Sep	Averages 1 - 5	1 - 7
Hour									
0000-0100	2	2	3	4	3	18	18	2.8	6.6
0100-0200	1	2	4	4	1	4	3	2.3	3.9
0200-0300	1	1	1	1	2	3	1	1.4	1.6
0300-0400	3	4	5	5	5	3	4	5.6	4.7
0400-0500	4	4	5	3	4	3	4	4.6	4.3
0500-0600	43	43	70	57	52	18	15	54.2	44.9
0600-0700	114	117	178	125	137	19	41	112.8	94.9
0700-0800	176	145	175	103	163	44	10	130.3	154.1
0800-0900	219<	244<	257<	241<	253<	153	126	242.8<	213.3
0900-1000	203	232	207	239	246	174	205	225.4	215.1<
1000-1100	182	143	176	203	190	153	207	193.4	196.7
1100-1200	157	133	185	188	204	259<	264<	186.6	202.1
1200-1300	134	150	171	223	179	211<	224	179.6	191.3
1300-1400	173	141	183	173	178	210	251<	169.4	186.9
1400-1500	169	195	175	204	190	190	246	186.6	195.6
1500-1600	217<	242<	224<	264	261<	161	210	241.6<	224.1<
1600-1700	210	219	221	280<	252	160	174	236.4	216.6
1700-1800	196	210	220	200	206	175	174	206.4	197.3
1800-1900	44	168	133	111	115	93	98	122.4	113.4
1900-2000	47	65	60	49	57	46	44	54.4	52.7
2000-2100	31	37	41	40	40	33	38	41.6	40.1
2100-2200	23	44	27	34	40	42	16	39.6	35.4
2200-2300	4	14	22	17	22	30	9	16.6	17.4
2300-2400	4	7	5	10	21	18	3	9.4	3.7
Totals									
0700-1900	2194	2311	2327	2539	2436	2043	2181	2361.4	2290.1
0600-2200	2435	2607	2563	2790	2680	2217	2322	2608.4	2512.4
0600-0000	1413	1611	2590	2817	2723	2211	2314	2634.4	2539.6
0000-0000	2439	2674	2673	2899	2794	2352	2353	2753.3	2602.4
AM Peak	18	18.6	36.6	16.1	38.6	11.9	11.1		
	219	244	257	241	253	153	126		
PM Peak	150.3	133.3	150.8	160.0	157.7	117.0	131.3		
	11	141	224	230	261	161	210		

* - No data.

Weekly Vehicle Counts

WeeklyVehicle-93

Site: 153B.0.0WE
Description: Near 500 Woodburn Evans Head Road, Doonbah
Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

	Mon 16 Sep	Tue 17 Sep	Wed 18 Sep	Thu 19 Sep	Fri 20 Sep	Sat 21 Sep	Sun 22 Sep	Averages 1 - 5	1 - 7
Hour									
0000-0100	4	3	4	3	4	13	17	3.6	6.8
0100-0200	3	3	2	4	3	19	14	2.2	5.7
0200-0300	3	4	3	5	2	7	4	3.4	3.1
0300-0400	3	4	4	3	6	2	3	3.4	4.3
0400-0500	11	3	4	4	12	11	14	7.6	9.7
0500-0600	34	12	53	49	49	16	21	46.6	40.7
0600-0700	102	44	112	123	104	47	37	107.4	91.6
0700-0800	197	181	184	161	153	96	43	175.2	149.3
0800-0900	244<	252<	240<	237	248<	142	121	244.2<	212.1
0900-1000	217	198	217	243<	231	234	198	221.2	222.6<
1000-1100	196	175	181	196	204	255<	240	191.6	207.6
1100-1200	172	162	163	192	200	219	242<	177.8	195.7
1200-1300	144	148	171	202	196	221	246	181.2	186.1
1300-1400	161	153	172	176	213	224<	233	175.3	190.3
1400-1500	162	149	153	172	203	228	256<	165.4	188.9
1500-1600	206<	246<	224<	231<	277<	199	235	236.8<	231.1<
1600-1700	183	210	218	228	250	198	174	213.6	208.4
1700-1800	159	191	193	194	193	189	142	182.4	173.3
1800-1900	75	128	126	123	144	93	99	113.2	112.6
1900-2000	53	75	72	78	59	59	63	63.4	61.3
2000-2100	23	37	35	41	60	48	24	39.2	40.7
2100-2200	12	37	31	29	40	35	24	29.4	29.4
2200-2300	11	27	19	17	29	24	10	19.2	19.6
2300-2400	3	3	4	14	11	22	9	8.6	13.6

Totals

0700-1900	2147	2192	2239	2334	2516	2291	2253	2259.4	2264.1
0600-2200	2354	2419	2490	2611	2773	2507	2391	2528.4	2597.1
0600-0000	2365	2437	2515	2642	2819	2563	2419	2556.2	2536.2
0000-0000	1447	2437	2587	2718	2895	2616	2495	2626.2	2606.1
AM Peak	194	2413	1900	1907	1800	1910	1136		
	194	2413	240	243	246	215	242		
PM Peak	181	1807	1800	1800	1800	1779	1400		
	218	247	224	231	277	214	284		

* - No data.

Weekly Vehicle Counts

WeeklyVehicle-93

Site: 153B.0.0WE
Description: Near 500 Woodburn Evans Head Road, Doonbah
Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

	Mon 23 Sep	Tue 24 Sep	Wed 25 Sep	Thu 26 Sep	Fri 27 Sep	Sat 28 Sep	Sun 29 Sep	Averages 1 - 5	1 - 7
Hour									
0000-0100	2	2	1	2	5	3	13	2.4	4.7
0100-0200	4	2	2	1	3	6	4	2.4	3.1
0200-0300	0	2	3	3	1	6	1	2.6	3.1
0300-0400	4	2	1	7	10	2	7	3.6	5.6
0400-0500	13	7	12	15	12	13	5	11.2	13.6
0500-0600	30	49	57	56	60	16	19	34.4	45.4
0600-0700	178	165	173	165	99	66	84	156.8	93.4
0700-0800	154	144	156	153	162	101	84	153.8	136.9
0800-0900	227	181	208	197	204	181	138	201.6	186.7
0900-1000	244	222<	238	211	264<	274	112	235.4	227.6
1000-1100	245<	221	240<	266<	244	247<	283	243.2<	246.6<
1100-1200	218	199	196	211	214	245	295<	206.4	224.6
1200-1300	182	199	212	249	216	216<	257	213.6	219.4
1300-1400	145	133	215	228	221<	187	254<	206.4	207.6
1400-1500	139	119	197	261<	214	187	281	217.8	213.4
1500-1600	224	199	212	239	215	141	229	217.8	213.4
1600-1700	226<	224<	224<	237	216	197	235	224.2<	221.9<
1700-1800	212	193	192	190	220	164	106	189.4	167.4
1800-1900	96	96	109	110	126	93	111	107.6	106.4
1900-2000	64	61	66	63	76	45	67	64.2	61.7
2000-2100	46	44	47	42	52	47	49	45.6	45.9
2100-2200	20	25	37	42	37	47	26	37.4	33.6
2200-2300	9	4	21	15	37	27	14	18.0	18.7
2300-2400	6	11	9	12	11	24	3	9.6	11.4

Totals

0700-1900	2401	2238	2354	2542	2510	2173	2464	2426.4	2342.7
0600-2200	2641	2523	2642	2794	2774	2338	2667	2674.6	2617.3
0600-0000	2635	2542	2671	2621	2822	2349	2702	2712.2	2637.4
0000-0000	1733	2617	2753	1909	2912	2453	2709	2781.2	2723.9

AM Peak

1811	1400	1737	1000	890	1000	1110
245	222	240	266	264	247	285

PM Peak

1811	1671	1609	1400	1390	1200	1311
220	224	224	267	221	218	254

* - No data.

Weekly Vehicle Counts

WeeklyVehicle-93

Site: 153B.0.0WE
Description: Near 500 Woodburn Evans Head Road, Doonbah
Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Hour	Mon 30 Sep	Tue 01 Oct	Wed 02 Oct	Thu 03 Oct	Fri 04 Oct	Sat 05 Oct	Sun 06 Oct	Averages 1 - 5	1 - 7
0000-0100	3	1	4	2	5	13	19	4.2	7.6
0100-0200	1	3	3	4	4	9	7	3.0	4.3
0200-0300	0	2	1	2	3	4	2	1.6	2.6
0300-0400	8	6	6	5	4	9	9	6.4	6.3
0400-0500	10	8	11	9	12	4	10	9.4	10.6
0500-0600	65	12	56	61	51	38	52	56.2	53.0
0600-0700	87	125	112	125	98	69	10	115.6	95.6
0700-0800	182	181	189	162	111	111	114	181.4	141.3
0800-0900	193	213	198	211	190	168	202	193.4	195.3
0900-1000	226	217	168	220	227	229	265	215.6	224.6
1000-1100	234<	249<	253	229<	308<	280	284<	254.6<	259.6<
1100-1200	221	226	259<	222	229	288<	244	237.4	242.3
1200-1300	232<	217	241	231	243	266<	253	237.6	239.3
1300-1400	214	199	253	230	251<	244	278<	227.2	236.9
1400-1500	211	249<	265<	221	249	233	253	238.8<	240.7<
1500-1600	214	234	244	235<	244	234	213	234.2	225.4
1600-1700	206	247	244	228	221	191	163	229.2	214.3
1700-1800	184	226	226	202	203	173	98	212.2	188.9
1800-1900	188	193	193	123	137	140	12	114.2	111.9
1900-2000	55	51	53	59	65	58	48	56.6	55.0
2000-2100	27	33	43	47	51	33	51	40.2	43.6
2100-2200	26	29	29	28	48	43	27	30.2	31.6
2200-2300	17	18	17	21	35	27	4	21.6	29.6
2300-2400	7	11	5	5	11	20	10	7.6	10.3

Totals

0700-1900	2492	2473	2435	2514	2653	2512	2434	2536.9	2519.6
0600-2200	2604	2639	2870	2776	2913	2734	2435	2776.9	2746.1
0600-0000	2629	2719	2892	2702	1961	2781	2450	2800.4	2777.9
0000-0000	2716	2753	2972	2830	2940	2881	2768	2880.6	2861.7

AM Peak

234	249	253	229	308	280	284

PM Peak

220	240	244	202	203	173	98

* - No data.

Weekly Vehicle Counts

WeeklyVehicle-93

Site: 153B.0.0WE
Description: Near 500 Woodburn Evans Head Road, Doonbah
Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

	Mon 07 Oct	Tue 08 Oct	Wed 09 Oct	Thu 10 Oct	Fri 11 Oct	Sat 12 Oct	Sun 13 Oct	Averages 1 - 5	1 - 7
Hour									
0000-0100	2	7	3	6	5	7	5	3.6	4.3
0100-0200	7	11	4	2	1	4	1	1.4	1.9
0200-0300	3	4	2	3	7	6		4.2	4.6
0300-0400	10	8	6	5	11	8	12	8.4	8.9
0400-0500	29	35	43	47	44	45	15	39.6	34.1
0500-0600	41	116	108	123	107	79	29	98.0	88.1
0600-0700	12	182	176	166	152	90	63	139.8	122.6
0700-0800	91	261<	246<	258<	245<	187	119	221.8	197.8
0800-0900	213	208	204	231	219	231	115	216.1	214.1
0900-1000	233	205	193	207	199	255	237<	224.8<	230.9<
1000-1100	330<	179	174	193	155	300<	231	208.2	223.0
1100-1200	324	161	162	197	177	223	221	204.2	209.3
1200-1300	308<	190	191	168	191	206<	179	203.4	200.2
1300-1400	295	191	219	181	179	193	194<	203.0	198.9
1400-1500	272	234<	245<	211	215	174	112	235.6<	217.7<
1500-1600	234	125	236	241<	212	148	144	230.4	206.9
1600-1700	127	199	204	224	222<	148	136	195.2	180.1
1700-1800	68	177	143	139	122	110	88	115.8	112.4
1800-1900	61	52	83	54	81	94	18	72.6	76.4
1900-2000	31	34	49	75	46	80	38	47.0	50.4
2000-2100	10	26	35	35	52	59	25	33.0	34.3
2100-2200	-	15	3	14	37	19	17	16.4	18.3
2200-2300	5	7	11	6	13	26	8	8.8	10.7
2300-2400	4	3	5	-	12	14	-	5.5	5.9

Totals

0700-1900	1865	2193	2283	2318	2196	2229	2128	2329.1	2271.3
0600-2200	2772	2421	2552	2593	2483	2434	2178	2565.2	2446.9
0600-0000	2741	2431	2568	2613	2510	2524	2175	2599.3	2518.4
0000-0000	1544	1596	2730	2799	2673	2631	2243	2734.2	1652.7

AM Peak

1030	711	770	770	770	770	1030	971
33	241	240	238	245	301	137	

PM Peak

1213	1414	1909	1511	1800	1170	1314	1314
374	134	245	141	222	276	184	

* - No data.

Richmond Valley Council Class Speed Matrix

ClassMatrix-94 -- English (ENA)

Datasets:

Site: [153B] Near 500 Woodburn Evans Head Road, Doonbah
Direction: 6 - West bound A>B, East bound B>A. Lane: 0
Survey Duration: 14:37 Friday, 30 August 2013 => 19:44 Monday, 14 October 2013
Zone:
File: 153B Woodburn Evans Head Rd Doonbah 19Dec2013.EC0 (Plus)
Identifier: AB4100NR MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default (v3.21 - 15322)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range: 10 - 160 km/h.
Direction: North, East, South, West (bound)
Separation: All - (Headway)
Name: Default Profile
Scheme: Vehicle classification (AustRoads94)
Units: Metric (meter, kilometer, m/s, km/h, kg, tonne)
In profile: Vehicles = 109694 / 114365 (95.92%)

Class Speed Matrix

ClassMatrix-94

Site: 153B.0.0WE
Description: Near 500 Woodburn Evans Head Road, Doonbah
Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Scheme: Vehicle classification (AustRoads94)
Filter: CIs(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10.160) Headway(>0)

Speed (km/h)		Class												Speed Totals	
		1	2	3	4	5	6	7	8	9	10	11	12		
0 - 10		0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
10 - 20		0	0	0	0	0	0	0	0	0	0	0	0	47	0.0%
20 - 30		0	0	0	0	0	0	0	0	0	0	0	0	100	0.1%
30 - 40		0	0	0	0	0	0	0	0	0	0	0	0	299	0.3%
40 - 50		0	0	0	0	0	0	0	0	0	0	0	0	603	0.5%
50 - 60		0	0	0	0	0	0	0	0	0	0	0	0	1038	0.9%
60 - 70		0	0	0	0	0	0	0	0	0	0	0	0	5871	5.4%
70 - 80		0	0	0	0	0	0	0	0	0	0	0	0	54458	49.6%
80 - 90		0	0	0	0	0	0	0	0	0	0	0	0	37931	34.6%
90 - 100		0	0	0	0	0	0	0	0	0	0	0	0	7596	6.9%
100 - 110		0	0	0	0	0	0	0	0	0	0	0	0	1365	1.2%
110 - 120		0	0	0	0	0	0	0	0	0	0	0	0	259	0.2%
120 - 130		0	0	0	0	0	0	0	0	0	0	0	0	68	0.1%
130 - 140		0	0	0	0	0	0	0	0	0	0	0	0	41	0.0%
140 - 150		0	0	0	0	0	0	0	0	0	0	0	0	13	0.0%
150 - 160		0	0	0	0	0	0	0	0	0	0	0	0	5	0.0%
160 - 170		0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
170 - 180		0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
180 - 190		0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
190 - 200		0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
Class Totals		100470	3836	3841	701	263	67	118	51	271	69	4	3	109694	
		91.6%	3.5%	3.5%	0.6%	0.2%	0.1%	0.1%	0.0%	0.2%	0.1%	0.0%	0.0%		

Richmond Valley Council Speed Statistics

SpeedStat-95 -- English (ENA)

Datasets:

Site: [153B] Near 500 Woodburn Evans Head Road, Doonbah
Direction: 6 - West bound A>B, East bound B>A. Lane: 0
Survey Duration: 14:37 Friday, 30 August 2013 => 19:44 Monday, 14 October 2013
Zone:
File: 153B Woodburn Evans Head Rd Doonbah 19Dec2013.EC0 (Plus)
Identifier: AB4100NR MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default (v3.21 - 15322)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range: 10 - 160 km/h.
Direction: North, East, South, West (bound)
Separation: All - (Headway)
Name: Default Profile
Scheme: Vehicle classification (AustRoads94)
Units: Metric (meter, kilometer, m/s, km/h, kg, tonne)
In profile: Vehicles = 109694 / 114365 (95.92%)

Speed Statistics

SpeedStat-95

Site: 153B.0.0WE
Description: Near 500 Woodburn Evans Head Road, Doonbah
Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 14 October 2013
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Vehicles = 109694

Posted speed limit = 80 km/h, Exceeding = 47278 (43.10%), Mean Exceeding = 86.22 km/h

Maximum = 157.7 km/h, Minimum = 10.6 km/h, Mean = 79.4 km/h

85% Speed = 86.4 km/h, 95% Speed = 92.9 km/h, Median = 78.8 km/h

20 km/h Pace = 69 - 89, Number in Pace = 92668 (84.48%)

Variance = 75.76, Standard Deviation = 8.70 km/h

Speed Bins

Speed	Bin	Below	Above	Energy	vMult	n * vMult
0 - 10	0	0	109694	0.00	0.00	0.00
10 - 20	47	47	109647	0.00	0.00	0.00
20 - 30	100	147	109547	0.00	0.00	0.00
30 - 40	199	146	109348	0.00	0.00	0.00
40 - 50	203	1049	108645	0.00	0.00	0.00
50 - 60	1038	1067	107607	0.00	0.00	0.00
60 - 70	5871	1058	101736	0.00	0.00	0.00
70 - 80	34458	61416	17078	0.00	0.00	0.00
80 - 90	37931	100347	9347	0.00	0.00	0.00
90 - 100	7586	107943	1761	0.00	0.00	0.00
100 - 110	1365	109308	386	0.00	0.00	0.00
110 - 120	259	109567	127	0.00	0.00	0.00
120 - 130	65	109635	59	0.00	0.00	0.00
130 - 140	41	109676	18	0.00	0.00	0.00
140 - 150	13	109689	5	0.00	0.00	0.00
150 - 160	5	109694	0	0.00	0.00	0.00
160 - 170	0	109694	0	0.00	0.00	0.00
170 - 180	0	109694	0	0.00	0.00	0.00
180 - 190	0	109694	0	0.00	0.00	0.00
190 - 200	0	109694	0	0.00	0.00	0.00

Total Speed Rating = 0.00

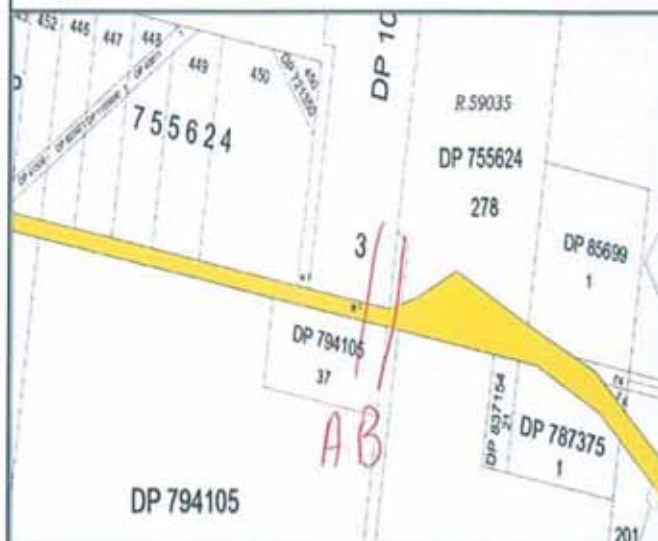
Total Moving Energy (Estimated) = 0.00

Speed limit fields

Limit	Below	Above
0 - 80 PSL	60416 56.9	47278 43.1



RICHMOND VALLEY COUNCIL TRAFFIC COUNT REPORT



Road Name:	WOODBURN EVANS HEAD ROAD, DOONBAH
Road No.:	153
Seg No.:	3040
Road Type:	MR
Direction:	WEST EAST
Reference No.:	153B
Year:	2/09/2013
Counter No.:	

Site Description:	NEAR 500 WOODBURN EVANS HEAD ROAD, DOONBAH (EAST OF QUARRY)
Date of Count:	3/9/2013 TO 30/9/2013
Number of Full Days of Count:	27 DAYS
Number of Vehicles:	71,097
Annual Average Daily Traffic Count (AADT): (No. of days / No. of Vehicles)	$71,097 \div 27$ 2,633.22 AADT
Heavy Vehicles:	5.2%
85 Percentile Speed (km/h):	86.4 km/h 80 km SIGN POSTED.

Comments:	

Richmond Valley Council

Weekly Vehicle Counts

WeeklyVehicle-77 -- English (ENA)

Datasets:

Site: [153B] Near 500 Woodburn Evans Head Road, Doonbah
Direction: 6 - West bound A>B, East bound B>A. Lane: 0
Survey Duration: 14:37 Friday, 30 August 2013 => 9:30 Monday, 30 September 2013
Zone:
File: 153B Woodburn Evans Head Rd Doonbah 30Sep2013.EC0 (Plus)
Identifier: AB4100NR MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default (v3.21 - 15322)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 30 September 2013
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range: 10 - 160 km/h.
Direction: North, East, South, West (bound)
Separation: All - (Headway)
Name: Default Profile
Scheme: Vehicle classification (AustRoads94)
Units: Metric (meter, kilometer, m/s, km/h, kg, tonne)
In profile: Vehicles = 71097 / 73809 (96.33%)

Weekly Vehicle Counts

WeeklyVehicle-77

153B.0.0WE

Site:

Description: Near 500 Woodburn Evans Head Road, Doonbah

Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 30 September 2013

Scheme: Vehicle classification (AustRoads94)

Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Hour	Mon 02 Sep	Tue 03 Sep	Wed 04 Sep	Thu 05 Sep	Fri 06 Sep	Sat 07 Sep	Sun 08 Sep	Averages		
								1	5	7
0000-0100	*	0	2	4	2	9	19	2.0	2.0	6.0
0100-0200	*	1	6	1	0	4	3	0.5	0.5	3.0
0200-0300	*	8	1	3	0	6	12	3.3	3.3	3.5
0300-0400	*	6	6	7	4	3	1	4.5	4.5	4.3
0400-0500	*	8	4	8	14	5	6	8.0	8.0	7.2
0500-0600	*	47	43	56	52	33	14	46.8	46.8	39.0
0600-0700	*	107	115	127	96	64	34	110.0	110.0	88.7
0700-0800	*	175	185	182	165	70	30	181.5	181.5	145.1
0800-0900	*	247<	266<	211	226<	186	108	237.5<	237.5<	207.3
0900-1000	*	212	188	213<	221	208	199	208.5	208.5	206.2
1000-1100	*	189	195	159	170	269<	267	178.8	178.8	208.5<
1100-1200	*	176	177	172	172	229	267<	183.5	183.5	206.8
1200-1300	*	144	182	177	196	141	252<	174.8	174.8	186.7
1300-1400	*	154	182	169	193	203<	245	174.5	174.5	191.0
1400-1500	*	172	203	182	186	183	223	185.8	185.8	191.5
1500-1600	*	240<	230	224	249<	184	180	236.3	236.3	218.2
1600-1700	*	231	268<	244<	233	173	178	244.0<	244.0<	221.2<
1700-1800	*	206	209	172	180	156	152	191.5	191.5	175.8
1800-1900	*	115	134	105	143	101	78	120.0	120.0	109.8
1900-2000	*	53	64	44	59	46	45	55.0	55.0	51.5
2000-2100	*	45	56	43	46	50	23	47.5	47.5	43.8
2100-2200	*	20	38	24	39	34	14	30.3	30.3	28.2
2200-2300	*	12	17	23	25	38	10	19.3	19.3	20.8
2300-2400	*	11	6	5	18	25	4	10.0	10.0	11.5
Totals										
0700-1900	*	2262	2431	2218	2356	2158	2214	2316.8	2316.8	2273.2
0600-2200	*	2487	2704	2452	2596	2342	2334	2559.3	2559.3	2485.7
0600-0000	*	2510	2727	2479	2639	2405	2348	2587.8	2587.8	2518.0
0000-0000	*	2578	2789	2546	2714	2465	2395	2656.8	2656.8	2581.2
AM Peak	*	0800	0800	0900	0800	1000	1100			
	*	247	166	213	226	269	267			
PM Peak	*	1500	1600	1600	1500	1300	1300			
	*	240	268	244	249	203	252			

* - No data.

Weekly Vehicle Counts

WeeklyVehicle-77

Site: 153B.0.0WE
 Description: Near 500 Woodburn Evans Head Road, Doonbah
 Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 30 September 2013
 Scheme: Vehicle classification (AustRoads94)
 Filter: CIs(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages		
	09 Sep	10 Sep	11 Sep	12 Sep	13 Sep	14 Sep	15 Sep	1 - 5	1 - 5	1 - 7
0000-0100	1	4	3	4	3	18	14	1.8	1.8	6.6
0100-0200	1	2	4	6	1	4	9	1.8	1.8	3.9
0200-0300	2	1	1	1	1	3	1	1.4	1.4	1.6
0300-0400	6	6	5	6	5	3	1	5.6	5.6	4.7
0400-0500	9	8	5	5	8	5	1	7.6	7.6	7.3
0500-0600	49	43	76	57	52	28	15	54.2	54.2	44.9
0600-0700	114	107	104	128	107	59	41	112.8	112.8	94.9
0700-0800	176	185	175	205	163	84	77	180.8	180.8	152.1
0800-0900	219<	244<	257<	241<	253<	153	126	242.8<	242.8<	213.3
0900-1000	203	232	207	239	246	174	205	225.4	225.4	215.1<
1000-1100	182	160	176	209	190	253	207	183.4	183.4	196.7
1100-1200	187	169	185	188	204	259<	264<	186.6	186.6	208.0
1200-1300	174	150	171	225	178	211<	228	179.6	179.6	191.0
1300-1400	173	140	183	173	178	210	251<	169.4	169.4	186.9
1400-1500	169	195	175	204	190	190	246	186.6	186.6	195.6
1500-1600	217<	242<	224<	264	261<	151	210	241.6<	241.6<	224.1<
1600-1700	210	219	221	280<	252	160	174	236.4	236.4	216.6
1700-1800	196	210	220	200	206	105	104	206.4	206.4	177.3
1800-1900	88	105	133	111	115	93	89	122.4	122.4	113.4
1900-2000	46	60	60	49	57	46	46	54.4	54.4	52.0
2000-2100	31	57	41	40	40	33	38	41.8	41.8	40.0
2100-2200	23	66	27	34	40	42	16	38.0	38.0	35.4
2200-2300	9	14	27	17	22	20	9	16.4	16.4	17.4
2300-2400	4	7	5	10	21	18	2	9.4	9.4	9.7
Totals	2194	2311	2327	2539	2436	2043	2184	2361.4	2361.4	2290.1
0700-1900	2406	2601	2562	2790	2680	2223	2332	2606.4	2606.4	2512.4
0600-0000	2420	2622	2590	2817	2723	2271	2334	2634.4	2634.4	2539.6
0000-0000	2489	2664	2678	2899	2794	2332	2383	2708.6	2708.6	2608.4
AM Peak	0800	0800	0800	0800	0800	1100	1100			
	219	246	237	241	252	259	264			
PM Peak	1500	1500	1500	1600	1500	1200	1300			
	217	242	224	240	201	211	251			

* - No data.

Weekly Vehicle Counts

WeeklyVehicle-77

Site: 153B.O.OWE
 Description: Near 500 Woodburn Evans Head Road, Doonbah
 Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 30 September 2013
 Scheme: Vehicle classification (AustRoads94)
 Filter: CIs(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages	
	16 Sep	17 Sep	18 Sep	19 Sep	20 Sep	21 Sep	22 Sep	1 - 5	1 - 7
0000-0100	4	4	4	3	4	5	17	3.6	4.9
0100-0200	4	4	3	0	4	0	14	1.7	5.0
0200-0300	3	4	3	5	4	1	4	4.4	3.1
0300-0400	9	4	4	4	6	0	0	6.4	4.9
0400-0500	10	3	6	7	12	11	19	7.6	9.7
0500-0600	50	33	53	49	49	26	41	46.8	40.1
0600-0700	102	94	112	123	104	67	37	107.4	91.6
0700-0800	197	180	186	160	153	96	63	175.2	147.9
0800-0900	244<	252<	240<	237	248<	142	121	244.2<	213.0
0900-1000	117	198	217	243<	131	254	198	221.2	222.6<
1000-1100	196	175	181	195	208	255<	240	191.6	107.6
1100-1200	172	162	163	192	200	239	242<	177.8	195.7
1200-1300	182	143	172	202	196	221	246	181.2	186.1
1300-1400	161	153	172	176	213	224<	233	175.0	190.3
1400-1500	152	149	153	172	202	223	256<	165.2	186.9
1500-1600	206<	246<	224<	231<	277<	199	235	236.8<	231.1<
1600-1700	193	210	212	228	250	188	176	218.6	204.3
1700-1800	159	191	193	176	193	157	142	182.4	173.0
1800-1900	75	128	136	123	144	93	99	119.2	112.6
1900-2000	53	55	72	74	59	54	53	63.4	61.3
2000-2100	23	37	35	41	60	65	24	39.3	40.7
2100-2200	16	30	31	29	40	35	24	29.4	29.4
2200-2300	11	20	19	17	19	24	10	19.2	18.6
2300-2400	3	9	6	14	11	22	9	8.6	10.6
Totals	2160	2192	2239	2338	2316	2291	2253	2289.0	2284.1
0700-1900	2354	2408	2490	2611	2779	2517	2391	2528.4	2507.1
0600-0000	2468	2437	2515	2642	2819	2563	2410	2556.7	1526.3
0000-0000	2447	2487	2587	2715	2895	2626	2485	2636.2	2606.0
AM Peak	6800	6900	6800	6900	6800	1000	1100		
	244	252	240	243	248	245	243		
PM Peak	1500	1500	1500	1500	1500	1300	1400		
	208	146	224	271	277	224	256		

* - No data.

Weekly Vehicle Counts

WeeklyVehicle-77

Site: 153B.0.0WE
 Description: Near 500 Woodburn Evans Head Road, Doonbah
 Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 30 September 2013
 Scheme: Vehicle classification (AustRoads94)
 Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Hour	Mon 23 Sep	Tue 24 Sep	Wed 25 Sep	Thu 26 Sep	Fri 27 Sep	Sat 28 Sep	Sun 29 Sep	Averages 1 - 5	1 - 7
0000-0100	2	2	1	2	3	2	13	3.4	3.7
0100-0200	4	7	2	1	3	2	4	3.4	3.1
0200-0300	5	3	3	3	1	6	1	2.8	3.0
0300-0400	4	3	5	7	10	3	9	5.8	5.6
0400-0500	13	7	14	13	17	13	5	11.2	10.6
0500-0600	50	49	57	56	60	28	18	54.4	45.4
0600-0700	109	108	113	105	99	66	54	106.8	93.4
0700-0800	154	144	156	153	162	101	88	153.8	136.9
0800-0900	220	181	206	197	204	161	138	201.6	186.7
0900-1000	244	222<	236	211	264<	204	213	235.4	227.6
1000-1100	245<	221	240<	266<	244	247<	263	243.2<	246.6<
1100-1200	212	199	196	211	214	245	295<	206.4	224.6
1200-1300	192	199	212	249	216	216<	252	213.6	219.4
1300-1400	185	193	205	228	221<	167	254<	206.4	207.6
1400-1500	199	219	196	261<	214	197	251	217.8	219.6
1500-1600	224	199	212	239	215	141	229	217.8	208.4
1600-1700	226<	224<	224<	237	216	197	235	224.2<	221.9<
1700-1800	213	188	192	190	226	164	156	198.4	187.4
1800-1900	98	96	109	110	136	93	111	107.8	106.1
1900-2000	54	61	66	63	76	45	67	64.0	61.7
2000-2100	40	44	47	42	52	47	49	45.0	45.9
2100-2200	26	25	32	42	37	47	36	32.4	33.6
2200-2300	9	8	31	15	37	27	14	18.0	28.7
2300-2400	6	11	8	12	11	24	8	9.4	11.4
Totals									
0700-1900	2411	2285	2384	2542	2510	2133	2484	2426.4	2392.7
0600-2200	2640	2523	2642	2794	2774	2338	2680	2674.6	2627.3
0600-0000	2655	2542	2671	2821	2822	2389	2702	2702.2	2657.4
0000-0000	2732	2607	2753	2900	2913	2453	2756	2781.2	2729.9
AM Peak	1000	0900	1000	1000	0900	1000	1100		
	245	223	240	266	264	247	295		
PM Peak	1600	1600	1600	1400	1300	1200	1300		
	234	234	234	241	221	216	254		

* - No data.

Richmond Valley Council

Class Speed Matrix

ClassMatrix-78 -- English (ENA)

Datasets:

Site: [153B] Near 500 Woodburn Evans Head Road, Doonbah
Direction: 6 - West bound A>B, East bound B>A, Lane: 0
Survey Duration: 14:37 Friday, 30 August 2013 => 9:30 Monday, 30 September 2013
Zone:
File: 153B Woodburn Evans Head Rd Doonbah 30Sep2013.EC0 (Plus)
Identifier: AB4100NR MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default (v3.21 - 15322)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 30 September 2013
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range: 10 - 160 km/h.
Direction: North, East, South, West (bound)
Separation: All - (Headway)
Name: Default Profile
Scheme: Vehicle classification (AustRoads94)
Units: Metric (meter, kilometer, m/s, km/h, kg, tonne)
In profile: Vehicles = 71097 / 73809 (96.33%)

[illegible]

Richmond Valley Council

Speed Statistics

SpeedStat-80 -- English (ENA)

Datasets:

Site: [153B] Near 500 Woodburn Evans Head Road, Doonbah
Direction: 6 - West bound A>B, East bound B>A, Lane: 0
Survey Duration: 14:37 Friday, 30 August 2013 => 9:30 Monday, 30 September 2013
Zone:
File: 153B Woodburn Evans Head Rd Doonbah 30Sep2013.EC0 (Plus)
Identifier: AB4100NR MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default (v3.21 - 15322)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 30 September 2013
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range: 10 - 160 km/h.
Direction: North, East, South, West (bound)
Separation: All - (Headway)
Name: Default Profile
Scheme: Vehicle classification (AustRoads94)
Units: Metric (meter, kilometer, m/s, km/h, kg, tonne)
In profile: Vehicles = 71097 / 73809 (96.33%)

Speed Statistics

SpeedStat-80

Site: 153B.0.0WE

Description: Near 500 Woodburn Evans Head Road, Doonbah

Filter time: 0:00 Tuesday, 3 September 2013 => 0:00 Monday, 30 September 2013

Scheme: Vehicle classification (AustRoads94)

Filter: CIs(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Vehicles = 71097

Posted speed limit = 80 km/h, Exceeding = 30961 (43.55%), Mean Exceeding = 86.24 km/h

Maximum = 157.7 km/h, Minimum = 10.6 km/h, Mean = 79.4 km/h

85% Speed = 86.4 km/h, 95% Speed = 93.2 km/h, Median = 78.8 km/h

20 km/h Pace = 70 - 90, Number in Pace = 59854 (84.19%)

Variance = 78.11, Standard Deviation = 8.84 km/h

Speed Bins

Speed	Bin	Below	Above	Energy	vMult	n * vMult
0 - 10	0	0	71097	0.00	0.00	0.00
10 - 20	30	30	71061	0.00	0.00	0.00
20 - 30	37	113	70984	0.00	0.00	0.00
30 - 40	210	303	70774	0.00	0.00	0.00
40 - 50	404	727	70370	0.00	0.00	0.00
50 - 60	706	1135	69664	0.00	0.00	0.00
60 - 70	3881	5314	65763	0.00	0.00	0.00
70 - 80	34832	46136	40961	0.00	0.00	0.00
80 - 90	24855	64991	6106	0.00	0.00	0.00
90 - 100	4962	69453	2144	0.00	0.00	0.00
100 - 110	89	70845	352	0.00	0.00	0.00
110 - 120	162	71017	83	0.00	0.00	0.00
120 - 130	44	71056	41	0.00	0.00	0.00
130 - 140	20	71086	11	0.00	0.00	0.00
140 - 150	8	71096	4	0.00	0.00	0.00
150 - 160	2	71097	0	0.00	0.00	0.00
160 - 170	0	71097	0	0.00	0.00	0.00
170 - 180	0	71097	0	0.00	0.00	0.00
180 - 190	0	71097	0	0.00	0.00	0.00
190 - 200	0	71097	0	0.00	0.00	0.00

Total Speed Rating = 0.00

Total Moving Energy (Estimated) = 0.00

Speed limit fields

Limit	Below	Above
0 - 80 (PSL)	40136	30961

Appendix B – Crash Data



Legend

- Fatal
- Injury
- Non-casualty (towaway)
- NR Classified_Roads_20022014
- State
- Regional
- PROPOSED_ALIGNMENTS
- HW10 - OTL

Day of the Week		# Holiday Periods				New Year				Queen's BD				Easter SH			
Monday	4	25.0%	Thursday	3	18.8%	Sunday	2	12.5%	Aust. Day	0	0.0%	Labour Day	0	0.0%	June/July SH	0	0.0%
Tuesday	0	0.0%	Friday	2	12.5%	WEEKDAY	10	62.5%	Easter	0	0.0%	Christmas	0	0.0%	Sept./Oct. SH	2	12.5%
Wednesday	1	6.3%	Saturday	4	25.0%	WEEKEND	6	37.5%	Anzac Day	0	0.0%	January SH	1	6.3%	December SH	1	6.3%

Note: Data for the 9 month period prior to the generated date of this report are incomplete and are subject to change.

Percentages are percentages of all crashes. Unknown values for each category are not shown on this report.

Detailed Crash Report

Crash No.	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors	
Northern Region																					
Richmond Valley LGA																					
Evans Head																					
Evans Head Rd																					
797727	18/05/2012	Fri	15:05		at NUMBER 425 HN	2WY	STR	Fine	Dry	80	2	CAR	F77	S in EVANS HEAD RD	80	Proceeding in lane	I	0	1		
E47818413						RUM:	31	Left rear				4WD	M53	S in EVANS HEAD RD	10	Turning left					
771052	15/10/2011	Sat	15:15	5.5 km	E PACIFIC HWY	2WY	CRV	Fine	Dry	80	1	CAR	M45	E in EVANS HEAD RD		Unk	Proceeding in lane	N	0	0	S
E45549970						RUM:	81	Off left/rt bnd=>obj				Tree/bush									
Woodburn Rd																					
648373	17/11/2008	Mon	07:12		at GOLF LINKS RD	TJN	STR	Raining	Wet	100	1	VAN	M39	W in WOODBURN RD	80	Proceeding in lane	N	0	0		
E147563294						RUM:	70	Off road to left													
720751	01/08/2010	Sun	11:15		at WALLUM DR	TJN	STR	Fine	Dry	80	2	P/C	M13	E in WOODBURN RD		Veering right	I	0	1		
E41797826						RUM:	34	Lane change right				CAR	F36	E in WOODBURN RD	80	Proceeding in lane					
723616	06/09/2010	Mon	07:30		at WALLUM DR	TJN	STR	Fine	Dry	80	1	4WD	M47	E in WOODBURN RD	80	Proceeding in lane	I	0	1		
E42515867						RUM:	71	Off rd left => obj				Drain/culvert									
Woodburn																					
Alfred St																					
824655	21/01/2013	Mon	14:26		at RICHMOND ST	XJN	STR	Fine	Wet	50	2	CAR	M17	W in RICHMOND ST	10	Proceeding in lane	N	0	0		
E177024296						RUM:	10	Cross traffic				4WD	F25	N in ALFRED ST	40	Proceeding in lane					
778670	21/11/2011	Mon	16:49		at WAGNER ST	TJN	STR	Fine	Dry	50	2	CAR	M17	E in WAGNER ST	15	Turning right	N	0	0		
E46273672						RUM:	13	Right near				TRK	M34	N in ALFRED ST	45	Proceeding in lane					
Evans Head Rd																					
685460	11/10/2009	Sun	08:00	6 km	W EVANS HEAD RD	2WY	CRV	Raining	Wet	100	1	WAG	M17	S in EVANS HEAD RD	100	Proceeding in lane	N	0	0	S	
E38476224						RUM:	81	Off left/rt bnd=>obj				Drain/culvert									
649855	05/12/2008	Fri	16:00	150 m	E GOLF LINKS RD	2WY	STR	Overcast	Dry	100	1	WAG	M17	W in EVANS HEAD RD	90	Proceeding in lane	I	0	2		
E35589133						RUM:	71	Off rd left => obj				Fence (prior to 2014)									
727158	09/10/2010	Sat	10:00	500 m	W GOLF LINKS RD	2WY	STR	Raining	Wet	80	1	CAR	U U	W in EVANS HEAD RD		Unk	Proceeding in lane	N	0	0	F
E41692960						RUM:	71	Off rd left => obj				Fence (prior to 2014)									
Woodburn Evans Rd																					
668784	02/05/2009	Sat	10:30	3.5 km	E PACIFIC HWY	2WY	CRV	Raining	Wet	100	1	TRK	M19	W in WOODBURN EVANS RD	100	Proceeding in lane	N	0	0	S	
E38957187						RUM:	81	Off left/rt bnd=>obj				Fence (prior to 2014)									
Woodburn Rd																					

Detailed Crash Report

Crash No.	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors

SF

722169	26/08/2010	Thu	11:20	5 km	W EVANS HEAD TN	2WY	STR	Fine	Dry	80	1	VAN	F29	E in WOODBURN RD	80	Proceeding in lane	N	0	0	
E41286060						RUM:	73	Off rd right => obj				Drain/culvert								
700321	25/02/2010	Thu	11:30		at GOLF LINKS RD	TJN	STR	Raining	Wet	100	2	4WD	M82	N in GOLF LINKS RD	5	Proceeding in lane	I	0	1	
E40883941						RUM:	10	Cross traffic				CAR	M24	W in WOODBURN RD	95	Proceeding in lane				
756260	16/06/2011	Thu	18:00		at GOLF LINKS RD	TJN	STR	Fine	Dry	80	1	CAR	M36	E in WOODBURN RD	80	Proceeding in lane	N	0	0	
E46587787						RUM:	67	Struck animal				Kangaroo								
823188	22/12/2012	Sat	02:00	5 km	E RICHMOND ST	2WY	STR	Fine	Dry	80	1	TRK	M22	E in WOODBURN RD	Unk	Proceeding in lane	N	0	0	
E49846944						RUM:	71	Off rd left => obj				Drain/culvert								
677750	05/08/2009	Wed	15:45	4.7 km	E WOODBURN TN	2WY	STR	Fine	Dry	100	2	4WD	F U	N in WOODBURN RD	Unk	Forward from drive	N	0	0	
E39178416						RUM:	47	Emerging from drive				SEM	U U	W in WOODBURN RD	Unk	Proceeding in lane				

Report Totals: Total Crashes: 16 Fatal Crashes: 0 Injury Crashes: 5 Killed: 0 Injured: 6

Crashid dataset Evans Head Road - Pacific Highway to Wallum Drive - Doonbah Crash data 1/10/2008 to 30/9/2013

Note: Data for the 9 month period prior to the generated date of this report are incomplete and are subject to change.

CrashLink Reports



EXPLANATION OF CODES

Notes for CrashLink reports

Brief Crash Report (BCR01)
Summary Crash Report (REG01)
Detailed Crash Report (DCR01)

Scope of crash statistics

Crash statistics included in these reports

The statistics recorded by the Roads and Traffic Authority are confined to those crashes which conform to the national guidelines for reporting and classifying road vehicle crashes. The main criteria are:

- The crash was reported to the police.
- The crash occurred on a road open to the public.
- The crash involved at least one moving road vehicle.
- The crash involved at least one person being killed or injured or at least one motor vehicle being towed away.

Reports for some crashes are not received until well into the following year and after the annual crash database has been finalised. These amount to less than two percent of recorded crashes and are counted in the following reporting year statistics.

Preliminary data

Fatalities will be removed from crash statistics if subsequent police or coronial investigation shows that they did not fall within national reporting guidelines. Fatalities will be added from a crash where a person subsequently dies within 30 days of the date of the crash or the crash is reported late.

Criteria for reporting crashes

Section 8(3) of the Traffic Act 1909 requires a road crash in New South Wales to be reported to the police when any person is killed or injured or property damage of \$500 is sustained.

Police are only required to attend a crash if:

- A person was killed or injured.
- There was over \$500 damage to property *other* than the vehicles concerned.
- One of the parties failed to stop and exchange particulars.
- One or more of the drivers was reported to be under the influence of alcohol or drugs.
- One or more of the vehicles was required to be towed away.

Other (minor) crashes can be reported to the police as a self reporting collision report which may be completed by each of the drivers involved.

Criteria for determining speeding and fatigue involvement

Speeding

The identification of speeding (excessive speed for the prevailing conditions) as a contributing factor in road crashes cannot always be determined directly from the police reports of those crashes. Certain circumstances however suggest the involvement of speeding. The Roads and Traffic Authority has therefore drawn up criteria for determining whether or not a crash is to be considered as having involved speeding as a contributing factor.

Speeding is considered to have been a contributing factor to a road traffic crash if that crash involved at least one *speeding* motor vehicle.

A motor vehicle is assessed as having been *speeding* if it satisfies the conditions described below under (a) or (b) or both:

- (a) The vehicle's controller (driver or rider) was charged with a speeding offence; or the vehicle was described by police as travelling at excessive speed; or the stated speed of the vehicle was in excess of the speed limit.
- (b) The vehicle was performing a manoeuvre characteristic of excessive speed, that is:
 - While on a curve the vehicle jack-knifed, skidded, slid or the controller lost control; or
 - The vehicle ran off the road while negotiating a bend or turning a corner and the controller was not distracted by something or disadvantaged by drowsiness or sudden illness and was not swerving to avoid another vehicle, animal or object and the vehicle did not suffer equipment failure.

Fatigue

The identification of fatigue as a contributing factor in road traffic crashes similarly cannot always be determined directly from police reports of those crashes and the following criteria are used to assess its involvement. Fatigue is considered to have been involved as a contributing factor to a road traffic crash if that crash involved at least one *fatigued* motor vehicle controller.

A motor vehicle controller is assessed as having been *fatigued* if the conditions described under (c) or (d) are satisfied together or separately:

- (c) The vehicle's controller was described by police as being asleep, drowsy or fatigued.
- (d) The vehicle performed a manoeuvre which suggested loss of concentration of the controller due to fatigue, that is:
 - The vehicle travelled onto the incorrect side of a straight road and was involved in a head-on collision (and was not overtaking another vehicle and no other relevant factor was identified); or
 - The vehicle ran off a straight road or off the road to the outside of a curve and the vehicle was not directly identified as travelling at excessive speed and there was no other relevant factor identified for the manoeuvre.

Special note

Pedal cycle crashes

It is recognised that a substantial proportion of non-fatal pedal cycle crashes are not reported to the police. As the NSW Police Service's P4 Traffic Collision Report is the only source of crash data used in this report, statistics relating to pedal cycle crashes may not accurately reflect the situation.

Definitions and explanatory notes

Articulated truck: Comprised of road train, B-double, articulated tanker, semi-trailer, low loader.

Bicycle rider: See *Pedal cycle rider*

Bus: Includes 'State Transit Authority' bus, long distance/tourist coach or other bus.

Car: Includes sedan, hatchback/liftback, station wagon, utility (based on car design), panel van (based on car design), forward control passenger van, 4WD vehicle not based on car design.

Carriageway: That part of the road improved or designed and/or ordinarily used for vehicular movement. When a road has two or more of these portions, divided by a median strip or other physical separation, each of these is a separate carriageway.

Casualty: Any person killed or injured as a result of a crash.

Controller: A person occupying the controlling position of a road vehicle.

Crash: Any apparently unpremeditated event reported to the police and resulting in death, injury or property damage attributable to the movement of a road vehicle on a road.

Driver: A controller of a motor vehicle other than a motorcycle.

Emergency vehicle: Includes ambulance, fire brigade vehicle, police patrol car (or van) and tow truck.

Fatal crash: A crash for which there is at least one fatality.

Footpath: That part of the road which is ordinarily reserved for pedestrian movement as a matter of right or custom.

Heavy rigid truck: Comprised of large rigid lorry and rigid tanker.

Heavy truck: Comprised of heavy rigid truck and articulated truck.

Light truck: Includes panel van / utility not based on car design.

Motor vehicle: Any road vehicle which is mechanically or electrically powered but not operated on rails.

Motorcycle: Any mechanically or electrically propelled two or three-wheeled machine with or without side-car. Includes; motorcycle, motorcycle with sidecar, motor scooter, mini-bike, moped (motorised pedal cycle), special mobility vehicle, motorised push scooter.

Motorcycle rider: A person occupying the controlling position of a motorcycle.

Non-casualty crash: A crash for which at least one vehicle is towed away but there is no fatality or person injured.

Non-motorised vehicle: Includes any vehicle not mechanically or electrically powered or operated on rails. Includes; small box trailer, small boat trailer, horse float, other small trailer, large trailer, caravan, detached trailer section of semi-trailer, agricultural implement.

Other motor vehicle: Self propelled plant, motorised wheelchair, tractor, quad bike, unknown motor vehicle, Includes taxis and emergency vehicles (prior to CrashLink data capture).

Passenger: Any person, other than the controller, who is in, on, boarding, entering, alighting or falling from a road vehicle at the time of the crash, provided a portion of the person is in/on the road vehicle.

Pedal cycle: Any two or three-wheeled device operated solely by pedals and propelled by human power (not motor assisted) including bicycles with side-car, trailer or training wheels attached. Does not include toy vehicles or other pedestrian conveyances.

Pedestrian: Any person who is not in, on, boarding, entering, alighting or falling from a road vehicle at the time of the crash. Includes; pedestrian in/operating toy vehicle, pedal car, pram, barrow, billycart or non-motorised wheelchair.

Road: The area devoted to public travel within a surveyed road reserve. Includes; a footpath and cycle path inside the road reserve and a median strip or traffic island.

Road vehicle: Any device (except pedestrian conveyance) upon which or by which any person or property may be transported or drawn on a road.

Brief Crash Report

This report shows details for each crash on one line with details for up to two traffic units involved in the crash.

The report is sorted by the following default order, with sub-headings for each:

RTA Region
Local Government Area
Suburb
Street

Totals are given at the base of the report for:

Number of crashes
Number of fatal crashes
Number of injury crashes
Number of non-casualty crashes
Number of traffic units involved
Number of person killed
Number of persons injured

Report fields

Crash No: unique crash identification number.

Date: date on which the crash occurred, or if this is not known, the earliest date within a specified range. Format DD/MM/YYYY

Day: Day of the week on which the crash occurred

SUN 'Sunday'
MON 'Monday'
TUE 'Tuesday'
WED 'Wednesday'
THU 'Thursday'
FRI 'Friday'
SAT 'Saturday'

Time: time at which the crash occurred, or if this is not known, the earliest time within a specified range. Format HH:MM
2400 – midnight
9999 - unknown

Dist: distance from the identifying feature used to locate the crash in metres (m) or kilometres (km). The word 'at' indicates the crash occurred at zero distance from the identifying feature.

ID Feature: identifying feature used to locate the crash, usually a street.
at – right at the spot
N – north
E – east
S – south
W – west
unk – unknown distance

Street abbreviations

AVE – Avenue
BLV – Boulevard
BYP – Bypass
CH – Chase
CIR – Circle/Circuit
CL – Close
CR – Crescent
CT – Court
DR – Drive
ESP – Esplanade
EX – Expressway
GNS – Gardens
GRV – Grove
HWY – Highway
LA – Lane
MR – Main Road
MSC – Miscellaneous
PDE – Parade
PLA – Plaza
PRO – Promenade
PWY – Parkway
QY – Quay
RD – Road
SQ – Square
ST – Street
TCE – Terrace
TR – Trunk Road
UK – Unknown
WAY – Way

Loc: type of location at which the crash occurred.

Intersection locations:

XJN – Cross intersection
YJN – Y intersection
TJN – T intersection
MJN – Multi intersection
RDB – Roundabout

Non-intersection locations:

LJN – L junction
1WY – one way street
2WY – two way undivided street
DIV – divided road
SF – single carriageway
DF – dual carriageway
OTH – other
UNK - unknown/not stated

Alg: alignment of the road at the location of the crash.

STR – straight
CRV – curved
UNK – unknown/not stated

Lgt: status of street lighting at the time of the crash.

On – on
Off – off
Nil – nil
Unk – unknown/not stated

Wth: weather conditions at the time of the crash.

Fine – fine
Raining – raining
Overcast – overcast
Fog – fog or mist
Snow – snow or sleet
Other – other eg Hail
Unk - unknown/not stated

Sfc: condition of the road surface at the crash location.

Wet – wet
Dry – dry
Snow – snow or ice
Unk – unknown/not stated

SL: maximum speed limit applicable at the location of the crash (in km/h).

900 – excessive speed
999 – unknown/not stated

DCA: Definition for Coding Accidents. A code describing the movements of the vehicles involved in the first impact that occurred during the crash. May be followed by a supplementary code to describe which side of the road the key vehicle travelled off. Categories are as listed below. See also the tabular diagram on final page of this document.

Pedestrian

0 – other
1 – near side
2 – emerging
3 – far side
4 – playing, working, lying, standing on carriageway
5 – walking with traffic
6 – facing traffic
7 – driveway
8 – on footpath

Intersection – vehicles from adjacent approaches

- 100 – other
- 101 – cross traffic
- 102 – right-through from left
- 103 – left-through from left
- 104 – right-through from right
- 105 – two right turning
- 106 – right-left from right
- 107 – left-through from left
- 108 – right-left from left
- 109 – two left turning

Vehicles from opposing directions

- 200 – other
- 201 – head on not overtaking
- 202 – right-through
- 203 – right-left
- 204 – right-right
- 205 – left-through
- 206 – left-left
- 207 – U-turn

Vehicles from same direction

- 300 – other
- Vehicles in same lane
- 301 – rear end
- 302 – rear left
- 303 – rear right
- 304 – U-turn

Vehicles in parallel lanes

- 305 – lane side swipe
- 306 – lane change right
- 307 – lane change left
- 308 – right turn side swipe
- 309 – left turn side swipe

Manoeuvring

- 400 – other
- 401 – leaving parking
- 402 – entering parking
- 403 – parking-parked vehicles only
- 404 – reversing in traffic
- 405 – reversing into fixed object
- 406 – emerging from driveway
- 408 – from footway
- 409 – U-turn into fixed object

Overtaking

- 500 – other
- 501 – head on includes side swipe
- 502 – out of control
- 503 – pulling out
- 504 – cutting in
- 505 – pulling out rear end
- 506 – overtaking right turn

On path

- 600 – other
- 601 – parked
- 602 – double parked
- 603 – accident or broken down
- 604 – vehicle door
- 605 – struck permanent obstruction on carriageway
- 606 – struck temporary roadworks on carriageway
- 607 – struck object on carriageway
- 609 – struck animal not ridden
- 610 – load or missile struck vehicle

Off path, on straight

- 700 – other
- 701 – off carriageway to left
- 702 – off carriageway to right
- 703 – left off carriageway into object
- 704 – right off carriageway into object
- 705 – out of control on carriageway
- 706 – left turn
- 707 – right turn
- 709 – off end of road or T intersection

Off path, on curve

- 800 – other
- 801 – off carriageway on right bend
- 802 – off carriageway on left bend
- 803 – off carriageway on right bend into object
- 804 – off carriageway on left bend into object
- 805 – out of control on carriageway

Passengers and miscellaneous

- 900 – other
- 901 – fell in/from vehicle
- 902 – struck while boarding or alighting
- 903 – struck train/aeroplane
- 906 – parked vehicle ran away
- 907 – vehicle movements not known

Supplementary code

- L – left
- R – right

Tus: actual number of traffic units involved in the crash.

TU1: traffic unit type corresponding to the 'key' traffic unit involved in the primary event of the crash.

- CAR – car
- WAG – station wagon
- UTE – utility based on car
- PAN – panel van based on car
- VAN – forward control passenger van
- 4WD – 4WD vehicle not based on car design
- TRK – light truck
- LOR – large rigid lorry
- RTKR – rigid tanker
- ATKR – articulated tanker
- SEM – semi trailer/low loader
- BDBL – B-double
- RDTR – road train
- STA – STA bus
- CCH – tourist coach
- BUS – other bus
- PLT – self propelled plant
- AMB – ambulance
- FIR – fire/bushfire vehicle
- PLC – police patrol car/van
- TOW – tow truck
- EMG – other emergency vehicle
- CHR – motorised wheelchair
- OMV – other motor vehicle (includes taxis)
- M/C – motorcycle
- MCC – motorcycle with sidecar
- PMC – police motorcycle
- M/S – motor scooter
- MIN – mini bike
- MOP – moped/motorised pedal cycle
- P/C – pedal cycle
- BOX – box trailer
- BTR – boat trailer
- FLO – horse float
- STR – other small trailer
- LTR – large trailer
- CVN – caravan
- DTR – detached trailer
- AGR – agricultural implement
- RA – ridden animal
- ADV – animal drawn
- TRN – train
- PLN – aeroplane
- PED – pedestrian
- TOY – pedestrian in toy vehicle
- UNK – unknown vehicle

S1: street of travel on which Key traffic unit (TU1) was travelling with respect to the street/s in the crash.

- 1 – street of crash
- 2 – identifying feature
- 9 – unknown/not stated

D: direction of travel of this traffic unit.

- N – north
- E – east
- S – south
- W – west

blank – unknown/not stated

Manoeuvre1: manoeuvre of key traffic unit (TU1) immediately prior to its involvement in the crash.

TU2: traffic unit type corresponding to the 'other' traffic unit involved in the first impact of the crash (see TU1 for traffic unit type definition).

S2: street of travel on which the 'other' traffic unit was travelling with respect to the street/s in the crash.

- 1 – street of crash
- 2 – identifying feature
- 9 – unknown/not stated

Manoeuvre2: manoeuvre of 'other' traffic unit immediately prior to its involvement in the crash.

K: number of people who died within 30 days of the crash as a result of injuries received in that crash.

I: number of people who were injured as a result of the crash and who did not die as a result of the injuries within 30 days of the crash.

Fac: factors considered to have contributed to the crash.

- S – speed
- F – fatigue
- A – alcohol

Summary Crash Report

This report summarises data in the selection.

McLean Periods: To analyse when crashes occur, the week is divided into what are called "McLean" times.

- A: Mon-Fri 3am-9am
- B: Sat-Sun 3am 9am
- C: Mon - Fri 9 am -3 pm
- D: Sat 9am - 3 pm
- E: Sun 9am - 3pm
- F: Mon -Wed 3pm - 9pm
- G: Thurs -Fri 3pm - 9pm
- H: Sat-Sun 3pm-9pm
- I: Sun-Wed 9pm-3am (the next day)
- J: Thurs-Sat 9pm-3am (the next day)

Detailed Crash Report

This report includes data for all traffic units involved in the crash.

Crash No. See **Crash No** in Brief Crash Report.

Date: See **Date** in Brief Crash Report.

Day of Week: See **Day** Brief Crash Report.

Time: See **Time** in Brief Crash Report.

Distance: See **Dist** in Brief Crash Report.

ID Feature: See **ID Feature** in Brief Crash Report.

Loc Type: See **Loc** in Brief Crash Report.

Alignment: See **Alg** in Brief Crash Report.

Weather: See **Wth** in Brief Crash Report.

Surface Condition: See **Sfc** in Brief Crash report.

Speed Limit: See **SL** in Brief Crash Report.

NO. of TUS: See **TUS** in Brief Crash Report.

TU Type/Obj: See **TU1** in Brief Crash Report for **Type**.

Age/Sex: Age of Controller/Sex of Controller
M Male
F Female
U Unknown

Street Travelling: See **S1** in Brief Crash Report.

Speed Travelling: See **SL** in Brief Crash Report.

Manoeuvre: The Manoeuvre of traffic unit immediately prior to its involvement in the crash.

Degree of Crash: The Severity of the Crash.

F Fatal

I Injury

N Non- Casualty (tow away)

Killed: See **K** in Brief Crash Report

Injured: See **I** in Brief Crash Report

Factors: See **Fac** in Brief Crash Report.

Definitions for Coding Accidents - DCA Codes

This code is recorded for the *first* impact according to the table below.

Note : The key vehicle is represented by the dark arrow:  and is recorded as the first vehicle in the accident.

	0	1	2	3	4	5	6	7	8	9
	PEDESTRIAN on foot, in toy/ pram	INTERSECTION VEHICLES FROM ADJACENT APPROACHES	VEHICLES FROM OPPOSING DIRECTIONS	VEHICLES FROM SAME DIRECTION	MANOEUVRING	OVERTAKING	ON PATH	OFF PATH, ON STRAIGHT	OFF PATH, ON CURVE	PASSENGERS & MISCELLANEOUS
00	OTHER 000	OTHER 100	OTHER 200	OTHER 300	OTHER 400	OTHER 500	OTHER 600	OTHER 700	OTHER 800	OTHER 900
01	NEAR SIDE 001	CROSS TRAFFIC 101	HEAD ON (not overtaking) 201	REAR END 301	LEAVING PARKING 401	HEAD ON (incl. side swipes) 501	PARKED 601	OFF CARRIAGEWAY TO LEFT 701	OFF CARRIAGEWAY ON RIGHT BEND 801	FELL IN / FROM VEHICLE 901
02	EMERGING 002	RIGHT-THRU FROM LEFT 102	RIGHT-THRU 202	REAR LEFT 302	ENTERING PARKING 402	OUT OF CONTROL 502	DOUBLE PARKED 602	OFF CARRIAGEWAY TO RIGHT 702	OFF CARRIAGEWAY ON LEFT BEND 802	STRUCK WHILE BOARDING OR ALIGHTING 902
03	FAR SIDE 003	LEFT-THRU FROM LEFT 103	RIGHT-LEFT 203	REAR RIGHT 303	PARKING VEHICLES ONLY 403	PULLING OUT 503	ACCIDENT OR BROKEN DOWN 603	LEFT OFF CARRIAGEWAY INTO OBJECT 703	OFF CARRIAGEWAY ON NIGHT BEND INTO OBJECT 803	STRUCK TRAIN/ AEROPLANE 903
04	PLAYING, WORKING LYING, STANDING ON CARRIAGEWAY 004	RIGHT-THRU FROM RIGHT 104	RIGHT-RIGHT 204	U-TURN 304	REVERSING 404	CUTTING IN 504	VEHICLE DOOR 604	RIGHT OFF CARRIAGEWAY INTO OBJECT 704	OFF CARRIAGEWAY ON LEFT BEND INTO OBJECT 804	
05	WALKING WITH TRAFFIC 005	TWO RIGHT TURNING 105	LEFT-THRU 205	LANE SIDE SWIPE 305	REVERSING INTO FIXED OBJECT 405	PULLING OUT REAR END 505	PERMANENT OBSTRUCTION ON CARRIAGEWAY 605	OUT OF CONTROL ON CARRIAGEWAY 705	OUT OF CONTROL ON CARRIAGEWAY 805	
06	FACING TRAFFIC 006	RIGHT-LEFT FROM RIGHT 106	LEFT-LEFT 206	LANE CHANGE RIGHT 306	EMERGING FROM DRIVEWAY 406	OVERTAKING RIGHT TURN 506	TEMPORARY ROADWORKS 606	LEFT TURN 706		PARKED VEHICLE RAN AWAY 906
07	DRIVEWAY 007	LEFT-THRU FROM RIGHT 107	U-TURN 207	LANE CHANGE LEFT 307	EMERGING FROM LOADING BAY 407		STRUCK OBJECT ON CARRIAGEWAY 607	RIGHT TURN 707		UNKNOWN 907
08	ON FOOTWAY/ MEDIAN 008	RIGHT-LEFT FROM LEFT 108		RIGHT TURN SIDE SWIPE 308	FROM FOOTWAY 408		ANIMAL (not ridden) 609	MOUNTAIN TRAFFIC ISLAND 708	MOUNTAIN TRAFFIC ISLAND 808	
09		TWO LEFT TURNING 109		LEFT TURN SIDE SWIPE 309	U-TURN INTO FIXED OBJECT 409		LOAD OR MISSILE STRUCK VEHICLE 610	OFF END OF ROAD/ T JUNCTION 709		
10				PULLING OUT (LANE CHANGE) 310						

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		Name	Signature	Name	Signature	Date
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Appendix I – Heritage Assessment

JUNE 2014

DUE DILIGENCE CULTURAL HERITAGE ASSESSMENT



DOONBAH QUARRY WOODBURN, NSW

PREPARED FOR GHD



Report Reference:

T. Robins, A. Piper and J. Towers 2014 *Cultural Heritage Due Diligence Assessment for Lot 2 DP1040274, Woodburn, Northern NSW (June 2014)*. Everick Heritage Consultants Pty Ltd. Unpublished report prepared for GHD and Rixa Quarries.

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EXECUTIVE SUMMARY

This assessment provides supporting information to an Application to the Director General by Rixa Quarries (No.2) Pty Ltd for expansion of the extraction areas at the existing Doonbah Quarry at Lot 2 in DP 1040274, Woodburn Evans Head Road in the Richmond Valley LGA.

Everick Heritage Consultants (The Consultant) was commissioned by GHD on behalf of its client Rixa Quarries (No.2) Pty Ltd (the Proponent) to undertake this assessment. The intent of the assessment is to identify any cultural heritage constraints to the expansion of the Doonbah Quarry to the limit of Profit A Prendre. Risks to Aboriginal cultural heritage were assessed through archaeological survey and application of the Office of Environment and Heritage (OEH) *Due Diligence Code for the Protection of Aboriginal Objects in NSW* (2010).

The brief for this project was to undertake a Due Diligence Assessment of suitable standard to be submitted as a stand-alone report. In accordance with the relevant administrative and legislative standards for New South Wales (see Section 2 below), the methods employed in this assessment included:

- a) searches of applicable Indigenous heritage registers;
- b) a review of current and historic satellite imagery;
- c) archaeological survey of the Project Area;
- d) desktop assessment
- e) assessment of the Project Area in accordance with the Due Diligence Code; and
- f) report findings and recommend management strategies.

The Project Area is in Northern New South Wales approximately 5 km east of the town of Woodburn on the Woodburn-Evans Head Road. The Project Area is approximately 12ha adjoining the existing Doonbah Quarry. An overview of the Project Area location is shown in Figure 1. Detailed plans of the lands under cultural heritage assessment (Assessment Area) are provided in Figure 2.

A search was conducted of the OEH Aboriginal Heritage Information Management System (AHIMS service number 127897), centring on the Project Area with a 1000 m buffer. The results of the AHIMS Register search were returned on 11 March 2014. There are no sites registered on the AHIMS register within the proposed expansion to the Doonbah Quarry extraction areas.



Results

As a result of a desktop study and field inspection of the proposed expansion to the Doonbah Quarry extraction areas and consultation with Bogal LALC Sites Officer Daryl Knight and Bundjalang Traditional Owner representatives Doug Wilson and Lewis Williams the following were agreed to.

- No Indigenous cultural heritage sites or relics were identified within the proposed expansion to the Doonbah Quarry extraction areas.
- No areas have been identified that are considered to potentially contain subsurface deposits of significant Aboriginal heritage.
- All of the Project Area has been disturbed in a manner which constitute 'disturbance' within the meaning of the Due Diligence Code and is consistent with the Due Diligence Code.
- The Bundjalang Traditional Owners and Bogal LALC representative agreed in discussion that no further Aboriginal cultural heritage investigation was required.

Recommendations - Aboriginal Heritage:

The following recommendations are cautionary in nature. Whilst it is considered unlikely that they will be required, they should be noted and adhered to, as they relate to managing the legal obligations of the Proponent that will continue to apply in relation to cultural heritage.

Recommendation 1: Aboriginal Cultural Material Finds Procedure

It is recommended that if it is suspected that Aboriginal material has been uncovered as a result of earth working activities within the Project Area:

- a) work in the surrounding area is to stop immediately;
- b) a temporary fence is to be erected around the site, with a buffer zone of at least 10 metres around the known edge of the site;
- c) an appropriately qualified archaeological consultant is to be engaged to identify the material;
and
- d) if the material is found to be of Aboriginal origin, the Aboriginal community is to be consulted in a manner as outlined in the OEH guidelines: Aboriginal Cultural Heritage Consultation Requirements for Proponents (2010).



Recommendation 2: Notifying the OEH

It is recommended that if Aboriginal cultural materials are uncovered as a result of development activities within the Project Area, they are to be registered as Sites in the AHIMS database managed by the OEH. Any management outcomes for the site will be included in the information provided to the OEH.

Recommendation 3: Aboriginal Human Remains

It is recommended that if human remains are located at any stage during earthworks within the Project Area, all works must halt in the immediate area to prevent any further impacts to the remains. The location where they were found should be cordoned off and the remains themselves should be left untouched. The nearest police station (Woodburn), the Bogal LALC, Bangalang Traditional Owners and the OEH Regional Office (Coffs Harbour) are to be notified as soon as possible. If the remains are found to be of Aboriginal origin and the police release the scene, the Aboriginal community and the OEH should be consulted as to how the remains should be dealt with. Work may only resume after agreement is reached between all notified parties, provided it is in accordance with all parties' statutory obligations.

It is also recommended that in all dealings with Aboriginal human remains, the Proponent should use respectful language, bearing in mind that they are the remains of Aboriginal people rather than scientific specimens.

Recommendation 4: Conservation Principles

In the unlikely event that Aboriginal cultural heritage is identified during Project works, it is recommended that all effort must be taken to avoid any impacts on Aboriginal Cultural Heritage values. Should a situation arise where impacts to Aboriginal cultural heritage is unavoidable, mitigation measures should be negotiated between the Proponent, OEH and the Aboriginal Community.

Recommendations – Non-Indigenous (Historic) Heritage:

There are no recommendations with regard to historic heritage. The Project does not impact on places of historic heritage significance



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DEFINITIONS

Aboriginal Object means any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains.

Aboriginal Place means 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.

ACHCR Guidelines means the OEH *Aboriginal Cultural Heritage Consultation Requirements for Proponents (2010)*.

Archaeological Code of Practice means the OEH *Code of Practice for Archaeological Conduct in New South Wales (2010)*.

Assessment Area means the lands under cultural heritage assessment.

BLALC means Bogal Local Aboriginal Land Council

BNTG means Bandjalang Native Title Group

Due Diligence Code means the OEH *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (2010)*.

EPA Act means the *Environmental Planning and Assessment Act 1979 (NSW)*.

EPBC Act means the *Environment Protection and Biodiversity Conservation Act 1999 (NSW)*.

GHD means Gutteridge Haskins Davies Pty Ltd

GSV means Ground Surface Visibility, and is a percentage of how much ground surface (bare earth) can be seen at the time an archaeological survey is conducted.

In situ an archaeological technical term for features remaining undisturbed in their original context.

NCREP 1988 means the North Coast Regional Environmental Plan 1988.

NPW Act means the *National Parks and Wildlife Act 1974 (NSW)*.

OEH means the New South Wales Office of Environment and Heritage.

Project Area means the land subject to Aboriginal cultural heritage assessment, and comprises an area of 10.1ha.

Proponent means Rixa Quarries (N0.2) Pty Ltd, and all employees and contractors of the Proponent.

The Project means the proposed extraction expansion area Lot 2 in DP 1040274 also described as the Project Area identified in Figure 2.

The Consultant means qualified archaeological staff and/or contractors of Everick Heritage Consultants Pty Ltd.

TSC 1997 means the N.S.W *Threatened Species Conservation Act 1997*.



1. INTRODUCTION

1.1 Purpose of the Cultural Heritage Assessment

This assessment provides supporting information to an Application to the Director General for expansion of the existing Doonbah Quarry at Lot 2 in DP 1040274 Woodburn Evans Head Road in the Richmond Valley LGA.

1.2 Proponent & Project Brief

Everick Heritage Consultants (The Consultant) was commissioned by GHD on behalf of its client Rixa Quarries (No.2) Pty Ltd (The Proponent) to undertake this assessment. The intent of the assessment is to identify any cultural heritage constraints to the expansion of the quarry to the limit of Profit A Prendre. Risks to Aboriginal cultural heritage were assessed through archaeological survey and application of the Office of Environment and Heritage (OEH) *Due Diligence Code for the Protection of Aboriginal Objects in NSW* (2010).

1.3 Methodology used during this assessment

The brief for this project was to undertake a Due Diligence Assessment of suitable standard to be submitted as a stand-alone report. In accordance with the relevant administrative and legislative standards for New South Wales (see Section 2 below), the methods employed in this assessment included:

- a) searches of applicable Indigenous heritage registers;
- b) a review of current and historic satellite imagery;
- c) archaeological survey of the Project Area;
- d) desktop assessment
- e) assessment of the Project Area in accordance with the Due Diligence Code; and
- f) report findings and recommend management strategies.

1.4 Defining the Project Area

The Project Area is in Northern New South Wales approximately 5km east of the town of Woodburn on the Woodburn-Evans Head Road. The Project Area is approximately 10.1.ha adjoining the existing Doonbah Quarry.



An overview of the Project Area location is shown in Figure 1. Detailed plans of the lands under cultural heritage assessment (Assessment Area) are provided in Figure 2.

1.5 Report Authorship

The site survey was undertaken by Everick Heritage qualified Senior Archaeologist Adrian Piper on the 23rd May 2014. The desktop study was undertaken by Adrian Piper and Tim Robins. This report was written by Adrian Piper assisted by Tim Robins and Jordan Towers.

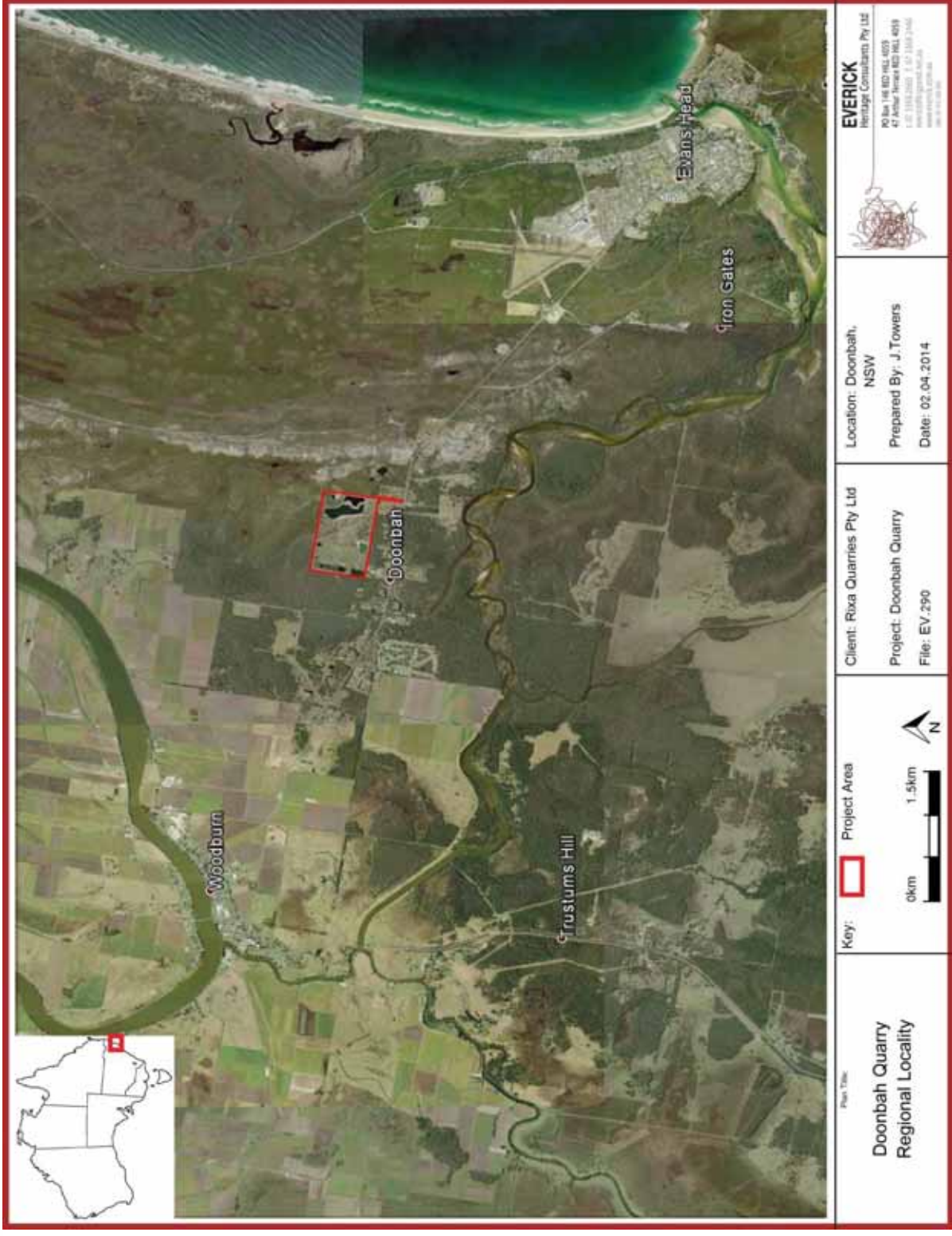


Figure 1: Project Area General Locality



Figure 2: Project Area



2. LEGISLATIVE AND PLANNING CONTEXT

The following legislation provides the context for cultural heritage in NSW: the *National Parks and Wildlife Act 1974* (NSW), the *Environmental Planning and Assessment Act 1979* (NSW) and local council Environmental Plans and Development Control Plans. The Commonwealth also has a role in the protection of nationally significant cultural heritage through the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth).

State legislative due diligence standards, as governed by the Office of Environment and Heritage, have also been referred to in this assessment. Whilst not strictly required, it is proposed that they offer assistance in objectively determining potential impacts and impact mitigation standards for the present scope of works.

In relation to cultural heritage, the proposed works primarily fall within the ambit of the *National Parks and Wildlife Act 1974* (NSW) and the *Heritage Act 1977* (NSW). The consent authorities will be the NSW Department of Planning and Environment and where a referral agency is required to be reported to, the OEH. The OEH will also be involved where the Project will impact on identified cultural heritage. The information below lists the legislative and policy framework within which this assessment is set.

The Commonwealth also has a role in the protection of nationally significant cultural heritage through the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth) and the *Protection of Movable Cultural Heritage Act 1986* (Cth).

2.1 The National Parks and Wildlife Act 1974 (NSW)

The *National Parks and Wildlife Act 1974* (NSW) ('NPW Act') is the primary legislation concerning the identification and protection of Aboriginal cultural heritage. It provides for the management of both Aboriginal Objects and Aboriginal Places. Under the NPW Act, an Aboriginal Object is any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area, regardless of whether the evidence of habitation occurred before or after non-Aboriginal settlement of the land. This means that every Aboriginal Object – regardless of its size or seeming isolation from other Objects – is protected under the Act.

An Aboriginal Place is an area of particular significance to Aboriginal people which has been *declared* an Aboriginal Place by the Minister. The drafting of this legislation reflects the traditional focus on Objects, rather than on areas of significance such as story places and ceremonial grounds. However, a gradual shift in cultural heritage management practices, towards recognising the value of identifying the significance of areas to



Indigenous peoples beyond their physical attributes, can be seen in local and State government policies (such as the ACHCR Guidelines discussed below).

Under Section 86 of the NPW Act, it is an offence to disturb, move, remove or destroy an Aboriginal Object without the consent of the Chief Executive of the OEH. This consent can be either to Investigate (Section 87) or Destroy (Section 90). If a land user is seeking a Consent to Destroy, best practice is to generally seek a Section 87 permit first, and then demonstrate to the OEH the minimal significance of the site before applying for a Section 90 Consent. Before applying for Consent under Section 87 or 90, the applicant must undertake broad-based Aboriginal community consultation in accordance with the ACHCR guidelines discussed below.

2.2 Due Diligence Code of Practice for the Protection of Aboriginal Objects

The Due Diligence Code has been applied to this assessment, and is addressed in Section 9 of this assessment. It operates by posing a series of questions for land users before they commence development. These questions are based around assessing previous ground disturbance. An activity will generally be unlikely to harm Aboriginal Objects where it:

- will cause no additional ground disturbance; or
- is in a developed area; or
- is in a significantly disturbed area.

Where these criteria are not fulfilled, further assessment for Aboriginal cultural heritage will typically be required prior to commencing the activity.

2.3 The ACHCRP (2010)

The *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (2010) (ACHCRP) provide an acceptable framework for conducting Aboriginal community consultation in preparation for impacts to Aboriginal cultural heritage. Proponents are required to follow them where a Project is likely to impact on cultural heritage and where required by Council. It is recommended by the OEH that all cultural heritage assessments involve this level of consultation, although it is not strictly a requirement unless it meets the above criteria.

The ACHCR Guidelines typically take a minimum of 90 days to complete. However, in complicated Projects this period may need to be extended by several months. The Guidelines require public notice of the assessment,



preparation of a proposed methodology, undertaking site meetings and excavations where required, the production of a draft report, which is distributed to the registered Aboriginal groups and the production of a final report. Although not strictly required, a thorough consultation process will treat the ACHCR Guidelines as a minimum standard of community consultation. Generally, consultants must go to further effort to identify the significance of a given site to the Aboriginal community. This will likely include undertaking additional site inspections if requested by Aboriginal stakeholders, fully resourcing the community by providing copies of past archaeological and environmental assessments in the region and meeting with community members to ascertain their opinions of the site.

2.4 The Heritage Act 1977 (NSW)

The *Heritage Act 1977* (NSW) ('Heritage Act') is aimed at identifying and protecting significant items of historic (as opposed to Aboriginal) cultural heritage. The focus of the legislation is on identifying places of either local or state heritage significance, and protecting them by registration on heritage registers. Significant historic heritage items are afforded little protection (other than at the discretion of councils) where they are not on a heritage register.

Of note are the provisions allowing for interim heritage orders (Part 3), which grants the Minister or the Minister's delegates, (which importantly may include a local government agent) the power to enter a property and provide emergency protection for places that have not yet been put on a heritage register but that may be of local or State significance.

The *Heritage Act 1977* (NSW) also makes allowances for the protection of archaeological deposits and relics (Part 6). An archaeological "relic" means any deposit, object or material evidence which relates to the settlement of the area, not being Aboriginal settlement. Importantly, a former requirement for an archaeological relic to be 50 years or older has recently been repealed. The focus is now on the item's potential heritage significance, not its age. As will be discussed below, it is highly unlikely that archaeological relics of significant historic sites are located within the Project Area.

2.5 Richmond Valley Local Environmental Plan 2012

The Richmond Valley LEP 2012 provides statutory protection for items already listed as being of heritage significance (Schedule 5), items that fall under the ambit of the Heritage Act 1977 (NSW) and Aboriginal Objects under the National Parks and Wildlife Act 1974 (NSW). It ensures that essential best practice components of the heritage decision making process are followed.



For listed heritage items, relics and heritage conservation areas, the following action can only be carried out with the consent of the Richmond Valley Council:

- a) demolishing, defacing, damaging or moving a heritage item or a building, work, relic, tree or place within a heritage conservation area, or
- b) altering a heritage item or a building, work or relic within a heritage conservation area by making structural changes to its exterior, or
- c) altering a heritage item or a building, work or relic within a heritage conservation area by making non-structural changes to the detail, fabric, finish or appearance of its exterior, except changes resulting from any maintenance necessary for its ongoing protective care, which does not adversely affect its heritage significance, or
- d) moving a relic, or excavating land for the purpose of discovering, exposing or moving a relic, or
- e) erecting a building on, or subdividing, land on which a heritage item is located or which is within a heritage conservation area.

In addition, Council may not grant development consent without considering whether the lands contain potential Aboriginal archaeological deposits (Part 5.10 and Schedule 2).

2.6 The North Coast Regional Environmental Plan (NCREP 1988)

The *North Coast Regional Environmental Plan 1988* ('NCREP 1988') recognises the importance of regionally significant heritage items and places to the State of NSW. It provides statutory protection for a select number of state and regionally significant heritage items and places in northern NSW. A 'heritage item' means a building, work, relic, tree or place of heritage significance to the North Coast Region specified as described in Schedule 2 or 3 of the NCREP 1988.

For these items, the Richmond Council remains the consent authority. Under the NCREP 1988, Council must consider:

- a) the views of the Heritage Council;
- b) the heritage significance of the item to the State or region;
- c) the extent to which the carrying out of the development would affect the heritage significance of the item and its site;
- d) whether the setting of the item, and in particular, whether any stylistic, horticultural or archaeological features of the setting should be retained;



- e) measures taken to conserve and preserve the heritage item, including where appropriate, any conservation plan; and
- f) if the item constitutes a danger to the users or occupiers.



3. DESCRIPTION OF PROPOSED WORKS

The following description is the understanding of the proposed works provided to Everick Heritage at the time of this assessment by GHD and reflects the level of detail provided to The Consultant.

The extraction is proposed to move to the west of the existing extraction areas and move south in three stages. Top soil will be removed initially and the sand extracted using an excavator. Once the excavation fills with water, a dredge will be introduced to extract sand to a depth of 15m (-12AHD). This expansion will increase the extraction areas to about 18.3ha which would be an increase of 12 ha on the current extraction areas. The depth of the excavation would increase by approximately 11m (GHD 'Proposal' Section 1.4).

4. ENVIRONMENTAL CONTEXT

The Project Area is an alluvial plain landscape of the Richmond River, mixed with an extensive back barrier plain (Thom 1984).

4.1 Geology

Quaternary alluvium composed of alluvium, sand and clay. The alluvium is derived from weathered basalts deposited on Pleistocene sands (Morand 1994). Surface soils are shallow black clay loams over brown cracking clays merging with dark brown to yellowish grey sands. Deep dark brown and black sub soil sands may lay over a harder indurated sand stone layer (Morand 1994: 124).

4.2 Vegetation

Extensively cleared coastal swamp forest is now pasture land and sand quarry. Formerly low dense mixed forest of eucalypts and paperbarks typically 152 m tall with minimal shrub cover and dense groundcover. The boggy ground is heavily clothed in leaf litter, interspersed with patches of sedges and ferns, temporary pools of water and bare ground. Tree cover may be composed *Callistemon salignus* (sweet willow bottlebrush), *Eucalyptus robusta* (swamp mahogany), *Melaleuca quinquenervia* (broad-leaved paperbark), and occasionally *Casuarina glauca* (swamp oak). Shrubs: *Banksia oblongifolia*, *Callistemon linearis* (narrow-leaved bottlebrush), *Leptospermum juniperinum* (prickly teatree), *Melaleuca nodosa*, *M. sieberi*, *Xanthorrhoea fulva* (NSW OEH Website Coastal Swamp Forests).



4.3 Water sources

The nearest major water source to the Project Area is the Evans River 1 km to the south and the Richmond River ca 5 kms to the west. Other water sources in original landscapes would have been coastal swamps and streams.

4.4 Review of Historic Aerial Photography

Historic images from 1953 and 1977 show the level of prior land disturbance within the Project Area.

The **1953** image shows that clearing had been undertaken across all of the site, more intensively in the western side of a fenceline running in a north south direction. Dwellings exist on the northern side of Evans Head Road to the south of the Project Area. Swampland in the north eastern part of the Project area extends to the east of the Project Area boundary.

By **1977** regrowth vegetation covers most of the Project Area, with the beginning of sand extraction visible in the north eastern corner of the Project Area. The land to the east of the Project Area shows considerable sand extraction activities that were an important economic base for the local community.



Figure 3: 1953 Historic Aerial Image showing Project Area (Red Border) (Base Image Google Earth 2014)



Figure 4: 1977 Historic Aerial Image showing Project Area (Red Border) (Base Image Google Earth 2014)



5. DESKTOP REVIEW: ABORIGINAL CULTURAL HERITAGE

5.1 Traditional Owner Knowledge

The Aboriginal Stakeholders are the primary determinants of the significance of their cultural heritage. Members of the Aboriginal community have been consulted in this instance, with regard to known archaeological sites in the region, and cultural values such as areas of historic and spiritual significance and values relating to flora and fauna. Everick recognise that there is Traditional Owner knowledge associated with the region that may have to be treated in a confidential manner.

5.2 Previous Indigenous Archaeological Assessments

The purpose of a review of previous archaeological and broader Aboriginal cultural heritage assessments is to provide insights into the potential types and locations of sites to be found in the wider locality. However the information must be used bearing in mind topography, access to food and material resources and the past and potential impacts of European land uses. It is seldom that the assessment purpose, environmental, historical and social contexts between one area of assessment and another allows the simple extrapolation of previous results to a current project assessment.

5.2.1 Coastal landscapes: Pacific Highway Upgrade-Iluka Road to Ballina Section

Aboriginal cultural heritage assessments in relation to the Pacific Highway Upgrade Woolgoolga to Ballina (PHU) have been the most comprehensive studies in this region, be it by necessity, in a narrow corridor of search and subsequent archaeological investigations. Preliminary Aboriginal heritage assessment was undertaken between Woodburn and Ballina during the route selection phase (Collins 2005). Collins' (2005) assessment commenced in 2004 and considered a number of route options, including the current route (NSW RMS EIS 2013).

Following the survey, 50 potential archaeological deposits and 54 Aboriginal heritage sites were identified and recorded within or near the Pacific Highway Upgrade (PHU) project boundary. Subsequently, 48 potential archaeological deposits were excavated, and 30 of these were found to contain subsurface Aboriginal deposits. Those potential archaeological deposits with Aboriginal archaeological deposits were then confirmed as being a site. Others were reassessed as not having archaeological potential.

The Iluka Road to Woodburn assessment section resulted in seven Aboriginal heritage sites and two PADs (both associated with existing sites) being found located within or near the PHU project boundary i.e. the highway upgrade corridor. These included one scarred tree near New Italy (13-1-0111) and a burial area at Sawpit Creek



south of New Italy (13-1-0059). In the vicinity of the Woodburn Interchange an artefact scatter and PAD (13-1-0112), an isolated artefact and a PAD (13-1-0115) and an isolated artefact (13-1-0113) were found. The PADS returned 11 mainly silcrete artefacts and 3 artefacts respectively from test pits on the spurs from the Richmond Ranges called the Tabbimobile rises (EIS 2012:50-54). The sites were assessed as being of moderate to high overall Aboriginal significance with exception of isolated artefacts 13-1-113 and 13-1-0114 which were judged low (NSW RMS EIS 2013:56).

Eleven Aboriginal cultural places were identified between Woodburn and Ballina. These locations are mythological sites, scarred trees, historic massacres, burials and habitation sites. The names of the Aboriginal cultural places were changed due to cultural sensitivity (NSW RMS EIS 2013:58).

For archaeological sites the EIS summarises: After completion of subsurface testing and cultural assessment between Woodburn and Ballina five PADs (all standalone) were assessed as no longer being sites. Resulting in 14 Aboriginal heritage sites and 15 PADs (five associated with existing sites and 10 standalone) (NSW RMS EIS 2012:59).

The Woodburn to Broadwater cultural heritage assessment section found the main concentration of Aboriginal sites to be on higher ground features surrounded by the Richmond River floodplain. The Gittoes Jali site contained artefact scatters, paint wells and ground stone. Test pits at the Gittoes Jali site returned 386 stone artefacts. The Cooks Hill feature at Broadwater contains a Bora/ceremonial ground and a scarred tree. Test excavations at artefact scatters and a midden in the vicinity of both features found 1003 artefacts and 13 stone artefacts (EIS 2012:61-62). The Aboriginal cultural heritage significance of these site areas was assessed as moderate to high on a judgement between scientific and social significance (NSW RMS EIS 2012:71).

5.2.2 Coastal Plain- Evans Head to Lennox Head

A large number of archaeological and cultural heritage assessments have assessed the dunal and adjoining floodplain landscapes between South Ballina, the Evans River and north to Lennox Head. A review of previous reports between the Evans Head area and Lennox Head indicates that Aboriginal sites may commonly be found in raised sand masses of Pleistocene or Holocene age adjacent to wetlands and or adjacent to high ground forest and wetlands. It would appear that groups occupying such locations maximised their food-gathering opportunities and access to raw materials. Sites in these raised sand masses adjacent to wetlands have been assessed in studies by Godwin (1986), Bonhomme (1988), Cane and Nicholson (1989), Sullivan (1980), Dallas (1990) and Rich (1994) and Collins/Piper (2000). The sites have ranged between sites of consolidated *in situ* shell and stone artefacts to sites of widely scattered stone artefacts. The Sullivan (1980), Godwin (1986), Bonhomme (1988) and Rich (1994) studies each suggested that where sites in raised sand



masses contained worked stone in addition to only shell material they were more likely to indicate base camps representing a range of activities rather than a single event.

The Evans Head area has been a focus of anthropological and archaeological studies. The Evans Headland (Goanna Headland) is well known for its importance in the mythological mosaic of beliefs among Bundjalung dialect groups. The Evans River and Goanna Headland are also the focus points of a documented massacre in 1842 or 1843 (Metcalf 1989: 5-7).

Archaeological studies by Sullivan (1980) and Dallas (1990) recorded sites in coastal dunal formations and estuarine foreshore locations. The Sullivan study (1980) included the area of the former Evans Head Bombing Range. The study investigated an area of Pleistocene inner barrier dunes to the west of a more recent Holocene outer barrier forming the present fore dunes. Sixteen sites were recorded. Twelve were almost or totally undisturbed. All were pipi shell deposits. Four sites were found in fore dunes four metres above the high tide mark. Two of the four midden sites were composed of pipi and gastropod shell mixed with pumice and rounded gravel. It was concluded that these sites were of Aboriginal origin that had been reworked by storm waves thus diminishing significantly their potential for research (Sullivan 1980: 6). While all sites were located in sand dune contexts four sites were recorded adjacent to fresh water lagoons west of the inner barrier dunes. Worked stone was also noted at these sites (Sullivan 1980:6-8).

The Dallas study (1990) was an impact assessment on Aboriginal sites in the close vicinity of the Evans River. She found six shell deposits, two of which were Aboriginal shell middens and the origin of the remaining four was uncertain. Shell deposit IGI was considered a disturbed scatter of cockle and whelk adjacent to a tidal creek. It was considered that preservation of the site was not warranted. The second confirmed Aboriginal site was a scarred tree IG7 considered significant to the Bogal L.A.L.C.

A quantitative analysis of the ecological contexts of fifty-three sites in the Ballina area north of the Richmond River found that below creek banks, the sand dune environments held the greater number of Aboriginal sites. Of the 53 sampled sites, 23 were located in dune contexts. These sites consist predominately of midden sites followed by open camp sites and burials. The environment most similar to the current Assessment Area containing the least number of Aboriginal sites was the Richmond River flood plain and bedrock hills to the west (Collins 1996:19), although Robins and Piper, (2005) recorded an extensive artefact scatter in extensively cultivated floodplain in the vicinity of Fishery Creek west Ballina.

The review of previous studies in the Ballina area and known distribution of Aboriginal sites in the South Ballina Empire Vale area would indicate that a moderate to high potential exists for Aboriginal sites to occur within the *in situ* sand dunes, or within deflated and eroded dunes. These dunes are mainly Holocene



transgressive dunes. These sites could include midden sites, open camp sites and burial sites. Midden sites in dune contexts tend to be thin, low density bands of pipi and other shell species with little associated artefactual or faunal material. Open camp sites will typically contain a predominance of stone artefactual materials and scattered shell fragments. Both midden sites and open camp sites are commonly found in sand strata above beds of indurated sand stone or sandy podzols indicative of previously stabilised dunes, since covered by more recent sand movements. There is no method of predicting where burials may occur. They may occur individually or in large groups. The greatest numbers of burials in coastal locations have been exposed in Holocene dunes.

5.2.3 Floodplain-Richmond River Locality

Given the nature of the European land use on the Richmond River floodplain there would appear little likelihood of sites surviving intact or undisturbed in the cultivated parts. Usually the archaeological value for diagnostic purposes of such materials if they exist is likely to be minimal due to their loss of depositional context. However the possibility that isolated stone artefacts and or scattered stone artefactual material with significant research potential can be found in these environmental contexts has been demonstrated by Robins and Piper (2005). The Robins (et al 2012) assessment north-west of Casino was of a range of wastewater treatment infrastructure, including for the installation of pipes, treatment tanks and irrigation works. No Aboriginal objects or places were identified in this assessment. Ground surface visibility was poor to fair, with most of the subject lands being highly disturbed. During the assessment an artefact scatter also containing hearth stones was located on slopes to the Richmond River. This site comprises a low density artefact scatter on a river terrace located approximately 30m west of the Richmond River.

The floodplain at the base of the slope was, before it was drained, an extensive area of wetland (Clarence Randall pers. comm. 2011). The site was thus located on relatively high ground between the Richmond River and the wetlands at the base of the hill. The site comprised approximately nine artefacts, a river pebble and a number of hearth fragments. The artefacts comprised one silcrete core, one silcrete micro-core, one silcrete retouched flake, two silcrete flakes, a silcrete pebble, and a chalcedony micro-core. Scattered amongst the artefacts were numerous small fragments (maximum size c. 7 cm) of orange clay hearthstone fragments.

The site significance assessment conclude; 'this site, though small and disturbed, is an interesting one. Few archaeological sites have been recorded near the river in this locality, although it is a logical place for site location. It is close to permanent water and a range of resources from a number of different resources. The raw materials are diverse and from different localities. The chalcedony possibly comes from further east where sources of this material have been recorded. The silcrete is not local and possibly comes from the ranges to the north. Clay heat retainers are also not a common feature of sites in the region' (Robins et al 2012:77-79).



5.2.4 Significant Sites

The Sites of Significance Survey Team recorded a large number of ceremonial, spiritual and natural mythological sites between 1974 and the 1980s. These include natural mythological sites, bora ceremonial areas, increase sites (djurbils), and various other types of sites, of which details remain confidential. The majority of these sites are located in the northern regions of the Galibal territory in the upper reaches of the Richmond River. A member of that team described the concentration of sites in the Bundjalung tribal area as, '... one of the densest concentrations of sites of significance to Aboriginal people in New South Wales' (Creamer: correspondence NPWS 1979). The Bora Ridge bora ring is located 7 km North West of the Moonimba Ridge on a low spur onto the Richmond River floodplain. Sources indicate it was last used in approximately the 1890's. A Primary School occupied part of the ceremonial ring until its closure. The ring bank is now fenced but indistinguishable due to tree growth. McBryde refers to three bora rings at Casino one at north Casino, Bentley and one unnamed location at Casino. She also records literary references to bora rings at Busby's Flat and Wyan in the Richmond Ranges (McBryde 1974: 57).



5.3 The OEH Aboriginal Heritage Information Management System (AHIMS)

Care should be taken when using the AHIMS database to reach conclusions about site prevalence or distribution. For example, a lack of sites in a given area should not be seen as evidence that the area was not occupied by Aboriginal people. It may simply be an indication that it has not been surveyed for Aboriginal sites, or that the survey was undertaken in areas of poor surface visibility. Further, care needs to be taken when looking at the classification of sites. For example, the decision to classify a site an Open Campsite containing shell, rather than a midden, can be a highly subjective exercise, the threshold for which may vary between archaeologists. There are also errors with the data.

A search was conducted on 3 December 2013 of the OEH Aboriginal Heritage Information Management System (AHIMS service number 118615), centring on the Project Area with a 1000 m buffer. The search of the AHIMS Register returned no Aboriginal Sites within the search area.

5.4 Other Heritage Register Searches

The following heritage registers were accessed for Indigenous places located in the Woodburn-Evans Head area:

- **The World Heritage List:** Contains no Aboriginal heritage listings places within close proximity to the Project Area.
- **Register of the National Estate:** Contains no Aboriginal heritage listings places within close proximity to the Project Area.
- **Commonwealth Heritage List (Australian Heritage Council):** Contains no Aboriginal heritage listings places within close proximity to the Project Area.
- **The National Heritage List (Australian Heritage Council):** Contains no Aboriginal heritage listings places within close proximity to the Project Area.
- **The State Heritage Register (NSW Heritage Office):** Contains no Aboriginal heritage listings places within close proximity to the Project Area.
- **The Richmond Valley LEP 2012:** Contains no Aboriginal heritage listings places within close proximity to the Project Area.



5.5 Cultural Context

5.5.1 Prehistory

A broad outline of the known chronology of occupation of the immediate coastal zone between the Tweed and the Richmond Rivers is outlined below. Doubtless the Aboriginal occupation of the Woodburn/Evans River region fits within the known chronology for the far North Coast. Coastal sites in northern N.S.W. date to within the Holocene period. The earliest of these is a shell midden at the base of Sexton Hill on the lower Tweed River where an occupation phase was dated between 4,700 BP and 4,200 BP (Appleton 1993:34). At Ballina a shell midden on Chickiba Creek was found to have accumulated between 1,750 BP and c.100 BP (Bailey 1975:52). Shell samples from the Angels Beach area are dated between 800 BP and 530 BP, with one sample at 900-1,000 BP (Rich 1994:195). Stone artefacts were assessed on technological grounds to date to within the past 2,000 years (Rich 1994:161). Bailey's basal date of 1,750 BP suggests that the modern resource-rich environment may not have been productive enough at an earlier time to support any more than small groups. In contrast, the Tweed River estuarine site was in use some 3,000 years earlier than this (Appleton 1993).

Beach foreshore sites investigated to date have been associated with more recent phases of occupation. Fore dune sites typically take the form of narrow bands of pipi shell, or surface scatters of pipi and stone artefacts. Pipi horizons at South Ballina and Broadwater have dated to 260 years BP and 200 years BP respectively (McBryde 1982:77). A more substantial pipi midden (AHIMS: #04-06-0061) investigated on the beach foreshore at Byron Bay had been used between approximately 1,000 and 400 years BP. The 80 cm deep midden deposit was overwhelmingly dominated by pipi shell, with minor inclusions of periwinkle, limpet, sand snail, oyster and cartrut. Bream was the most abundant vertebrate species. Although in lower quantities relative to bream, a broad range of fauna was represented in the midden, including other types of fish, tortoise, macropods, bandicoot, possums, rodents, birds and reptiles. The midden's stone assemblage was characterized by primary flaking debitage which reflected the poor knapping quality of the raw materials used. All of these materials are believed to have been collected from intertidal pebble beds adjacent to the site (Collins 1994).

The most extensive archaeological investigation of sites on Pleistocene sand substrate has been that conducted by Rich (1994) at what is now known as Angels Beach Estate, Ballina. This study resulted in the recovery of 40,000 shells and shell fragments, bone fragments, a piece of ochre and 9,000 stone artefacts. Rich's investigation at Angels Beach Estate produced results, which are largely in accord with those from other studies in the Lennox Head-Ballina area, revealing an assemblage of unmodified flakes, backed blades, cores, hammerstone, uni- and bifacially flaked pebble tools, manufactured chiefly on chalcedony, chert and acid volcanic beach/river pebbles. Bone and shell fragments indicated exploitation of estuarine shellfish and terrestrial animals in addition to fish. Rich concluded that evidence for the spatial distribution of intra-site activities, specifically meat butchering and tool manufacturing, suggested that the sites were not the product of



itinerant or random occupation, but of repeated occupation by groups larger than a single family unit (Rich 1994:204). Radiocarbon determinations for shell samples revealed an occupation phase dating between c. 100 BP and 530 BP. On technological grounds, stone working events were dated to within the last 2,000 years (Rich 1994:9).

5.5.2 Settlement

The Aboriginal people of the Woodburn/Coraki/Evans Head area were part of a wider linguistic group, the Bundjalung, which included about twenty dialects, spoken between the Clarence and Logan Rivers extending west to Tenterfield (Crowley 1978:1). Dialect groups and sub clans composed of interlinked family groups occupied distinct areas within the wider Bundjalung association. Land belonged to individual clans whose territorial boundaries had been established in mythology (Creamer 1974).

The concentration of Bundjalung dialects to the north, compared to the fewer dialect groups of the adjoining southern Kumbaingiri, led Crowley to suggest that the Bundjalung areas may have been colonised earlier than the Kumbaingiri, thus allowing a greater number of dialects to develop. Crowley also suggested that coastal Bundjalung dialects varied significantly from inland Bundjalung dialects (Crowley 1978). Joshua Bray, a settler on the Tweed River, travelled from the coast to the inland Bundjalung dialect country of the Upper Richmond and found that 'The language of Aboriginal People is sometimes completely different thirty miles away' (Bray 1901:193).

5.5.3 Movement

From the few eye witness sources available for the North Coast we can suggest that contact between members of the coastal clans was frequent and may have involved relatively large numbers. Bray records that the coastal Coodjinburra '...used to mix very much with the Ballina Richmond River Blacks' (Bray 1901:9). However it may have been a way of life that rapidly disappeared under the impacts of disease and restrictions on Aboriginal groups by 'authorities' on the movement of Aboriginal people. A review of sightings of Aboriginal coastal groups in Coleman's review of ethno historical sources led her to a conclusion that in the initial stages of European contact, observers of coastal groups describe, '...consistently high, semi sedentary local populations on the coast with a highly sophisticated organic material culture which vanished almost overnight with European contact' (Coleman 1982:7).

Population numbers on the coastal plain were high, possibly reflecting the wide variety and high productivity of coastal ecologies. Ainsworth (1922) is the most detailed of early sources for the coastal plain and estuary, writing specifically of the Aboriginal people of east and west Ballina. Ainsworth (1922:43) recorded '...In 1847 there were between 400 and 500 in the native tribes belonging to East and West Ballina'. Uniake an observer on John Oxley's ship 'Mermaid' estimated 200 men armed with spears observed the ship from Fingal Head following a



brief exploration of the lower Tweed River (Uniake 1825:40). Bray observed in the 1860s, 600 camped on the Wollumbin plain near Murwillumbah. Doubtless this gathering included significant numbers of the Coodjimburra/Minjungbal clans, who would have only needed to travel for a maximum of little more than a day to reach the area of Bray's residence. Pierce estimates that if on the basis that the 200 men observed by Oxley's expedition were drawn from coastal clans between the Brunswick and the Tweed Rivers, the population density between the rivers and inland for some miles was '...of about three per square mile...' (Pierce 1971:13). Population estimates by eye witnesses of Aboriginal numbers for the coastal regions immediately after European settlement are highly likely to be underestimates of pre contact numbers due to the impacts of diseases particularly small pox that spread throughout coastal groups prior to official settlement.

Contact between local clans and more distant groups took place for the purposes of exchange, intermarriage, armed conflict and during times of seasonally abundant food supply. A number of models have been proposed to account for the systematic use of the hunter gatherer environment of northern New South Wales and southern Queensland. Movement took place within territories in response to the availability of food supplies and across group territories for purposes of ceremonial occasions and tribal conflicts in addition to exploiting the seasonal abundance of particular food sources. However, it has been suggested that movement in the coastal river valleys does not seem to have been caused by food shortages as such, but rather to take advantage of different food types (Belshaw 1978:75).

McBryde (1974 and 1976) argues for a seasonal movement of people between the coast in summer exploiting marine foods and hunting inland in winter. On the ethno-historical evidence McBryde suggested that some seasonal movement was usual 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 1974:337). A number of early references refer to seasonal movement on a limited scale including Ainsworth (1922) on the Richmond River and Dawson (1935) and McFarlane on the Clarence River. Bray (1923) states that the Lismore 'tribe' used to go to Ballina at the mouth of the river. Sullivan (1964:20) recorded 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).

Movement within a clan territory in response to local conditions or availability of different food sources also occurred. Aboriginal People at Byron Bay often shifted camps but seldom moved far from a flying fox camp (Sullivan 1964). Bundock noted that on the upper Richmond flying fox were taken more easily in wet weather (Bundock 1898:4-5). Davey on the Tweed suggests that movement may have been frequent (Davey 1948). Moehead recorded that near Lismore the Richmond Aboriginal People, '...camped on the river flats until the rain set in and would then retire to the hills' (Moehead nd:1).



At Ballina, Ainsworth describes movement over the short distance between the beaches and the 'big scrub', a distance of only a few kilometres. He suggests that Aboriginal People of east and west Ballina were scattered in small groups combining at times of abundant food resources:

'... the tribe usually camped in divisions at different places except during the oyster season when they assembled unitedly at Chickiba, on North Creek ... The blacks in the month of September each year flocked to the beaches for salmon fishing' (Ainsworth 1922:44).

An exception to normal movement practices across tribal boundaries was that documented by Petrie (1975) and Bundock (1898). Bundock recorded the movement of the upper Richmond River Aboriginal People in the Wyangarie area to the Bunya Mountains, '... every third year or so ... under a sort of 'Truce of God'... for the blacks went through each other territories unharmed' (Bundock 1898). These gatherings occurred every fourth year, attracting groups to their own traditionally defined camping areas and served to promote trade and strengthen kinship networks across a vast area of western Queensland, south-east Queensland, and north-east N.S.W.

5.5.4 Economy

According to Ainsworth (1922:43-44) the coastal Badjalang (Tindale 1974) or Nyangbal (Keats 1988, Crowley 1978) people relied on '... fish and oysters and the varied products of the chase ...' He refers to the spearing of salmon on the beaches and the netting of estuarine fish by means of '... a "tow-row"-a finely meshed net attached to a stick of bamboo bent in the shape of a bow ...' He is not specific about which estuarine fish were caught by this method, although an excavation of a North Creek shell midden at Ballina did indicate the exploitation of flathead and bream (Bailey 1975:55).

Ainsworth places an emphasis on the consumption of oyster to the exclusion of other estuarine, coastal rock platform and open shore molluscs, all of which are recorded in local shell middens (Bailey 1975; Campbell 1982; Hughes 1991). Modern research supports Ainsworth's assessment as to the prominence of oyster at least for certain periods, in the diet of the Ballina group to the extent that this species comprises the greatest volume of estuarine shellfish represented in Aboriginal middens (Hughes 1991).

Terrestrial animal foods mentioned by Ainsworth (1922:43) include pademelons, wallabies, bandicoots, and iguanas. He reports that flying foxes provided a source of food and were easily brought down with the boomerang and pademelon stick. Bundock also records the hunting of flying fox '... by going into the camps where they sleep during the day, when it is raining heavily, as they will not fly...' (Bundock: 1898). At Byron Bay flying fox were so prolific and reliable that the natives though often shifting camp, seldom went far away on account of this source of food supply (Anon. n.d., b:1 in Sullivan 1978:107).



Ethnohistorical records are largely directed towards descriptions of hunting techniques which employed large groups of people and obvious types of technology requiring demonstrable physical skills-the use of spears, clubs, boomerangs, the 'tow-row' (net) etc. The role of plant foods in the local economy is often understated or overlooked entirely. Certainly, vegetable foods are given no particular prominence in Ainsworth's recollections at Ballina. He refers to yams obtainable in the scrubs, and to bread made from nuts which grew on the coastal headland (Ainsworth 1922:43). McFarlane (1934) writing of the Clarence River placed greater emphasis on the role of vegetable foods '... the woods supply much variety in the shape of fruit or berries but every description of vegetable contributed to the digestive requirements of the collector of food necessities...' In the Tweed/Brunswick coastal zone the rhizome of the Bungwahl Fern (*Blechnum indicum*) provided the major component of the vegetable diet. Thomas Pamphlett a shipwrecked convict observed that in the Moreton Bay region, '...fern root was a daily part of the diet and carried in bundles when the tribe moved. Women and children spent the bulk of the day procuring fern root...a part of which they gave the men in exchange for fish...' (Uniacke 1843:58).

The most detailed analysis of material culture of the North Coast has been that undertaken by McBryde (1978). The region of the Tweed, Richmond and Clarence Rivers would seem 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 a lighter and heavier variety (Byrne 1946:3). Neither the woomera nor the spear throwing stick were used in this region (Dawson *ibid*). The range of materials is considered wider than 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 requiring fewer 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).

The resources of sub-tropical rainforest were used extensively in the technology of the Richmond, which is heavily dependent on wood and bark fibre (McBryde 1978:197). Her sources refer to shields (McFarlane 1934; Dawson 1935), single point fire-hardened spears, three types of boomerang (Dawson 1935), clubs-nulla nulla and pademelon sticks, bark and palm leaf bags, wooden water vessels, possum rugs, cane and shell necklaces and stone knives (Bundock 1898). Bark was used for containers and shelter. Stone axes are referred to by Dawson (1935:22) and Byrne (1946:2). Fishing nets and rope was made from twine spun from the flame tree (Byrne *ibid*). Fishing nets were made a couple of yards long with a stick at each end used individually or in combination with many of the same (Seymour in Piper 1976). Bundock (1898) and Ainsworth (1922) described the same type of nets used for game drives in rainforests.



6. PREDICTIVE MODEL

Previous archaeological and cultural heritage assessments have been limited in terms of the range of landscapes that they have assessed. In addition, there is insubstantial data about the propensity of different landform types to contain a greater or lesser 'body' of archaeological evidence. Previous archaeological assessments in this region have been invariably hindered by the lack of accessible land, and the limited range and area of landforms available to archaeologists. For this reason, researchers are not able to make confident comparisons as to the likelihood or otherwise of Aboriginal sites.

6.1 Predictive Models - Environmental & Landscape Context

From previous assessments we can say that to date, Aboriginal campsites in this locality have been identified on dune fields, low hills and spurs that adjoin the Richmond River. They are also identified on some ridgelines, and within rock shelters at higher elevations. These sites statistically tend to be artefact scatters and isolated artefacts. Scarred trees, which would have been in far greater numbers in the region, mainly around regularly used campsites, have almost entirely disappeared due to clearing, cropping, urbanisation and natural processes.

One prevailing model in Aboriginal archaeology is the use of ridge lines as transit corridors between river valleys and major tributaries within those systems, as advanced by Byrne (1984), and Fox (2003). In the ridge line landform context, archaeological evidence consists of artefact scatters, scarred trees and isolated artefacts in 'open' situations, as opposed to rock shelters and caves. Associations between known ridge line sites, in terms of their contemporaneousness and contents, have not been adequately tested by archaeological investigation.

6.2 Aboriginal Sites and Features

The Project Area appears to have been a portion of coastal swamp forest now totally cleared and drained. There are no specific features of the Project Area or areas that could be demonstrated to have been particularly lucrative in terms of food or material resources that would warrant a moderate to high rating of potential for Aboriginal archaeological sites. Situated approximately halfway between the Richmond River and the modern coastline the Project Area may have been within the range of Aboriginal groups 'focused' around either the Evans River or the coastline at least at the beginning of the European period. The Project Area is not a natural corridor that would link creek headwaters or an area that would have provided distinct natural transit corridors between the coastal main range and the coastal plain and coast.



While there may be no surviving physical evidence of former Aboriginal sites within the landscape, the Aboriginal community may retain anecdotal traditions of ceremonial use and spiritual or mythological connections to a given location. Consultation, found no specific Aboriginal cultural associations with the current Project Area.

The following types of archaeological sites have a low to moderate potential to occur in the Project Area.

6.2.1 Isolated artefacts

These consist of single stone artefacts, which may have been randomly discarded or lost. They may occur in almost any environmental context exploited by Aboriginal people. They are commonly stone axes, single cores, hammer stones, bevelled pounders, pebbles and flakes. Their presence may indicate that more extensive scatters of stone artefacts exist or existed nearby, perhaps obscured by vegetation or dispersed by mechanical means.

It is predicted that this site type is the most likely type of site to occur within the Project Area, but would be more likely found in potential transit/camp areas on low sand rises possibly of Pleistocene age. There is no evidence that low sand rises occurred in the Project Area. The detection of such randomly scattered cultural objects within the Project Area would be fortuitous.

6.2.2 Open Campsites / Artefact Scatters

The greatest number of recorded sites on the coastal plains and hills in this region are artefact scatters. They may be found in almost any elevated position adjacent to wetlands or creeks. They will also be found on low grades or the level sections of ridge crests and spur lines, particularly where higher ground tapers toward the coastal plain. Materials at these sites are generally stone artefact material only.

It is accepted that this type of site may be present within the Project landscape, however the ground disturbances through clearing, drainage works, grazing, and subsequent vegetation clearance practices over time, indicate that the potential for this site type to remain *in situ* and intact in low swamp/marsh conditions is extremely low.

6.2.3 Burial Sites

Burial sites cannot be excluded as there are records of numbers of burial locations in the coastal northern New South Wales region. The majority of these have been found in coastal sand substrate situations particularly in association with middens. There is anecdotal and field evidence of burials on hilltops, rock shelters and rock faces within the Richmond and Tweed Valley regions. Numbers of Aboriginal burials are registered with the OEH AHIMS in the dune fields between the Richmond River and Evans Head. There is a particular concentration of



burials in the South Ballina Empire Vale dune fields. The potential for this site type to occur within the Project Area is considered to be extremely low, due to the former low swamp/marsh conditions and ground surface disturbance.

6.2.4 Scarred Trees

The majority of scarred trees on the North Coast of NSW result from the removal of bark for use as covering, shields, containers or canoes. There may also be carved trees where the bark has been removed and geometric patterns incised on the tap wood. Generally scarred tree sites are rare due to the extent of forest clearing and the natural aging and collapse of such trees that may have survived. There are no old growth trees with possibly one exception within the Project Area, therefore scarred trees are not a consideration.

6.2.5 Quarries

The Assessment Area is sand/peat substrate throughout with the hardest material being indurated sandstone. There are no naturally occurring outcrops of quarry materials known to have been used by Aboriginal people.

7. FIELD SURVEY: INDIGENOUS CULTURAL HERITAGE

7.1 Aboriginal Participation

The Project Area is within the area administered for Aboriginal cultural heritage purposes by Bogal LALC and Bandjalang Traditional Owners. A survey for Aboriginal cultural heritage at the Doonbah Quarry was undertaken by Mr. Darryl Knight, Sites Officer of the Bogal LALC, Doug Wilson and Lewis Williams the Bandjalang Traditional Owners representatives and Adrian Piper, Everick Heritage Consultants on 23 May 2014.

7.2 Field Methods – Sampling Strategy and Recording

The archaeological or scientific aim of the survey was to locate physical evidence of Aboriginal occupation within the Project Area; the evidence of which is most commonly stone artefact scatters; individual (isolated) artefacts; shell debris (fresh water or marine); and in clear ground situations traces of bone (human and animal) and ash-stained earth that might represent fireplaces. Woodland areas with 'old growth' trees would be inspected for evidence of Aboriginal scarring due to bark removal or holes/notches cut into bark and tap wood.

The survey methods aimed to inspect exposed ground surfaces as conditions would allow; to record any archaeological material found and assess its significance; and assess the potential for concealed Aboriginal archaeological sites.



As the Project Area has seen extensive ground disturbance (clearing, drainage and grazing) in the upper 1 metre leaving open level terrain it was possible to undertake a field inspection of all areas (Stages 2-4) that would be impacted by the proposed expansion to sand extraction. GHD have provided all mapping used in the cultural heritage assessment.

Photographs were taken as a record of general features and conditions, and to document the degree of surface visibility. Notes were made of the degree of surface visibility, the area of visibility, ground cover, land uses and any other relevant features. DGPS (WSG 84 datum) may be used to record the extent and lines of survey coverage except where fence lines, Google and topographic mapping provided clear reference points.

7.3 Constraints to Site Detection

An assessment of the constraints to site detection is made to assist in formulating a view as to the effectiveness of the field inspection to find Aboriginal sites and cultural materials. It also assists in the forming of a view of the likelihood of concealed sites, keeping in mind a site specific knowledge of the impacts that European land uses and natural processes may have had on the 'survivability' of Aboriginal sites in a Project Areas.

The constraints to site detection in regions such as northern NSW are almost always most influenced by post European settlement land uses and seldom by natural erosion processes. The constraints to site detection are influenced by previous European land uses, the area of surface exposure, the degree of surface visibility, current land uses and natural and accelerated (man-made) erosion, aggradation and inundation by sediments (McDonald et. al. 1990:92-96).

These conditions are particularly the case in the proposed sand quarry expansion areas where it is unlikely that any of the areas under field assessment have not been heavily disturbed due to the impacts of clearing, drainage works, mechanical scraping and filling.

7.4 Survey Units

The proposed quarry expansion is essentially located on a low drained former swamp forest in the broader floodplain context. The 'topographic' features are uniform throughout varied only by drains, dams and spoil heaps. For ease of description the survey units are based upon the proposed Stages 2-4 of extraction, not on distinct variations in topographic features. Stage 1 is not included as it is the current working quarry and not under consideration for cultural heritage. The following summary broadly describes the conditions for site detection in the proposed Stages of extraction.



Stage 2: 2.4ha Low lying, totally cleared with a small area of regrowth heath in the north eastern corner, merges with the working quarry to the east. Features: shallow excavated pits, drains, spoil and rubble heaps. Ground cover of slashed grasses and marsh shrubs. Area of surface exposure: ca. 75%. Types: Spoil heaps, drain banks, low cut slashed areas. Surface visibility: 80-90%.

Stage 3: 2.6ha Low lying pasture totally cleared of old growth trees. A broad dish (ca 160mx15mx0.7m) drain passes north to south. A small dam is situated on the north eastern boundary beyond which a barrier bank controls water flow from the adjoining wetland. Features: Ground cover of slashed grasses and marsh shrubs. Marsh conditions on the north west and eastern boundaries. Area of surface exposure: ca. 30%. Types: Exposures in dish drain, low cut slashed areas. Surface visibility: 80-90%.

Stage 4: 5.1ha. Conditions are identical to Stage 3. Low lying pasture totally cleared of old growth trees. A broad dish drain (ca 250mx15mx0.7m) passes north to south from Stage 3 to a dam on the south boundary. A dish drain (ca 270mx10mx0.75m) carries run off from the Stage 1 area on the southern boundary. Features: Ground cover of slashed grasses and marsh shrubs. Marsh shrubs and grasses on the eastern boundaries. Area of surface exposure: ca. 10%. Types: Exposures in dish drain, low cut slashed areas. Surface visibility: 80-90%.



Figure 5: Stage 1 Existing Doonbah Quarry works (Photo A. Piper)



Figure 6: Swampland adjoining Project Area - example of remnant swamp vegetation (Photo A. Piper)



Figure 7: Project Area Stage 2 - facing south east (Photo A. Piper)



Figure 8: Project Area Stage 2 facing south (Photo A. Piper)



Figure 9: Project Area Stages 3 - 4. Main dish drain to right, boundary approximately to tree line (Photo A. Piper)



Figure 10: Project area Stage 3 facing north east (Photo A. Piper)



Figure 11: Project Area Stage 4 facing south east (Photo A. Piper))



7.5 Survey Coverage

The effectiveness of a sampling strategy is based upon the extent (in metres square) and 'quality' (e.g. 5%, 90%) of ground surface visibility. The available area of surface visibility and its 'quality' is dependent upon natural erosional processes and man-made (accelerated) erosional processes such as construction and / or cultivation (McDonald et al. 1990:92). 'Quality' or clearness is either impeded or enhanced by a lack of vegetation cover. To achieve as thorough and effective an archaeological assessment as possible, in ideal conditions a systematic ground survey in a grid pattern, of all surfaces is the best method to achieve high percentages of ground coverage. In this case with detailed mapping and clear conditions for walking the inspection was a systematic search of all sections of the proposed quarry expansion.

The search pattern was a 30-40m spread between the four participants that could be revised down if cultural heritage was found. Old growth trees would be inspected for Aboriginal scarred or modified trees. For Stages 3-4 sweeps were conducted north to south, Stage 2 east to west. All exposed ground surfaces were inspected for evidence of Aboriginal archaeological materials such as stone artefacts, shell or hearths. Organic materials such as fibre or wood were not expected at the surface in open conditions. There are no caves, rock overhangs or stone outcrops on the proposed expansion areas.

7.6 Ground Surface Visibility

Ground Surface Visibility (GSV) is a measure of how much ground surface (or bare earth) can be seen at the time of an archaeological survey. It is usually worked out as a percentage (%) of the overall Project Area, although it can also be worked out as a range when GSV changes dramatically within the Project Area. For this assessment, GSV was worked out by assessing a 1 m x 1 m area and inferring how much ground surface was seen within that. This gave a percentage of GSV within the square, which was extrapolated to the entire Assessment Area – so long as the ground conditions did not fundamentally change.

Table 1: Doonbah Quarry Survey

Survey Unit (Stage 2-4)	2	3	4
Landform	Floodplain	Floodplain	Floodplain
Landform Element	Marsh/swamp	Marsh/swamp	Marsh/swamp
Area (ha)	2.4	2.6	5.1
Exposure %	75	30	10
Area of Exposure (ha)	1.8	0.75	0.5
Visibility %	80	90	90
Area for Site Detection (ha)	1.5	0.67	0.45
% of LF for Site Detection	62.5	25	9.0
Total Average for Ground Detection: 26 %			



Table 1 presents information on the extent to which survey data provides sufficient evidence for an evaluation of the distribution of archaeological materials across the study area. The evaluation of survey coverage provides a measure of the potential for landform elements to reveal archaeological evidence. The calculations in Table 1 do not provide an exact percentage of coverage. Given the clear ground conditions for survey and the systematic grid pattern of search by four persons, it can be argued that sufficient and effective coverage was achieved. The total average of surface available for site detection is achieved by totalling the areas for site detection in each unit and dividing by total area. Grass and marsh plant cover was the main impediment to ground visibility which due to slashing was very high at 90-100%. The percentage of land form available for site detection ranged between 62.5% (Stage 2), 25% (Stage 3) and 9% (Stage 4) which are generally high for assessments in this locality. An average of 26% of ground surface available, over the Project Area as a whole, is a conservative figure and an adequate proportion on which to base statements as to a lack of cultural heritage archaeological sites with a high degree of certainty.

8. RESULTS OF ABORIGINAL CULTURAL HERITAGE ASSESSMENT

As a result of the desktop study and field inspection of the proposed expansion to the Doonbah Quarry extraction areas and consultation with Bogal LALC Sites Officer Daryl Knight and Bandjalang Traditional Owner representatives Doug Wilson and Lewis Williams the following were agreed to.

- No Indigenous cultural heritage sites or relics were identified within the proposed Stages of expansion to the Doonbah Quarry extraction areas.
- No areas have been identified that are considered to potentially contain subsurface deposits of significant Aboriginal heritage.
- All of the Project Area has been disturbed in a manner which constitutes 'disturbance' within the meaning of the Due Diligence Code and is consistent with the Due Diligence Code.
- The Traditional Owners and Bogal LALC representatives agreed in discussion that no further Aboriginal cultural heritage investigation was required.



9. CULTURAL HERITAGE DUE DILIGENCE ASSESSMENT

The Due Diligence Code recommends a staged analysis of cultural and archaeological factors. This section discusses the analysis of the Project Area when compared against these guidelines.

9.1 Step 1: Will the activity disturb the ground surface?

Yes. See the proposed sand extraction activities described in the Project Description.

9.2 Step 2a: Search of AHIMS Database

A search was conducted of the OEH Aboriginal Heritage Information Management System (AHIMS service number 127897), centring on the Project Area with a 1000 m buffer. The results of the AHIMS Register search were returned on 11 March 2014. There are no sites registered on the AHIMS register within the search area, none of which are within the Project Area nor will be impacted by the proposed expansion to the Doonbah Quarry extraction areas.

9.3 Step 2b: Does the activity occur in an area where landscape features indicate the presence of Aboriginal cultural heritage?

The Due Diligence Code identifies particular landforms as having a higher potential to contain archaeological sites. Ridgelines, elevated areas adjoining alluvial plains, dune fields and river/creek foreshores for example, are known to have a higher association with Aboriginal archaeological sites than slopes and seasonally or permanently inundated wetlands. The Project Area is cleared and drained former swamp forest in the midst of seasonally inundated marsh and swamp. The Evans River is approximately 1km to the south where Aboriginal campsites are more commonly found in the form of artefact scatters, middens, scarred trees, ceremonial grounds. The courses of rivers and creeks were also commonly transit corridors through the vast swamps that characterise the coastal plain of this locality, prior to European settlement.

The review of *Previous Aboriginal Archaeological Assessments* for this report has indicated that all Aboriginal archaeological sites to date, between the Richmond River the Evans River and Iluka have been identified on high ground features e.g. Cooks Hill Broadwater, coastal dune fields and estuarine foreshores. Scarred trees are the most common if only type of site to be found in wetland/swamp conditions. Wetlands specifically do not have the landscape characteristics that would warrant an assessment of moderate to high potential for archaeological sites, as might a ridge or spur line or elevated level areas close to water and food/material resources. There are no particular parts of the Project Area which because of access to permanent water, food or material resources would make the areas 'attractive' as camp sites or 'lucrative' as a source of a particular resource. As Doug Wilson Bunjalang



Traditional Owner stated during the field survey, referring to the Project Area “...my people didn’t camp in wetlands...” (Doug Wilson pers comm).

Ethnographic sources quoted in McBryde (1978) by Campbell, Sullivan and Pierce, indicate the coastal wetlands/swamps as distinct from sand rises and dune fields, were exploited by Aboriginal People for raw material procurement of wood/fibre, medicinal plants and a vast catalogue of birds, reptiles and terrestrial animals. Access to these resources was via established transit corridors the Evans River and or the dune fields to the east. The archaeological evidence for these activities within extant or former wetlands/swamp is restricted to a small number of scarred trees. There can be no doubt that a background scatter of stone artefacts lost or broken may be randomly scattered throughout the area. However devising a strategy to recover such items prior to the proposed extension to sand extraction is impractical and would be purely speculative.

While the topography may not have altered to a marked degree, with the exception of drainage excavations and top soil/sand spreading, the current vegetation regime within the Project Area bears no resemblance to the original mosaic. Therefore it is impossible to draw specific conclusions as to whether the Project Area contained flora and fauna resources of significance to Aboriginal people.

9.4 Step 2c: Is there evidence of past ground disturbance?

There is abundant evidence of past ground disturbance through the complete removal of the original swamp forest and subsequent drainage works and mechanical levelling. The Project Areas range between areas of demonstrably high disturbance and areas where the absence of mature trees, suggests that all of the former original closed forest/wetland is now open grazing land. It is reasonable to form the conclusion that outside of those areas of visibly high or ‘total’ ground disturbance such as drainage works the remainder is moderately to highly disturbed. The Quarry Site Manager informed the survey team that to his knowledge topsoil shaping and spreading had occurred over the Project Area post clearing, but to a precise period he was unsure. It would seem unlikely that Aboriginal archaeological sites would ‘survive’ *in situ* given the extent and apparent depths of disturbance to at least the upper metre. At any greater depth or possibly less the natural water table would be met.

Under the definitions of the Due Diligence Code, all of the Project Area has been ‘disturbed’.

In total a range of disturbance ‘events’ have taken place in the Project Area both past and present. McDonald (et.al) (1990:88) lists eight broad categories of disturbance ranging between:

0. No effective disturbance. Natural
1. No effective disturbance other than by grazing by hoofed animals



2. Limited clearing. E.g. selective logging
3. Extensive clearing, e.g. poisoning, ringbarking
4. Complete clearing. Pasture, never cultivated
5. Complete clearing. Pasture, cultivated at some stage
6. Cultivation. Rainfed
7. Cultivation. Irrigation past or present
8. Highly disturbed for example quarrying, road works, mining, landfill, urban

The categories of disturbance that have impacted the Project Area to the best of our knowledge are indicated below. The types of disturbance and degree are uniform for each proposed Stage. Where a question mark is indicated there is a strong likelihood.

Table 2: Project Area - Disturbance Levels

Disturbance Categories:	1	2	3	4	5	6	7	8
Stages 2-4		?	?	x				X

All of the Project Area has undergone land uses constituting moderately to highly disturbed under the meaning of the Due Diligence Code. Applying the Due Diligence Code, it is clear that no further assessment or impact mitigation activities are required.

To devise an archaeological investigation programme to recover archaeological cultural materials from the Project Area would be purely a speculative, unwarranted exercise.

10. DISCUSSION & RECOMMENDATIONS: ABORIGINAL CULTURAL HERITAGE

Having evaluated the cultural values of the Project Area, there would appear to be minimal cultural heritage constraints for the Project.

To aid in the interpretation of the site, the Project Area has been divided into a number of risk areas based on archaeological and disturbance characteristics. Table 1 presents a summary of the Aboriginal cultural heritage risks for the Project.



Aboriginal cultural heritage constraints to Projects typically come in three forms of cultural site:

1. **High Significance:** Aboriginal sites of high significance that must be retained *in situ* (where they lie). Sites of this nature typically included large Aboriginal middens, scarred trees or burials. The area affected typically ranges from 200 m² to 400 m², as even small sites will have to be retained in an appropriate setting.
2. **Low – Moderate Significance:** Aboriginal sites of low to moderate significance that need to be salvaged before development can commence. Sites of this nature typically include artefact scatters, isolated artefacts and cultural shell scatters. The area affected typically ranges from 100 m² to 2000 m².
3. **Sacred Sites:** Aboriginal sacred sites that hold special spiritual significance, and must be preserved. Sites of this nature typically include bora rings, ceremonial sites and story places. The area of these sites is generally confined to within 200 m² – 600 m². However, the site will be situated within a 'cultural landscape', the significance areas of which may extend well beyond the physical boundaries of the site.

Table 3: Aboriginal cultural heritage Risk Summary for the Project Area

Stage	Risk Type	Likelihood	Depth of Deposit (m)
2	High Significance	Nil	N/A
	Low – Moderate Significance	Extremely Low	0.5 – 1.0
	Sacred Sites	Nil	N/A
3	High Significance	Nil	N/A
	Low – Moderate Significance	Extremely Low	0.5 – 1.0
	Sacred Sites	Nil	N/A
4	High Significance	Nil	N/A
	Low – Moderate Significance	Extremely Low	0.5 – 1.0
	Sacred Sites	Nil	N/A

Having regard to the above, any physical Aboriginal cultural heritage constraints for the Project would most likely be limited to randomly scattered subsurface cultural deposits (artefacts or middens) below the brown loam or peat soil layer. However, the risk is extremely low.

If the Project was to proceed, Everick would most likely recommend that no further assessment or investigative works are required. This assumption is made on the basis that prior to European settlement the Project Area was a seasonally and or permanently inundated wetland and quite unsuited to Aboriginal campsites and therefore unlikely to contain significant Aboriginal cultural heritage. We could not argue conclusively that there are no artefacts (unless the area had been sand mined).



A number of cautionary recommendations would be included in a report to Council that would focus on developing an Aboriginal cultural heritage find procedure and inductions of contractors.

11. RECOMMENDATIONS

The following recommendations are cautionary in nature. Whilst it is considered unlikely that they will be required, they should be noted and adhered to, as they relate to managing the legal obligations of the Proponent, that will continue to apply in relation to cultural heritage.

Recommendation 1: Aboriginal Cultural Material Finds Procedure

It is recommended that if it is suspected that Aboriginal material has been uncovered as a result of earth working activities within the Project Area:

- a) work in the surrounding area is to stop immediately;
- b) a temporary fence is to be erected around the site, with a buffer zone of at least 10 metres around the known edge of the site;
- c) an appropriately qualified archaeological consultant is to be engaged to identify the material; and
- d) if the material is found to be of Aboriginal origin, the Aboriginal community is to be consulted in a manner as outlined in the OEH guidelines: Aboriginal Cultural Heritage Consultation Requirements for Proponents (2010).

Recommendation 2: Notifying the OEH

It is recommended that if Aboriginal cultural materials are uncovered as a result of development activities within the Project Area, they are to be registered as Sites in the AHIMS database managed by the OEH. Any management outcomes for the site will be included in the information provided to the OEH.

Recommendation 3: Aboriginal Human Remains

It is recommended that if human remains are located at any stage during earthworks within the Project Area, all works must halt in the immediate area to prevent any further impacts to the remains. The location where they were found should be cordoned off and the remains themselves should be left untouched. The nearest police station (Woodburn), the Bogal LALC, Bangalang Traditional Owners and the OEH Regional Office (Coffs Harbour) are to be notified as soon as possible. If the remains are found to be of Aboriginal origin and the police release the scene, the Aboriginal community and the OEH should be consulted as to how the remains should be dealt with. Work may only resume after agreement is reached between all notified parties, provided it is in accordance with all parties' statutory obligations.



It is also recommended that in all dealings with Aboriginal human remains, the Proponent should use respectful language, bearing in mind that they are the remains of Aboriginal people rather than scientific specimens.

Recommendation 4: Conservation Principles

In the unlikely event that Aboriginal cultural heritage is identified during Project works, it is recommended that all effort must be taken to avoid any impacts on Aboriginal Cultural Heritage values. Should a situation arise where impacts to Aboriginal cultural heritage is unavoidable, mitigation measures should be negotiated between the Proponent, OEH and the Aboriginal Community.

12. DESKTOP REVIEW: HISTORIC CULTURAL HERITAGE

12.1 Project Area History

12.1.1 General Woodburn Shire History

The earliest European exploration of the Richmond River was by Captain Rous from the ship 'Rainbow' who took a boat upriver to the vicinity of Broadwater, August 24 1828. Reports of large stands of cedar attracted timber getters, who were led by Steve King 'overland' from the Clarence to the Richmond in 1842. The group set up camp at Pelican Creek Codrington, a short distance upstream from Coraki or the Junction as it was then known to Europeans.

The early 'squatter period' centred on Casino. Casino was originally known as The Falls and is considered the oldest settlement on the Richmond River. In 1840, Henry Clay and George Stapleton took up 30,000 acres of rich grazing land along the east bank of the Richmond River, and formed a station they named Cassino (Daley 1968:24). When inspected just a year later, they had already found a level track to Grafton, built a weatherboard house, outbuildings, a piggery, and had land under cultivation (Daley 1968:25). For a year Clay and Stapleton were the only squatters in the whole of the Richmond Valley (Daley 1968:25). However, by 1848 the area had also become the centre of the squatting runs of the Richmond and Upper Clarence (Richmond Valley Council 2007), with 21 stations taking up all the good grazing land on the Richmond (Daley 1968:43). During this period in 1843, William Yabsley established a cedar camp at the Junction. The later history of Coraki is closely linked with the fortunes and endeavours of the Yabsley family.

William Yabsley became the lessee of the Brook run an estimated 9600 acres. The Brook run became the centre of a thriving cattle station, ship building yards and the cedar trade. The training and selling of bullock teams was a lucrative concern during cedar getting period (Daley 1968:111). Yabsley using his pre-emptive rights was able to



purchase a good portion of the Brook run. Later, during the free selection era, he was able to secure the choice blocks of the run. The Yabsley family were able to gain freehold and retain most of the original Pastoral Lease (Keats 1988: 157).

Being a ship builder, Yabsley built the 'Pelican' at Ballina in 1848 and returned to the Junction in 1850. While pastoral interests were a major preoccupation for family members, Yabsley is best known for his ship building, including his largest ship, the 'Examiner'-265 tons, which was launched at Coraki on July 5, 1870. The tug 'Index' was built in 1874 and the last vessel built by Yabsley, the 'Beagle' launched at Coraki in 1876. William Yabsley was drowned on January 21, 1880. at the age of 68 returning from Casino on the steamer 'Vesta' (Keats 1988: 320-321).

By the end of the 1860s, Coraki – known to Aboriginal inhabitants as Hooaki – was well formed with a homestead, saw pits, a dealers store, school room, timber yard, dock yard and a great ship shed. The shed was 30 feet high supported on pillars of 5 tons each. Coraki grew around the Yabsley settlement. A Presbyterian church was built in 1867 and the ship yard apprentices built the first Provisional School in 1869. Sugar cane cuttings came to the district in 1866 via the Presbyterian minister John Thom. Dairying began from small beginnings attracting many unsuccessful cane farmers. One result from the increasing numbers of dairy farms was the rapid felling of vast areas of the original scrub which until dairying had only been felled by selective timber getting. The growth of the dairy industry was hampered by variable quality and the lack of refrigeration. Many small factories went out of business with the foundation of the North Coast Co-operative Company known as Norco in 1895 which prospered until the 1960's (Daley 1966:145).

12.1.2 Woodburn History

Woodburn was first inhabited by non Indigenous people in the 1840's. These early occupants called the area Rocky Mouth, however that name was already in use in another region of NSW, which led to the name change to Woodburn. Billy Wright was a timber merchant in early Woodburn and he commissioned a shipwright company to build vessels suitable for transportation in the Richmond River. This led to the establishment of ports at Wardell, Broadwater and Coraki.

By 1960, the township of Woodburn was settled and continued to grow around the home of William Cravigan. The establishment of a town store by William Gollan was followed by a Post Office. The trajectory of many small towns in the region was followed in Woodburn with early settlers of the town quickly followed by the establishment of services and facilities such as shops and hotels. Law and order came to the town with the first policeman in 1879. This was followed by the Presbyterian Church on the southern side of the township and a nearby school.



Whilst the town was developing, sugar cane growing had become a primary concern in the nearby region, which increased shipping activity on the Richmond River. Woodburn became an important port during this period and was proclaimed a village a year after the establishment of the Woodburn Court House in 1884.



Figure 12 Canefields on Richmond River near Woodburn - 1936

12.2 Heritage Register Searches

The desktop review concluded that no historically significant cultural heritage sites would be impacted by the Project. The following heritage databases were reviewed 11 March 2014 to assess the potential for non-Indigenous heritage attributes within the Richmond Valley LGA and specifically for the Doonbah area;

- **The World Heritage List:** Contains no historic heritage listings within or within close proximity to the Project Area.
- **Register of the National Estate:** returned four (4) historic heritage listings all of which were located in Woodburn, with the closest being the Broadwater National Park, situated northeast of the Project Area.



- **Commonwealth Heritage List (Australian Heritage Council):** Contains no historic heritage listings within or within close proximity to the Project Area.
- **The National Heritage List (Australian Heritage Council):** Contains no historic heritage listings within or within close proximity to the Project Area.
- **The National Trust Register:** Contains no historic heritage listings within or within close proximity to the Project Area.
- **The State Heritage Register (NSW Heritage Office):** Contains no historic heritage listings FOR Doonbah. One (1) historic heritage item is listed for Evans Head under Section 1 (Heritage Council) and will not be impacted by the Project. Section 2 (Local Councils, Shires and State Agencies) lists one (1) item for Evans Head and seven (7) listings for Woodburn, none of which will be impacted by the Project.
- **Richmond Valley Local Environment Plan 2012:** Contains no historic heritage listings for the Doonbah area. Seventeen (17) items are listed for Evans Head and twelve (12) items are listed for Woodburn, none of which will be impacted by the Project.

13. RESULTS OF HISTORIC HERITAGE FIELD SURVEY

There are no places of historic heritage listed in heritage lists or have there been places of historic heritage found within the Project Area as a result of the field survey.

14. RECOMMENDATIONS: HISTORIC HERITAGE

There are no recommendations with regard to historic heritage. The Project does not impact on places of historic heritage significance.



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APPENDIX A: AHIMS SEARCHES



Office of
Environment
& Heritage

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : EV289

Client Service ID : 127897

SiteID	SiteName	Contact	Datum	Zone	Eastng	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
There are no sites found for given search criteria.											

Report generated by AHIMS Web Service on 11/02/2014 for Jordan Towers for the following area at Lot : 2, DP-DP1840274 with a Buffer of 1000 meters. Additional Info : Quilans/Doonbah Quarry Due Diligence. Number of Aboriginal sites and Aboriginal objects found is 0

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (OEH) and its employees disclaim liability for any use done or omission made on the information and consequences of such acts or omissions.

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Figure 13: AHIMS Search Results

GHD

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	B Cork	B Luffman		S Lawer		26/11/2014

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