Matters of National Environmental Significance Report

Gold Coast Quarry EIS

12CEL001

Prepared for
Boral Resources (Qld) Pty Limited

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Cardno
Shaping the Future

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Executive Summary

This Matters of National Environmental Significance (MNES) Report has been prepared in relation to the Gold Coast Quarry project that is proposed for development near Reedy Creek in Queensland. The project was referred to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and on 21 December 2010 was determined to constitute a controlled action. Boral self nominated as a controlled action.

This MNES Report addresses the EPBC Act controlling provisions relevant to the project through providing descriptions of the EPBC-listed species potentially affected by the proposed action, and identifying potential impacts to these MNES. Controlling provisions identified in the referral decision notice were listed threatened species and ecological communities. (Section18 and Section18A).

Field surveys within the Study Area identified the presence of two flora species that are *Vulnerable* under the EPBC Act. Specifically, *Syzygium moorei* (Durobby) and *Taeniophyllum muelleri* (Ribbon Orchid) were found within some drainage lines and waterways within the Study Area. With the exception of a single feeding Grey Headed Flying Fox EPBC- no listed threatened fauna species were documented within the Study Area, and only 2 EPBC-listed migratory fauna species were recorded. No threatened ecological communities were documented within the Study Area. A further 5 migratory species were predicted to potentially (possible – likely) utilise the habitats of the Study Area on occasion, but not as part of an important breeding or habitat resource.

While it is acknowledged that the Koala was recorded in the Study Area it was not scheduled as a vulnerable species at the time when SEWPaC made the controlled action determination. Despite this, Boral has committed to providing a net benefit to the Koala.

Impacts of the proposed action were identified as land clearing and the associated loss of biodiversity, habitat fragmentation and increased edge effects; changes to environmental flows; and dispersal and establishment of exotic species.

The proposed action will not directly or indirectly affect threatened plant species in or outside of the Study Area. Analysis of the potential impacts confirmed there is a risk that changes in hydrology will affect these species, but that this risk can be managed.

With regards to impacts to migratory fauna species, it is relevant to note that extensive tracts of native vegetation surround the Study Area and provide habitat with characteristics similar to that proposed for removal, such that a decrease in the population size of any significant fauna species is unlikely.

This report identifies a number of best practice management measures that can be implemented so as to mitigate or reduce any environmental impacts that may potentially occur as a result of the project, together with environmental monitoring that will aim to observe and report on the performance of proposed mitigation and management measures, with a focus on facilitating early intervention and remediation of any identified non-conformances.

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Glossary

EIS	environmental impact statement
EMP	environmental management plan
EPBC Act	(Commonwealth) *Environment Protection and Biodiversity Conservation Act 1999*
MNES	Matters of National Environmental Significance
SEWPaC	(Commonwealth Department of) Sustainability, Environment, Water, Population and Communities
SPRAT	Species Profile and Threats (Database)
TOR	Terms of Reference

1 Introduction

1.1 Background

Boral is seeking to establish an extractive industry operation (quarry) on a greenfield site at Tallebudgera Creek Road, near Reedy Creek, on the Gold Coast. The project was referred to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) on 1 December 2010, for determination as to whether the project constitutes a 'controlled action' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Boral self nominated as a controlled action.

On 21 December 2010, the Australian Government Minister for Sustainability, Environment, Water, Population and Communities determined that the project is a 'controlled action' under the EPBC Act (reference number EPBC 2010/5757), due to the likely potential impacts on matters of national environmental significance (MNES). The controlling provision under the EPBC Act that is relevant to the Gold Coast Quarry project was identified as sections 18 and 18A, namely, listed threatened species and communities. Listed migratory species were not triggered under the controlling provisions but have nonetheless been considered in this assessment in the interest of completeness.

Furthermore, the Queensland Coordinator-General declared the Gold Coast Quarry project to be a 'Coordinated project' requiring an environmental impact statement (EIS) under the Queensland *State Development and Public Works Organisation Act 1971*. The Australian Government has accredited the EIS process under a bilateral agreement between the Australian and Queensland governments, thereby enabling the EIS to meet the impact assessment requirements under both Commonwealth and Queensland legislation.

This MNES Report has been prepared as part of the EIS for the Gold Coast Quarry project, and serves to address Section 11 (Part B) of the Co-ordinator General's terms of reference (TOR) for the project. Specifically, this MNES Report addresses the relevant controlling provisions through providing descriptions of MNES potentially affected by the proposed action and identifying potential impacts, thereby facilitating assessment under the EPBC Act. For completeness, this report also considers MNES that are present within the project site but were not specified to constitute controlling provisions, namely, sections 20 and 20A (listed migratory species).

1.2 Terms of Reference

This report is prepared in consideration of the requirements of the Gold Coast Quarry Project Terms of Reference (ToR) for the Environmental Impact Statement (EIS) July 2011, specifically including section 11 'Matters of national environmental significance'.

1.3 Description of the Action

The action is proposed near Reedy Creek in Queensland, within a 216.7 ha site comprising Lot 105 on SP144215 ('the Study Area'). A site locality plan is provided as **Figure 1** herein, and identifies the development footprint which will encompass an estimated 64.81 ha.

The proponent is proposing to establish a new extractive industry operation on a greenfield site bordering Old Coach Rd and Tallebudgera Creek Road, at Reedy Creek on the Gold Coast, in the area identified as the 'subject site' (Lot 105 on SP144215).

In developing this proposal, Boral Resources (Qld) Pty Limited has attempted to balance the need to secure this hard rock resource with the social and environmental factors associated with extractive industry development. After taking into account a range of environmental constraints and providing appropriate separation buffers during the detailed design process for the proposed quarry footprint, it has been estimated

that a total of 78 million tonnes of measured, indicated and inferred quarry resources have been delineated on the site (within the optimised pit shell and including the area to be developed for the plant and associated infrastructure). Boral Resources (Qld) Pty Limited has voluntarily sterilised a significant proportion of the resource which is known to occur on the site in order to achieve an appropriate balance between environmental, economic and community interests.

The site will be developed in a sequence of discrete stages, each of which will involve a series of phases:

> Site Establishment (E), Development (D), and Construction (C) stages (featuring a number of intermediate phases);

> Quarry operation stage (featuring several phases) associated with quarry pit development; and

> Rehabilitation and decommissioning of the site once the operations have concluded.

The timing, and rate of progression through the stages associated with the pit development will be defined by market conditions and demand, but the quarry will have an operational life of at least 40 years.

During the construction and site preparation stage, the proposed Gold Coast Quarry will operate with mobile plant(s), and be replaced with a permanent fixed plant as soon as practicable after the plant site infrastructure area and initial pit have been established (estimated to occur between years 4 and 5 of the approved development).

A full description of the proposed action is described in detail in Section 2.0 of this report.

1.4 Other Relevant Actions

The proponent and EIS project team are not aware of any other actions that have been taken, or are being taken, or that have been approved in the immediate site locality. A search of SEWPaC's online list of referrals was undertaken on 26 November 2012 and identified the closest referred project to be for the Gold Coast Ocean Terminal located approximately 10 km south-east from the Study Area. Other projects in proximity to the Study Area included the Springbrook Conservation Area and Day Use Facilities located approximately 14 km south-west of the Study Area, upgrade of the Smith Street Motorway approximately 17 km north of the Study Area, and the Helensvale Waste Transfer Station Expansion located approximately 26 km north-west from the Study Area.

Existing land-uses supported by the surrounding landscape predominantly include urban residential development, rural residential development and nature conservation.

1.5 Persons and Agencies Consulted

The key stakeholders who comprise the community of interest for the project were identified and included:

> Individuals directly affected by the project, including adjacent landholders and business people who may be affected by project activities;

> Organisations and groups in geographic proximity to the project;

> Special interest groups, including environment and heritage;

> The Mayor, Councillors and Chief Executive Officer of the Gold Coast City Council;

> Relevant State and Federal Government agencies;

> State and Federal Members of Parliament relevant to the project (portfolio responsibility) and project area (local MPs);

> Relevant industry sectors;

> Traditional owners and indigenous groups; and

> Media.

The list of those who may be directly affected was populated through searching a landholder database which identified all title holders in the project area. Other stakeholders were identified from various sources such as local elected representatives, the internet, local directories and community groups.

Please note contacts are presented below with the positions they were in at the last point of contact with the project team.

Stakeholders who comprise the community of interest for the project include those listed in **Table 1-1**.

Table 1-1 List of Stakeholders consulted

Category	Stakeholders
Project update subscribers	As at mid-December 2012, 467 people had subscribed to receive project updates
Federal Government	Mrs Karen Andrews MP, Federal Member for McPherson Mrs Margaret May, previous Federal Member for McPherson
Current State Government stakeholders	Mr Barry Broe, Coordinator General Mr Dan Hunt, Acting Director-General, Department of Natural Resources and Mines Mr Michael Hart MP, Member for Burleigh Mr Mick Lord, Director, Office of the Coordinator General Mr Ray Barkmeyer, Senior Project Officer, Office of the Coordinator-General Mr Ray Stevens MP, Member for Mermaid Beach Mr Steve Mill, Assistant Coordinator-General Ms Kadie Scott, Representative from the Hon. Jann Stuckey's electorate office Ms Lisa Palu, Senior Policy Advisor, Office of the Premier Ms Susan McDonald, COS to the Minister for Natural Resources and Mines The Hon. Andrew Cripps MP, Minister for Natural Resources and Mines The Hon. Andrew Powell MP, Minister for Environment and Heritage Protection The Hon. Campbell Newman MP, Premier of Queensland The Hon. Jann Stuckey MP, State Member for Currumbin and Minister for Tourism, Major Events, Small Business and the Commonwealth Games The Hon. Jeff Seeney MP, Deputy Premier and Minister for State Development, Infrastructure and Planning The Hon. Ros Bates MP, State Member for Mudgeeraba and Minister for Science, IT, Innovation and the Arts Previous State Government stakeholders (inc. current govt. contacts in previous positions): Dr Mark Robinson MP, then Shadow Minister for Main Roads, Fisheries and Marine Infrastructure Mr Andrew Fraser, then Treasurer and Minister for State Development and Trade Mr Craig Wallace, then Minister for Main Roads Mr Keith Davies, previously Coordinator General Mr Murray Watt, then Parliamentary Secretary for Health Mr Peter Lawlor, previously Minister for Tourism and Fair Trading Mr Simon Finn, previously Minister for Government Services, Building Industry and Information and Communication Technology
Previous State Government stakeholders (inc. current govt. contacts in previous positions):	Mr Steven Robertson, then Minister for Natural Resources, Mines and Energy and Minister for Trade Mr Stirling Hinchliffe, then Minister for Infrastructure and Planning Ms Annastacia Palaszczuk MP, then Minister for Transport and Multicultural Affairs Ms Christine Smith, previously State Member for Burleigh Ms Desley Boyle, then Minister for Local Government and Aboriginal and Torres Strait Islander Partnerships Ms Kate Jones, then Minister for Climate Change and Sustainability Ms Peta-Kaye Croft, then Parliamentary Secretary for Education Ms Rachel Nolan, previously Minister for Transport

Category	Stakeholders
	Ms Sonya Booth, previously Project Manager, Significant Projects Coordination The Hon. Anna Bligh, then Premier of Queensland and Minister for Reconstruction The Hon. Fiona Simpson MP, then Shadow Minister for Transport and Main Roads The Hon. Jack Dempsey MP, then Shadow Minister for the Environment The Hon. John-Paul Langbroek MP, then Leader of the Opposition and Shadow Minister for the Arts and Multicultural Affairs Mr Joshua Cooney, previously Principal Policy Advisor to the Minister for Environment and Resource Management (then the Hon. Kate Jones MP) The Hon. Lawrence Springborg MP, then Shadow Minister for State Development, Major Projects, Infrastructure and Planning The Hon. Scott Emerson MP, then Shadow Minister for Transport, Shadow Minister for Multicultural Affairs and Shadow Minister for the Arts The Hon. Tim Nicholls MP, then Shadow Minister for Environment and Economic Development
Current Gold Coast City Council stakeholders:	Mr Dale Dickson, CEO, GCCC Cr Tom Tate, Mayor, GCCC Cr Donna Gates, Division 1, GCCC Cr William Owen-Jones, Division 2, GCCC Cr Cameron Caldwell, Division 3, GCCC Cr Margaret Grummitt, Division 4, GCCC Cr Tracey Gilmore, Division 5, GCCC Cr Dawn Crichlow OAM, Division 6, GCCC Cr Lex Bell, Division 7, GCCC Cr Robert La Castra, Division 8, GCCC Cr Glenn Tozer, Division 9, GCCC Cr Paul Taylor, Division 10, GCCC Cr Jan Grew, Division 11, GCCC Cr Greg Betts, Division 12, GCCC Cr Daphne McDonald, Division 13, GCCC Cr Chris Robbins, Division 14, GCCC
Previous Gold Coast City Council stakeholders (inc. candidates):	Mr David Power, GCCC Mayoral Candidate Mr Tom Tate, GCCC Mayoral Candidate Mr Eddy Sarroff, previous Division 10, GCCC Mr Peter Young, previous Division 5, GCCC Mr Ron Clarke MBE, previous Mayor, GCCC Mr Ted Shepherd, previous Division 9, GCCC
Other government agencies	Mudgeeraba Police Nerang Police Fire and Rescue Service
Business associations	Cement Concrete and Aggregates Australia Central Gold Coast Chamber of Commerce Civil Contractors Federation Creek to Creek Chamber of Commerce Gold Coast Catchment Association Gold Coast Combined Chamber of Commerce Housing Industry Association (HIA) Master Builders Queensland Master Concreters' Association of QLD Property Council of Australia UDIA Gold Coast

Category	Stakeholders
Local Businesses	Burleigh West Golf Driving Range GCCC Tallebudgera Transfer Station: Mr Kevin Quantick, Coordinator, Waste Management Infrastructure, GCCC > Mr Matt Fraser, Manager - Waste and Resources Management, GCCC > Mr Steve Cantrill, Coordinator Waste Operations, GCCC Lechaim Pty Ltd (Kingsmore) Stockland Tallebudgera Heritage Cafe Teavine House
Businesses - customer/supplier/other organisations	A2Z Enterprises Addeco Alders Constructions Ashs Bob Cat Hire Australian Bitumen Services Aussie Rockmen Pty Ltd Axle's Earthmoving Bartmans Landscaping and Garden Supplies Bastemeyers Big Splash Communications BMD Group Gold Coast Boyds Bay Garden World Landscape Supplies Brims Earthmoving Budget Slashing Burleigh Garden Supplies Caltex Reedy Creek South Carter Rytenskild Group (CRG) CB Constructions Civic Construction Group Pty Ltd Civplumb Pty Ltd Currumbin Garden Centre D&S Barclay Pty Ltd Dr Pooh Environmental Solutions Electrical Workshop Australia Enzed Gold Coast Tweed Head Epico Industrial Pty Ltd ESS Engineering Services and Supplies Evolution Traffic Control Gary Dean Constructions Gold Coast Cranes Pty Ltd Gold Coast MX Club Greens Concrete Construction Hardings Earthmoving ICON JT Environmental Labrador Landscape Supplies MD Cooper Consulting Pty Ltd Miami Landscaping Supplies Pty Ltd Mitchelmore Transport Morrison Geotechnic Pty Ltd MPR Cleaning and Maintenance Services

Category	Stakeholders
	Nyholt Constructions Professionals Burleigh Heads Queensland Air Cleaner Services Repmont Pty Ltd Reynolds Soil Technologies Pty Ltd Rossi Gearmotors Saul's Bearings and Transmission Supplies SEQ Excavations Pty Ltd Shell Currumbin Stenhouse Lifting Equipment Waterama Wayne Hughes Excavations WD Enterprises
Local Real Estate Agents	First National Burleigh LJ Hooker Burleigh Heads Lowing & Bushe Real Estate Pty Ltd Master Agents Premium Realty Ray White (Burleigh) Real Estate On-Line Gold Coast The Real Estate
Environmental Organisations	Gold Coast and Hinterland Environment Council (GECKO) Greening Australia Wildcare Australia
Media	ABC Coast FM Sea FM Gold Coast 92.5 GOLD FM Channel 7 Gold Coast Channel 9 Gold Coast Channel 10 Gold Coast Gold Coast Bulletin Gold Coast Mail Gold Coast Sun/Tweed Sun
Schools	ABC Tallebudgera (now Goodstart Early Learning) ABC Tallebudgera Central (now Goodstart Early Learning) Gold Coast Christian College Hillcrest Christian College Ingleside Primary School King's Christian College Red Leaf School of Early Learning St Andrews Lutheran College Tallebudgera Primary School
Church	Seventh-Day Adventist Church
Indigenous Groups	Jabree Limited (Native Title holder)
Community Groups	Talley Valley Versus Boral Stop The Gold Coast Quarry

Further comments in relation to the public consultation process that was followed are discussed in Section 1.7 of the EIS.

1.6 EIS Project Team

The proponent has engaged a multi-disciplinary team to address all of the items raised in the TOR. A summary of the consultant team and the disciplines with which they are associated in provided in **Table 1-2** below:

Table 1-2 Project Team

Consultant	Project Specialisation
Cardno HRP	> Project Management > Town Planning
Acoustics RB	> Acoustics
Katestone Environmental Pty Ltd	> Air Quality > Climate change > Greenhouse gas emissions
Blastechnology	> Blasting impact (vibration and overpressure)
Lambert & Rehbein	> Project engineers
Three Plus	> Community stakeholder engagement
Jabree Limited	> Indigenous cultural heritage
Norling Consulting	> Economic impact > Cost benefit analysis
Cardno Chenoweth	> Ecological aspects (terrestrial fauna and flora) > Visual assessment
FRC Environmental	> Aquatic flora and fauna
BMT WBM Pty Ltd	> Stormwater quality and quantity > Surface water hydraulics > Flooding
Groundwork Plus	> Geotechnical and geological aspects
Australasian Groundwater & Environmental Consultants	> Groundwater
Risk Tools Pty Ltd	> Risk management
Converge Heritage and Community	> Non-Indigenous cultural heritage
Cardno Traffic & Transport	> Traffic impact
ImpaxSIA Consulting	> Social Impact

Specific details relating to the personnel from each of the above described firms and the technical reports with which they were associated are provided in **Appendix WW** of the overall EIS document.

Team members from Cardno Chenoweth and their sub consultants specifically involved in the identification of MNES in the Study Area include those listed in **Table 1-3**.

Table 1-3 Flora and fauna ecologists

Name	Qualification	Experience
David Francis (Cardno Chenoweth)	BSc (Hons)	David is an environmental scientist with 19 years experience in flora and fauna studies, vegetation mapping, ecological assessments, ecological restoration plans and environmental planning. He has an excellent knowledge of the vegetation communities and plant species of Southeast and Central Queensland, including identification of 'at risk' species.
Doug Mohr (Cardno Chenoweth)	BA, Dip CLM	Doug has over 14 year's field and reporting experience in natural resource management, specialising in ecological restoration. Domestically he has worked with and led large ecological restoration crews in numerous locations across Queensland. His expertise in flora identification and understanding of restoration principals has been utilised in consulting, training and extension

Name	Qualification	Experience
		projects throughout South-east Queensland.
Nicolas Rakotopare (Cardno Chenoweth)	BSc	Nicolas has been with Cardno Chenoweth since early 2012. In addition to his consulting experience has over 600 hours of volunteer research experience in the field of ecology and conservation biology. He is skilled in ecological reporting, flora and fauna field survey techniques and GIS and data presentation.
Damian White (DDW Fauna)	BSc, PGDip	Damian has been involved in environmental consultancy for over 15 years. As a result of his consultancy work, he is recognised as one of the regions most proficient and prolific fauna surveyors, having completed studies at over 160 sites.

1.7 Environmental Record

Boral Resources (Qld) Pty. Limited (Boral Construction Materials, Queensland) has never received a penalty or been convicted of an offence under the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999*.The environmental policy of the proponent is provided as **Attachment A** of this report.

The proponent's environmental record with respect to both State and Commonwealth legislation is contained in **Attachment A** of this report. The environmental record included with the EIS identifies infringement notices issued between the period of 1 July 2007 and 19 February 2013.

2 Project and General Site Description

2.1 Site Location

2.1.1 Real Property Description and Land Ownership

The land considered in this EIS comprises Lot 105 on SP144215 and Lot 901 on SP907357.

Lot 105 on SP144215 is a freehold title that is in the ownership of Boral Resources (QLD) Pty Limited. The current title search for this particular parcel confirms that Lot 105 is not benefitted or burdened by any existing easements.

Lot 901 on SP907357 effectively bisects Lot 105. Lot 901 traverses the site generally in a south-east to north-west direction between Tallebudgera Creek Road and Chesterfield Drive and it is a reserve administered by the Council of the City of the Gold Coast as a trustee. The current title search for this parcel also confirms that this allotment is not benefitted or burdened by any existing easements.

The project does not rely on Lot 901 on SP907357 for any part of the construction and future operation of the quarry.

The EIS demonstrates that the project will be undertaken entirely within the portion of Lot 105 that is situated to the north of Lot 901 on SP907357. Refer to Map 1 in **Attachment C**.

2.2 Overview of the Project

It is to be noted that Chapter 2.0 of the EIS provides a comprehensive overview of the project. The sections that follow includes some of the key elements from this particular EIS chapter.

2.2.1 Rational for Preferred Operating Scenario

The operating scenario for the proposed quarry will be similar to almost virtually every other operating system utilised in Boral's quarries throughout Australia.

2.2.2 Key Components of the Project

The proponent is proposing to establish a new extractive industry operation on a greenfield site bordering Old Coach Rd and Tallebudgera Creek Road, at Reedy Creek on the Gold Coast. Refer to Map 1 in **Attachment B**. The design plans for the proposed quarry are submitted as **Attachment C** and **Attachment D**.

The project is necessary to compensate for the scheduled winding down of Boral's existing West Burleigh Quarry, which has sufficient reserves for only a further 6.5 to 9 years of production (depending on market conditions). Given the lead times that are involved (in gaining development and environmental approvals; establishing the operation and completing preliminary site works in order to enable full scale production), it has been necessary for Boral to commence the relevant approval processes to ensure that an adequate, uninterrupted and efficient and cost-effective supply of construction materials remains available for critical infrastructure and construction projects in the Gold Coast region.

The Gold Coast Quarry will represent an investment of $140-$160million (2012[1] dollars) by Boral and is projected to provide continuity of employment for approximately 100 staff across Boral's integrated quarrying, asphalt, concrete and transport operations. An estimated total of 246 full-time equivalent (FTE) person-years will be directly required for the development and on-site construction works of the project. The flow-on benefits of this employment would generate further employment opportunities for the wider Gold Coast region and Queensland, resulting in a total of approximately 480 and 490 full-time equivalent person-years, respectively. Once operational, the proposed Gold Coast Quarry would directly generate around 24 FTE positions. The flow-on benefits of this employment would support about 65 FTE positions in Queensland, with 62 positions generated in the Gold Coast. The proposed Gold Coast Quarry would provide a net increase in employment

[1] Based on the value of the Australian dollar during 2012

opportunities and help continue quarrying industry jobs within the area once the West Burleigh Quarry resources are exhausted.

The proposed Gold Coast Quarry contains the last and largest known deposit of meta-greywacke quarry rock resource on the southern Gold Coast. Meta-greywacke is a high quality source of construction materials and forms the excavated and processed quarry product. The meta-greywacke resource is located within a deposit that is favourably surrounded by ridgelines and has the benefit of having substantial vegetated buffers on land owned by Boral. In developing this proposal, Boral has balanced the need to secure and develop this hard rock resource with the social and environmental factors associated with extractive industry development. After taking into account a range of environmental constraints and providing appropriate separation buffers during the detailed design process for the proposed quarry footprint, it has been estimated that a total of 79 million tonnes of measured, indicated and inferred quarry resources have been delineated on the site (within the adopted pit shell and including the area to be developed for the plant and associated infrastructure). Boral has voluntarily sterilised a proportion of the resource which is known to occur on the site in order to achieve an appropriate balance between environmental, economic and community interests.

The proposed development will operate as a quarry for the extraction and processing of hard rock primarily for use in concrete, asphalt, drainage materials, road base, bricks/blocks, pavers, pipes and landscape supplies. Investigations confirm that the quality and consistency of the resource at the site is of equal or better quality than the meta-greywacke deposit situated at Boral's existing West Burleigh Quarry, providing an opportunity to ultimately replace the current quarry operations at Boral's existing West Burleigh Quarry. The proposed Gold Coast Quarry will supply the Gold Coast region with high grade construction materials for at least 40 years whilst maintaining continuity of employment across Boral's integrated quarrying, asphalt, concrete and transport operations.

The greenfield site will be fully developed and operated in accordance with recognised industry best practice standards. Initial development requires the removal of significant quantities of overburden over the first few years of site development, including the introduction of mobile crushing plants to develop the site and value some of the excavated material. Boral estimates that approximately 5-6 million tonnes of materials (all types) will be removed from the site to allow the site infrastructure and fixed plant to be built.

Overall, the proposed Gold Coast Quarry's processing plants and supporting heavy mobile equipment (HME) will comprise:

> **Mobile Crushing Plants**

Proprietary modular trains from recognised (best practice) manufacturers such as Sandvik or Metso. The 3-stage roadbase train consists of a Primary Jaw, Secondary and Tertiary Cone Crushers complete with screens, conveyors and stockpiling conveyors. The second train (for aggregates production) will be the same or similar to the first and may include a vertical shaft impactor (VSI) to improve aggregate quality for use in higher specification applications. Each train will be targeting to achieve a minimum of 300 tonnes per hour of aggregate or crushed rock materials. The estimated capital cost of each train is $6 million (2012 dollars).

> **Fixed Plant**

The plant will be designed as a modern, 'fit for purpose' crushing plant which will target the production of aggregates. It is estimated that the production rate will be between 750 - 900 tonnes per hour to achieve an annual production of 2 million tonnes. The estimated cost of the plant is $75 million with a construction timeframe of 18-24 months.

> **Mobile Fleet**

There will be two distinct fleets, firstly a development fleet which will service the site development and stripping works, through to load and haul service for the mobile crushing trains. The second fleet will be sized to service the 750-900 tonne per hour fixed plant. Over the course of the establishment and operation of the project, there will be a range of equipment on the site for various periods of time (refer to **Table 2-3**). This equipment includes the following:

- Excavators;
- Graders;

- Drill rigs;
- Front-end Loaders;
- Bulldozers;
- Compactors;
- Articulated Dump Trucks;
- Water Trucks;
- Haulage Trucks; and
- Cranes.

2.2.3 The Quarry Process

The quarrying process commences with a survey of the rock face and bench to be developed (by drilling and blasting). Laser survey equipment defines the rock mass, and an optimised blast hole pattern is designed, and drilled. As production requirements demand, the drilled "shot" is then charged with bulk explosives, and fired, in accordance with the site blasting model and procedures.

Once the rock has been blasted, fragmented rock will be loaded from the pit floor into haul trucks, whereas any larger rock fragments ("oversize") will typically be broken by a rock breaker before loading. The load and haul fleet will generally be operated continuously during the operating hours of the quarry, in order to maintain continuity of supply for processing.

The primary stage of processing involves the use of a jaw crusher and vibratory screens, with crushed product being held in an interim stockpile called a "surge pile". From this stage, material will be transferred to several downstream stages of crushing and screening equipment. After processing, the material will be conveyed to individual product stockpiles. The processing plant, including primary and secondary crushers (and screens to separate dust and aggregates) will be located within the plant and infrastructure area, near the individual product stockpiles.

The quarry materials are then either loaded directly by a front end loader ('sales loader') from the stockpiles, or via overhead storage bins at the plant (under typical conditions), to road haulage trucks. The road haulage trucks then proceed across the weighbridge and through the wheel wash before exiting the site to deliver quarry materials to the market.

2.2.4 Stages of Development

The site will be developed in a sequence of discrete stages. Each stage will involve a series of phases:

> Site establishment ('E') , development ('D'), and construction ('C') stages (featuring a number of intermediate phases);

> Quarry operation ('Q') stage (featuring a number of phases) associated with the development of the quarry pit itself; and

> Rehabilitation and decommissioning of the site once the operations have concluded.

The timing, and rate of progression through the stages associated with the pit development will be defined by market conditions and demand. It is not appropriate to specify exact timeframes for the development of each respective phase of the project at this early point, but the quarry is expected to have an operational life of at least 40 years.

During the construction and site development stage, the proposed Gold Coast Quarry will operate with mobile plant(s), and be replaced with a permanent fixed plant as soon as practicable after the plant site infrastructure area and initial pit have been established (estimated to occur between years 4 and 6 of the approved development).

The staging plans for the project, as prepared by Lambert & Rehbein detail how the development of the quarry is intended to progress (refer to **Attachment C**). **Table 2-1** provides a general overview of the works

that will be undertaken as part of each phase of the development stage, with a more specific analysis contained in Sections 2.2.5, 2.2.8 and 2.2.9 of this report.

Table 2-1 Quarry Development Staging

SITE ESTABLISHMENT STAGE	
PHASE	**WORKS UNDERTAKEN**
E1	> The external access road and associated intersection (from Old Coach Road) will be constructed. > During this phase, approximately 58,000 tonnes of excess material will be removed.
E2	> A portion of the access road, as it enters the site from the intersection constructed as part of Phase E1, will be constructed and sealed (with bitumen). > Earthworks (cut) associated with the development of the internal road network are undertaken, specifically for the construction of: > the internal road that will ultimately link to the plant facility and ROM pads; and > the access and maintenance road extending to the dam. > Temporary weighbridge and wheel wash area will be developed. > The water storage dam embankment wall (requiring around 89,300 tonnes of fill) and associated spillway will be constructed. > Overall, a total of approximately 233,000 tonnes of overburden will be removed from the site as a result of the development of this phase.
E3	> The extent of the internal access road created in Phase E2 will be sealed with bitumen. > The temporary weighbridges and wheel wash areas will be removed and replaced by the permanent facilities. > The construction of the facilities pad will be commenced. > The sedimentation pond will be developed. > The temporary buildings associated with the (construction) facilities pad will also be constructed. > Filling works will be completed in an existing gully so as to facilitate the future pad area for the plant equipment. > Overall, a total of approximately 263,000 tonnes of overburden will be removed from the site as a result of the development of this phase. > The extent of filling completed as part of this phase equates to 115,900 tonnes.

DEVELOPMENT AND CONSTRUCTION STAGE	
PHASE	**WORKS UNDERTAKEN**
D1	> Earthworks associated with the construction of the plant pad will be continuing. These earthworks will be performed in a 'receding rim' fashion in order to minimum impacts on nearby sensitive receptors. > By this time, the quarry dam and sedimentation pond will be operational. > Overall, a total of approximately 768,000 tonnes of overburden will be removed from the site as a result of the development of this phase. > Furthermore, approximately 279,000 tonnes of quarry product extracted from the site will be utilised and sold as marketable material.
D2	> Earthworks associated with the construction of the plant pad will be continuing. > Overall, a total of approximately 751,000 tonnes of overburden will be removed from the site as a result of the development of this phase. > Furthermore, approximately 559,000 tonnes of quarry product extracted from the site will be utilised and sold as marketable material.
D3	> Earthworks associated with the construction of the plant pad will be continuing. > The ROM pad and ROM ramp will be created, and a small amount of fill will be required to develop this area (24,890 tonnes). > Overall, a total of approximately 746,000 tonnes of overburden will be removed from the site as a result of the development of this phase. > Furthermore, approximately 559,000 tonnes of quarry product extracted from the site will be

DEVELOPMENT AND CONSTRUCTION STAGE	
PHASE	**WORKS UNDERTAKEN**
	utilised and sold as marketable material.
D4	> Earthworks associated with the construction of the plant pad will be completed. > The final floor level for the plant area will be RL 34m AHD. > The final floor level for the ROM pad will be RL 50m AHD. > The stockpile area for the storing of materials will be cleared of its overburden. > The stockpile area rock (suitable for product) will be left in place for processing at a more economic rate once the permanent plant has been established. > Overall, a total of approximately 214,000 tonnes of overburden will be removed from the site as a result of the development of this phase. > Furthermore, approximately 540,000 tonnes of quarry product that can be utilised and sold is extracted.
C1	> The construction / erection of the crushing plant will be commenced. > All permanent buildings (e.g. site office, employee facilities, workshop etc.) will be constructed. > Earthworks associated with the removal of overburden are commenced with respect to extending into the area that will ultimately become the quarry pit.
C2	> The construction / erection of the crushing plant will be completed. > Earthworks associated with the removal of overburden will be continuing with respect to extending into the area that will ultimately become the quarry pit.

QUARRY OPERATION STAGE	
PHASE	**WORKS UNDERTAKEN**
Q1	> Extractive activities associated with Q1 will be undertaken. > The base levels for Q1 will range between RL 78.0m AHD (western end of the pit area) and RL 66.0m AHD (eastern end of the pit area, adjacent to the ROM pad).
Q2	> Extractive activities associated with Q2 will be undertaken. > The base levels for Pit Stage 2 will be RL 54m AHD (eastern end of the pit area, adjacent to the ROM pad). > Rehabilitation of the benches associated with the pit will commence as soon as practicable.
Q3	> Extractive activities associated with Q3 will be undertaken. > The base levels for Q3 will be RL 30m AHD (western end of the pit area). > Rehabilitation of the benches associated with the pit will commence as soon as practicable.
Q4	> Extractive activities associated with Q 4 will be undertaken. > The base levels for Q4 will be RL 6m AHD (centrally located within the pit area). > Rehabilitation of the benches associated with the pit will commence as soon as practicable.
Q5	> Extractive activities associated with Q5 will be undertaken. > The base levels for Q5 will be RL -66m AHD centrally located within the pit area). > Rehabilitation of the benches associated with the pit will commence as soon as practicable.

The haulage routes associated with the project have been defined by State Planning Policy 2/07. The Key Resource Mapping (KRA 96) details that the haulage routes associated with the resource on Lot 105 are as follows:

> Old Coach Road, heading north-west to link with the Pacific Motorway; and

> Accessing the Pacific Motorway via the proposed Bermuda Street extension, which will be situated a few hundred metres to the east of Lot 105. This particular proposal is yet to be constructed, however it is a project that has been planned by both the Gold Coast City Council and Department of Transport and Main Roads for some time.

The EIS has assessed the impacts of the proposed development in terms of both haulage routes nominated in the State Planning Policy however the project only relies on the Old Coach Road route.

2.2.5 Extent of Works in the Various Development Stages

As a general overview of the project, it is noted that it will be progressively developed over time, and over a number of stages. The information provided below is a more specific overview of the information contained in Chapter 1.2 of the EIS. The design stage plans are submitted in **Attachment C**.

Overall, the project entails the following:

> Establishment Stage comprising 3 phases;

> Development Stage comprising 4 phases;

> Construction Stage comprising 2 phases; and

> Operation Stage comprising 5 stages of pit development.

The above described Stages includes the following:

2.2.5.1 Establishment Stage

Establishment is generally defined as the activities required to gain access to the site and future quarry plant floor, establish the quarry dam and establish the sediment control pond. Establishment has been divided into three phases.

The estimated timeframe for this Stage to be completed is approximately 9 to 12 months.

> **Phase E1 – Establishment Works – External**

This phase involves the construction of a CHR and AUL intersection at the entrance point to the quarry. The right turn (across traffic) into the quarry has been designed with storage for up to two trucks (truck and dog or semi-trailer configuration) It is envisaged that these works would be performed by a road / civil contractor as part of a pre-works package.

	Earthworks			Material Export Stream		Vegetation Impact	
Material	Top Soil (t)	Cut (t)	Fill (t)	Overburden (t)	Product (t)	Clearing (Ha)	Clearing (% total)
Incremental (this phase)	1,035	57,800	0	57,800	0	1.08	1.9%
Project Cumulative	1,035	57,800	0	57,800	0	1.08	1.9%

> **Phase E2 – Establishment Works – Internal 50% complete**

This phase involves the internal site establishment works of cutting a ramp down to the future crushing plant platform at a maximum longitudinal grade of 9.3%.

This stage also utilises approximately 30% of the cut material produced, whilst at a similar elevation, to construct the quarry dam and a small section of ramp fill. The remaining cut will be trucked offsite as overburden. All overburden will be primary crushed by mobile plant to condition it for transport and compaction during filling.

	Earthworks			Material Export Stream		Vegetation Impact	
Material	Top Soil (t)	Cut (t)	Fill (t)	Overburden (t)	Product (t)	Clearing (Ha)	Clearing (% total)
Incremental (this phase)	5,220	329,200	95,760	223,440	0	5.31	9.3%
Project Cumulative	6,255	387,000	95,760	291,240	0	6.40	11.2%

> **Phase E3 - Establishment Works – Internal 100% complete**

This phase involves internal site establishment works of cutting and filling the starter pad for the development works, this includes levelling approximately 0.4Ha for contractor's facilities, filling of a gully and excavation of the permanent sediment control pond and its access portal.

At this stage, the permanent weighbridge including truck wheel wash will be installed and the dam and sediment pond will have been commissioned. This will mark the end of the establishment works as the site moves into the development stage.

	Earthworks			Material Export Stream		Vegetation Impact	
Material	Top Soil (t)	Cut (t)	Fill (t)	Overburden (t)	Product (t)	Clearing (Ha)	Clearing (% total)
Incremental (this phase)	2,880	379,100	115,900	263,200	0	5.96	10.4%
Project Cumulative	9,135	766,100	211,660	554,440	0	12.36	21.5%

2.2.5.2 Development Stage

Development is generally defined as the activities required to prepare the future crushing plant ROM pad and main platform floor. This includes cutting the floor down to RL34m, cutting the ROM to RL50m, cutting the future stockpile area to top of rock and some minor filling. A ramp from the floor to the ROM and from the ROM into the Pit will also be established.

Development works will involve the removal of approximately 10m of overburden, which will be primary crushed prior to removal from site. Material below 10m deep will be treated to produce value added roadbase and aggregates. All overburden and product will be crushed by mobile plant. Development works will provide finished earthworks the final level prior to construction of the permanent Crushing Plant.

The estimated timeframe for this Stage to be completed is approximately 2 to 2.5 years.

> **Phase D1 – Development Works – Plant Earthworks 25% Complete**

This phase is the first of the four phases of the development works. It represents the status, approximately 25% by time, into the works. Material removal is estimated to be as follows:

- The overburden removal crew using a primary crushing/scalping plant will remove an average of 10m of material, leaving the site 10m below the natural contours, and benched for further works.
- The crushing crew (including mobile three-stage crushing plant) will remove the remainder of the material down to finished surface level. The crushing crew will need to allow the overburden crew sufficient lead time such that the two work zones do not conflict. This has been provided for in the preliminary scheduling.

Sequentially all works will be performed in a receding rim fashion, where practical. Material is planned to be removed from the centre of the site outwards, with works only day-lighting once the edge of the work area is reached. This will assist in reducing visual and noise impacts.

	Earthworks			Material Export Stream		Vegetation Impact	
Material	Top Soil (t)	Cut (t)	Fill (t)	Overburden (t)	Product (t)	Clearing (Ha)	Clearing (% total)
Incremental (this phase)	8,640	1,047,103	0	768,099	279,099	4.01	7.0%
Project Cumulative	17,775	1,813,203	211,660	1,322,539	279,005	16.37	28.5%

> **Phase D2 - Development Works – Plant Earthworks 50% Complete**

This phase is the second of the four phases of the development works. It represents the status, approximately 50% by time, into the works.

	Earthworks			Material Export Stream		Vegetation Impact	
Material	**Top Soil (t)**	**Cut (t)**	**Fill (t)**	**Overburden (t)**	**Product (t)**	**Clearing (Ha)**	**Clearing (% total)**
Incremental (this phase)	0	1,310,113	0	751,027	559,086	3.81	6.6%
Project Cumulative	17,775	3,123,316	211,660	2,073,566	838,090	20.18	35.2%

> **Phase D3 - Development Works – Plant Earthworks 75% Complete**

This phase is the third of the four phases of the development works. It represents the status, approximately 75% by time, into the works.

	Earthworks			Material Export Stream		Vegetation Impact	
Material	**Top Soil (t)**	**Cut (t)**	**Fill (t)**	**Overburden (t)**	**Product (t)**	**Clearing (Ha)**	**Clearing (% total)**
Incremental (this phase)	6,300	1,329,532	24,890	745,557	559,086	3.08	5.4%
Project Cumulative	24,075	4,452,848	236,550	2,819,122	1,397,176	23.26	40.6%

> **Phase D4 - Development Works – Plant Earthworks 100% Complete**

This phase is the final of the four phases of the development works. It represents the status, approximately 100% by time, into the works.

At the end of this phase approximately 350,000 tonnes of rock will be left in-situ to the north of the site in the future stockpile area. This material will be left as it is outside the footprint of the permanent plant, and as such can be processed more efficiently and with improved amenity outcomes once the permanent plant is installed. This material will also potentially supplement feed to the plant during the early parts of pit operations and during plant commissioning.

The completion of this phase will conclude the development works and will allow the start of permanent plant construction works.

	Earthworks			Material Export Stream		Vegetation Impact	
Material	**Top Soil (t)**	**Cut (t)**	**Fill (t)**	**Overburden (t)**	**Product (t)**	**Clearing (Ha)**	**Clearing (% total)**
Incremental (this phase)	0	754,262	0	213,828	540,434	3.48	6.1%
Project Cumulative	24,075	5,207,110	236,550	3,032,950	1,937,610	26.74	46.6%

2.2.5.3 Construction Stage

The construction works will involve the construction of the permanent crushing plant and all support buildings, workshop and infrastructure. During this time overburden will also be removed from part of the pit area to expose rock for processing once the plant is complete. A temporary haul circuit will need to be established between the ROM pad and the internal access road to continue removal of overburden from the pit.

The estimated timeframe for this Stage to be completed is approximately 2 to 2.5 years.

> **Phase C1 – Construction Works – Crushing Plant 50% Complete**

This phase is the first of the two phases of the construction works. It represents the status, approximately 50% by time, into the works. By this point it is anticipated that the support buildings and workshop will be complete, and plant foundations and civil works will be well advanced.

	Earthworks			Material Export Stream		Vegetation Impact	
Material	**Top Soil (t)**	**Cut (t)**	**Fill (t)**	**Overburden (t)**	**Product (t)**	**Clearing (Ha)**	**Clearing (% total)**
Incremental (this phase)	1,292	153,736	0	153,736	0	2.58	4.5%
Project Cumulative	25,367	5,360,846	236,550	3,186,686	1,937,610	29.32	51.1%

> **Phase C2 – Construction Works – Crushing Plant 100% Complete**

This phase is the second of the two phases of the construction works. It represents the status, approximately 100% by time, into the works. Upon completion of the construction works the plant should be fully commissioned and the pit should have exposed rock available. Conclusion of construction works will mark the start of Quarry operations.

	Earthworks			Material Export Stream		Vegetation Impact	
Material	**Top Soil (t)**	**Cut (t)**	**Fill (t)**	**Overburden (t)**	**Product (t)**	**Clearing (Ha)**	**Clearing (% total)**
Incremental (this phase)	3,955	470,591	0	470,591	0	7.91	13.8%
Project Cumulative	29,321	5,831,438	236,550	3,657,278	1,937,610	37.23	64.9%

2.2.5.4 Operational Stage

Quarry operations will progress for at least 40 years beyond the completion of plant civil and plant works. The quarry has been modelled in five distinct phases to demonstrate its development to a terminal bench profile. The quarry will have an ultimate floor level of -RL66m.

A specific timeframe for this stage to be completed cannot be quantified. Market conditions will determine the rate of extraction of the material, which in turn will dictate the progression through the various phases of this particular Stage.

> **Phase Q1 – Quarry Operations**

	Quarry Export Stream			Plant Exp. Stream*	Vegetation Impact	
Material	**Quarry Overburden (t)**	**Weathered Rock (t)**	**Fresh Rock (t)**	**Fresh Rock (t)**	**Clearing (Ha)**	**Clearing (% total)**
Incremental (this phase)	1,000,000	1,584,000	2,403,000	351,000	7.56	13.2%
Project Cumulative	1,000,000	1,584,000	2,403,000	351,000	44.79	78.1%
Total Tonnage	4,987,000			351,000		

* Note that there is approximately 130,000m^3 (351,000t) of fresh rock preserved in the plant stockpile area that will be processed during Phase Q1.

> **Phase Q2 – Quarry Operations**

	Quarry Export Stream			Plant Exp. Stream*	Vegetation Impact	
Material	**Quarry Overburden (t)**	**Weathered Rock (t)**	**Fresh Rock (t)**	**Fresh Rock (t)**	**Clearing (Ha)**	**Clearing (% total)**
Incremental (this phase)	140,000	480,000	4,536,000	0	1.28	2.2%
Project Cumulative	1,140,000	2,064,000	6,939,000	351,000	46.07	80.3%
Total Tonnage	10,143,000			351,000		

> **Phase Q3 – Quarry Operations**

	Quarry Export Stream			Plant Exp. Stream*	Vegetation Impact	
Material	**Quarry Overburden (t)**	**Weathered Rock (t)**	**Fresh Rock (t)**	**Fresh Rock (t)**	**Clearing (Ha)**	**Clearing (% total)**
Incremental (this phase)	360,000	648,000	14,256,000	0	7.30	12.7%
Project Cumulative	1,500,000	2,712,000	21,195,000	351,000	53.38	93.1%
Total Tonnage	25,407,000			351,000		

> **Phase Q4 – Quarry Operations**

	Quarry Export Stream			Plant Exp. Stream*	Vegetation Impact	
Material	**Quarry Overburden (t)**	**Weathered Rock (t)**	**Fresh Rock (t)**	**Fresh Rock (t)**	**Clearing (Ha)**	**Clearing (% total)**
Incremental (this phase)	300,000	624,000	18,873,000	0	3.97	6.9%
Project Cumulative	1,800,000	3,336,000	40,068,000	351,000	57.35	100.0%
Total Tonnage	45,204,000			351,000		

> **Phase Q5 – Quarry Operations**

	Quarry Export Stream			Plant Exp. Stream*	Vegetation Impact	
Material	**Quarry Overburden (t)**	**Weathered Rock (t)**	**Fresh Rock (t)**	**Fresh Rock (t)**	**Clearing (Ha)**	**Clearing (% total)**
Incremental (this phase)	120,000	168,000	27,432,000	0	0.00	0.0%
Project Cumulative	1,920,000	3,504,000	67,500,000	351,000	57.35	100.0%
Total Tonnage	72,924,000			351,000		

2.2.6 Planning - Refinement of the Project Design Process

The design process associated with the project has undergone continual and focussed refinement in order to ensure that potential impacts are minimised. The extent and configuration of the disturbance footprint and the internal design of the quarry that is now proposed represents the outcome of this process. A summary of the process undertaken is as follows:

> The disturbance footprint does not encroach on any vegetation species of national significance;

> Identified areas of endangered regional ecosystem on Lot 105 will not be cleared. The disturbance footprint was refined to avoid this identified area;

> The disturbance footprint was refined in order to provide a separation distance between the quarry and the known nesting tree of a White-bellied Sea Eagle;

> The ground levels associated with the run of mine (ROM) pad and processing area were raised in order to reduce the amount of overburden that would be required to be excavated, and compress the development timeline prior to the commissioning of the permanent fixed plant;

> The progression of the pit development will be undertaken in a manner that reduces potential external views for the longest period possible. This process that will be adopted is not necessarily the most efficient in pure quarrying terms, but it will achieve an appropriate balance with scenic amenity aspects;

> As a result of acoustic modelling, noise bund areas originally proposed have been removed from the final extent of the disturbance footprint, and other treatments adopted;

> The access intersection to the site from Old Coach Road is the best location in terms of sight distance and road safety considerations; and

> The footprint was refined as a result of technical studies completed for the EIS to ensure that appropriate mitigation measures could be implemented within the subject site.

> Overall, all works associated with the quarry project will be undertaken within the defined boundaries of the disturbance footprint. The disturbance footprint has an area of 65 hectares, which equates to approximately 30% of the total site area of Lot 105.

The proponent has adopted a design and development methodology that achieves an appropriate balance between the environmental and amenity aspects and the need to feasibly extract a State-significant resource.

2.2.7 Planning - Environmental Design Features of the Project

With respect to environmental aspects associated with Lot 105 and the extent of the proposed development, the following is noted:

> Approximately 70% of Lot 105 will be retained as a vegetated buffer area. This area will be rehabilitated and restored as part of the overall project. It is also noted that a net benefit will be achieved on lot 105 for koala habitat.

> The disturbance footprint has been aligned so that it does not encroach or adversely impact on any identified threatened floral species of National significance. This footprint also avoids identified endangered remnant ecosystem vegetation.

> Rehabilitation will be progressively undertaken within the quarry area to assist with soil stabilisation and to reduce potential visual impacts.

> To assist with minimising impacts on fauna, features including ground ramps and glider poles have been incorporated into the design of the access road to support fauna crossing opportunities.

Chapter 4.3 of the EIS provides a comprehensive overview of the environmental features of the subject site in response to the TOR. Chapter 2.3 below provides a general overview of the environmental features of the land.

2.2.8 Construction Phase

The ToR details the requirement to provide a description of the construction phase. As outlined in Section 2.2.4 and **Table 2-1**, it is more appropriate for this project to consider the Construction Phase in the context of the Establishment, Development and Construction Stages.

The individual phases associated with each of the above mentioned Stages have been previously described in Section 2.2.4 and **Table 2-1**.

It is important to note that there will be no set commissioning time for the project. Once works commence on Lot 105, the quarry use has effectively commenced given that hard rock resources will be extracted for market.

The following table (**Table 2-2**) provides further information in relation to the Establishment, Development and Construction Stages of the project:

Table 2-2 Establishment, Development and Construction Stages

Future Approvals required for these stages	The following approvals would be required to be obtained prior to the commencement of the Establishment, Development and Construction Stages: > Material Change of Use development permit issued by Gold Coast City Council for an Extractive Industry land use; and > Operational Works approvals issued by Gold Coast City Council for civil works, earthworks and vegetation clearing.
Land acquisition / easement requirements	Based on the proposed design, no land will be required to be acquired in order to facilitate the proposed development. Easements may be necessary at some point as a result of the need to provide Lot 105 will an adequate electricity supply. The need for potential easements will be based on future negotiations with Energex.
Nature, scale and timing of vegetation clearing	Section 2.2.5 details the extent of vegetation that will be cleared during the Establishment, Development and Construction Stages. The extent of clearing will be undertaken in a staged process. A staged clearing plan has been prepared as part of the Koala Management Plan for the EIS. Refer to **Appendix Y**.
Site Access	Access to the site will be via Old Coach Road. It is noted that there will be one access and egress point to the proposed quarry from this particular carriageway. The intersection and access road design is submitted in **Attachment D**. This plan demonstrates that all works associated with constructing the access intersection will be contained entirely within the existing road reserve area of Old Coach Road.
Operation hours for undertaking of Establishment, Development and Construction Stages	During the Establishment, Development and Construction Stages, the proposed development will be operated within the following hours:- > **Access (general activities)**: 6:00am to 6:00pm Monday to Saturday > **Construction activities and site works***:6:30am to 6:00pm Monday to Saturday > **Sales and Dispatch**: 6:30am to 6:00pm Monday to Saturday > **Mobile Crushing and Screening**: 7:00am to 6:00pm Monday to Saturday > **Maintenance**: 24 hours Monday to Saturday and 8:00am to 6:00pm Sundays > **Blasting**: 9:00am to 5:00pm Monday to Friday * Operation of major items of noise-generating plant, specifically bulldozers, rock breakers and rock drills will not commence until 7:00am.
Equipment to be used	**Table 2-3** in the EIS document (page 67) outlines the equipment that will be utilised during the Establishment, Development and Construction Stages.
Earthworks	Earthworks will be required to be undertaken during the Establishment, Development and Construction Stages. Section 2.2.5 provides an overview of the extent of cut and fill work that will be undertaken during the Establishment, Development and Construction Stages.
Interference with watercourses and floodplain areas, including wetlands	Wetlands and floodplain areas will not be interfered with during the Establishment, Development and Construction Stages. Minor works may be carried out to establish discharge points in the two watercourses on the site. Refer to **Appendix CC** of the overall EIS.

Upgrade, relocation, realignment, deviation of or impediment of access to roads and other infrastructure	Minor realignment works to Old Coach Road will be required as part of the construction of the access intersection. This realignment is required in order to ensure that the design of the intersection meets the relevant design codes and road safety requirements. As indicated on the plan submitted as **Attachment D**, this realignment work will occur entirely within the existing road reserve area of Old Coach Road.
Site Establishment Requirements for Construction > **Access Restrictions measure**	There may be the requirement for traffic control and occasional lane closures along Old Coach Road to facilitate roadworks and to enable over-dimensional loads to safely enter and leave the site. Similar control measures may also be required when the access intersection for the project is being constructed.
> **Expected size, source and control of the construction workforce accommodation**	No on-site accommodation for the workforce will be proposed as part of any stage the project.
> **Services (water, sewerage, communication, power, recreation)**	The site will not be connected to the Council trunk water or sewer systems.
> **Safety requirements**	Safety measures will be undertaken in accordance with the proponent's health and safety policy, and meeting statutory requirements.
Temporary Works	No temporary works, other than contractor's site facilities, are anticipated during the Establishment, Development and Construction Stages.
Estimated numbers and roles of persons to be employed during the pre-construction phase of the project	An estimated total of 246 full-time equivalent (FTE) person-years will be directly required for the on-site development and construction of the project. The flow-on benefits of this employment would generate further employment opportunities for the wider Gold Coast region and Queensland, resulting in a total of approximately 480 and 490 full-time equivalent person-years, respectively. **Table 2-2** of the EIS document (page 63) details the positions that will be generated during the Establishment, Development and Construction Stages.
Detailed staging plan and approximate timeframes	The design plans clearly detail the Stages and the associated Phases associated with the project. The estimated timeframes for the completion of each Stage are summarised as follows: > Establishment Stage = 9-12 months > Development Stage = 2-2.5 years > Construction Stage = 2-2.5 years Refer to **Attachment C**.
Indicative construction timetable, including expected commissioning and start-up dates and hours of operation	The anticipated commencement date for the Establishment Stage of the project is 2016. It will be 5 to 6 years from the commencement date before the Construction Stage is completed.
Construction equipment to be used	**Table 2-3** in the EIS document (page 67) outlines the equipment that will be utilised during the Establishment, Development and Construction Stages.
Construction inputs, handling and storage, including an outline of potential locations for source of construction materials	The waste management plan prepared for the EIS describes the types of wastes that could be expected during the Establishment, Development and Construction Stages. Refer to Chapter 4.8 of the EIS (page 233) and **Appendix KK** of the overall EIS document.
Major hazardous materials to be transported, stored and/or used-on site, including environmental toxicity	The waste management plan prepared for the EIS describes the types of regulated and potentially hazardous wastes that could be expected during the Establishment, Development and Construction Stages. Refer to Chapter 4.8 of the EIS (page 233) and **Appendix KK** of the overall EIS document.

data and biodegradability	
Clean-up and restoration of areas used during construction, including storage areas	The disturbance footprint will be utilised for the storage of equipment etc. during the Establishment, Development and Construction Stages. Restoration and rehabilitation works will not be necessary within the disturbance footprint other than for temporary contractor facilities and those later activities associated with quarry benches.
Construction Traffic	The road impact assessment that has been prepared for the EIS details peak vehicle trips associated with: > The haulage fleet; and > Worker traffic. The haulage fleet is confirmed as consisting of: > Tandem Rear Axle Trucks; > Tri Rear Axle Semi Trucks; and > Tandem Rear Axle Truck and Quad Dog Trucks. The road impact assessment included illustrations of each of the above described vehicles. Access routes associated with all vehicles have also been defined in the road impact assessment. Consideration has been given to access routes, and particularly haulage routes, in terms of whether or not the proposed Bermuda Street extension exists. Refer to **Appendix LL** of the overall EIS document.

2.2.9 Operation Stage

The ToR makes no reference to the Operation Stages of the project in the context of the MNES report. Further to Section 2.2.4 and **Table 2-1**, the following, further information is provided in **Table 2-3**:

Table 2-3 Operational Phase

Concept and Layout Plans of Buildings	Specific design for the buildings associated with the quarry has yet to be finalised. This process will be undertaken as part of any future Material Change of Use or Operational Works or Building Approval application that may be lodged with Gold Coast City Council.
Structures **Plans and Equipment to be employed**	**Table 2-3** in the EIS document (page 67) outlines the equipment that will be utilised during the Operation Stage.
Hours and Days of operation, including details of public holidays	During the Quarrying Phases Q1 to Q5, the proposed development will be operated within the following hours:- **Access (general operations)**: 6:00am to 6:00pm Monday to Saturday **Extraction**: 6:30am to 6:00pm Monday to Saturday **Sales and Dispatch**: 6:30am to 6:00pm Monday to Saturday **Crushing and Screening**: 6:30am to 6:00pm Monday to Saturday **Maintenance**: 24 hours Monday to Saturday and 8:00am to 6:00pm Sundays **Blasting**: 9:00am to 5:00pm Monday to Friday
Capacity of the project equipment and operations	The proposed crushing and screening plant has a maximum production capacity of 2 million tonnes per annum.
Staging plan for works over the site throughout the life of the operations	The design plans clearly detail the Phases associated with the Operational Stage of the project. The exact timeframes for the completion of each Phase within the Operation Stage is unknown as it will be driven by market conditions.
Estimated numbers and roles of persons to be employed during the operation phase of the project	Once operational, the proposed Gold Coast Quarry would directly generate 24 FTE positions. The flow-on benefits of this employment would support about 65 FTE positions in Queensland, with 62 positions generated in the Gold Coast. The proposed Gold Coast Quarry would provide a net increase in employment opportunities and help continue quarrying industry jobs within the area once the West Burleigh Quarry resources are exhausted. **Table 2-2** of the EIS document (page 63) details the positions that will be generated during the Operational Stage.

Traffic generation/traffic requirements for the operation of the quarry and facilities associated with the project, including movement of workers	The design plans detail the car parking areas within the site for the employees and visitors. The traffic impact assessment prepared for the EIS provides an analysis of traffic movements and associated transport routes. Refer to **Appendix LL** of the overall EIS document.

2.2.10 Associated Project Infrastructure

With respect to infrastructure and service requirements associated with the proposed development, the following is noted:

> Access to the site will be via Old Coach Road. A CHR / AUR intersection will be constructed during the Establishment Stage. The preliminary design plans associated with this intersection are submitted in **Attachment D**.

> The proposed development will not rely on rail or ship infrastructure. The proposed extension of the rail network south of Varsity Lakes is situated on the opposite side of the Pacific Motorway. The proposed development will not impact on this future extension.

> Lot 105 will be connected to the local telecommunications infrastructure.

It is proposed that the incoming telephone services be terminated within the Weighbridge Office at the entrance to the site and fibre reticulation is provided from there to the various site buildings.

From this location a 6-core fibre-optic cable shall be run in dedicated conduits and pits to the various buildings and electrical substations located around the site. In the various buildings FOBOTS shall be used to terminate the fibre cables and media converters used to convert the signals to a local copper carrier service.

The design will comply with AS3080 Tele-communications Installations

Refer to **Appendix M** of the overall EIS document for further details.

> Lot 105 will not be connected to Council's trunk water reticulation system. All water captured within the disturbance footprint will be stored for the everyday operation of the quarry. As a result, the proposed development will be entirely self-sufficient in the context of non-potable water demand.

A quarry dam is required to provide water for processing and for use in dust suppression during the development and operational life of the quarry. Water will be pumped from the quarry dam into a water header tank in close proximity to the processing area and then used for materials processing or used by water trucks for dust suppression on haul roads.

The quarry dam is approximately 200 m long and varies from 80 to 120 m wide. Most of the water held in the quarry dam will be pumped in from the larger quarry pit catchment, rather than originating from within the quarry dam catchment. Even during early quarry operations when the bottom of the quarry is at a relatively high elevation, the quarry will be internally draining. A drop cut will be used to create a sump for collecting quarry affected runoff which will be contribute to the quarry water supply, including the quarry dam.

The quarry dam will likely be decommissioned and potentially breached when quarry operations cease.

> Lot 105 will be ultimately connected to the local electrical mains infrastructure.

Energex has advised that there is no 33kV in the vicinity of the site. There is 11kV along Tallebudgera Creek Road but it does have the capacity to power the new quarry. There is also no infrastructure along Old Coach Road near the entry to the site.

Based on a preliminary electrical load of 6.8MW, Energex has advised that new (major) infrastructure to their network will be required and could take up to 2 years to implement. A number of options have been discussed with Energex and these are outlined in **Appendix M** of the overall EIS document. Depending

on the option that is ultimately agreed upon, there may be a requirement for easements to be obtained over adjoining allotments in order to facilitate the provision of electricity.

Within the site, it is proposed to reticulate HV cables around the site in underground conduits and pits to the various locations of the substations that will supply the processing plant and buildings. Currently, only schematic plans have been prepared for the internal reticulation and therefore further input will be required from the design team in relation to ratings of equipment, locations of transformers, route of conduits etc.

The design will comply with AS3000 Electrical Installation Wiring Rules, and relevant Mining Regulations.

> Stormwater runoff will be captured on-site and may be treated if required.

A sediment pond will be constructed to capture stormwater flowing from the processing and stockpiling areas. It is proposed that a sediment pond will extend approximately 100 m along the edge of the operations area and will be approximately 60 m wide at the widest point. To ensure that all stormwater flows into the sediment pond, surfaces will be profiled and drains will be constructed around the perimeter of the processing area and as required, beside haul roads including the ramp descending from the ROM pad.

Stormwater quality and quantity management plans have been prepared for the EIS. Refer to Chapter 4.4 of the EIS and **Appendix CC** of the overall EIS document.

> The range of waste products anticipated from the project has been identified and a management plan has been prepared for the EIS. Refer to Chapter 4.8 of the EIS and **Appendix KK** of the overall EIS document.

> Lot 105 will not be connected to the Council's trunk sewage network. An on-site system is proposed to cater for the development. Refer to **Appendix L** of the overall EIS document. Further comments in relation to the proposed on-site sewage system are provided below. The project proposes an on-site sewage treatment system. While the system is yet to be designed in detail, it will be entirely contained within the proposed disturbance footprint. The proponent will need to obtain an Environmentally Relevant Activity approval prior to constructing and operating the system.

2.2.10.1 On-Site Sewage

Several potential arrangements to dispose of sewage from the proposed quarry buildings were investigated, including:

> Gravity connection to the municipal sewer network;

> Provision of an on-site sewage pump station and rising main discharging to the municipal sewer network; and

> On-site treatment of sewage.

It was found that connection to the municipal sewer network by gravity or pressure main would require additional clearing of an outfall alignment, and consent from an adjacent property owner would be required to construct the sewer through their property. Construction of a connection to the municipal sewer network was also anticipated to be significantly more costly than provision of on-site sewage treatment devices.

In liaising with Gold Coast City Council engineers regarding the matter of dealing with sewage generated by the proposed development, it was Council's position that on-site treatment would be preferred in consideration of the Extractive Industry use of the proposed development. Council's recommendation has been adopted.

On-site sewage treatment is considered an Environmentally Relevant Activity under the *Environmental Protection Regulation 2008*, since the facility will likely cater for greater than 21EP.

2.2.10.1.1 Equivalent Person Population

The equivalent person (EP) population is estimated to be 25EP for the purposes of determining the minimum requirements the on-site sewage system. This has been based upon the maximum number of employees working at the quarry at any one time during the operations phase of the project. It is acknowledged that 24 full time positions will be generated as a respect of the project.

2.2.10.1.2 Wastewater Produced

In general the amount of wastewater generated on site will equal the amount of water consumed by various activities. Activities which contribute to the generation of sewerage include:

> Personnel Usage (drinking, washing, showering, toilets, meals); and

> Cleaning (floors etc.).

A maximum sewerage flow of 3200 litres/day has been calculated based on the estimated amount of water consumed by the above mentioned activities for 25 people.

2.2.10.1.3 Sewage System

The package treatment plant system will be gravity fed by a PVC pipe network which transports the waste from the building facilities. The package plant will need to cater for 30EP in order to ensure the system remains under loaded at all times. The treatment system can include septic tanks which can be coupled with filters and aerobic systems involving artificially forced aeration units. A typical 30EP package treatment plant will consist of:

> Primary septic tank;

> Secondary septic tank;

> Three stages of aeration;

> Sediment chamber; and

> Disinfection pump.

2.2.10.1.4 Irrigation Area Required

As the system requires a means of effluent disposal, an area of land within Lot 105 has been allocated for the disposal of effluent through a sub-surface dripper. The irrigation area required is determined by the amount of flow produced (number of EP), the type of soil into which the effluent will flow and the type of irrigation which is used, be it sub-surface dripper or surface sprayer.

As a worst case scenario, it is assumed that the type of soil present on the selected site possesses poor absorption rates. Poor clay will require 334m^2 for every 1,000 litres of effluent produced in one day. At 3200 litres/day the sub-surface dripper will require a land area of 1,069m^2.

The irrigation area is located uphill of the proposed treatment plant, adjacent to the weighbridge and is entirely within the disturbance footprint.

It is not anticipated that the irrigation area for the on-site sewage treatment system will adversely impact upon matters of national environmental significance. This is because the location of the irrigation area is situated within the disturbance footprint, and any potential runoff from this area will be captured in the on-site stormwater system (it is noted that the irrigation area is surrounded by internal access roads and associated benching). Furthermore, and as will be demonstrated in the future application that will be required to achieve an ERA approval, the wastewater will be treated to an appropriate level. This would be a requirement of an ERA approval in any case.

2.2.10.2 On-Site Water Requirements

The proposed development will be self-sufficient with respect to water usage, and as detailed above, the subject site will not be connected to Council's trunk water infrastructure system. As a result, the EIS included a water cycle management plan to demonstrate that enough water can be collected on site to ensure the effective operation of the

The Stormwater Quality, Hydrology and Water Cycle Management Plan contained in Appendix B of the Water Resources and Floodplain Management report provides an overview of the water cycle management process that will be implemented. Reference is to be made to **Appendix CC** of the overall EIS document.

The proposed water cycle management strategy for the site includes the following:

> Construction of a new dam (the '**quarry dam**').

> Quarry dam to be utilised to harvest runoff from the upstream catchment.

> Flows from the quarry pit (and catchment flowing into the quarry pit) will be collected in a sump at the invert of the quarry pit, and subsequently pumped to the quarry dam.

> Sediment basin utilised for stormwater treatment only. However, there is potential to utilise some stormwater flows retained in this pond to supplement non-potable water demands (e.g. dust suppression).

> Roof runoff from buildings within the processing and infrastructure areas will be collected in rainwater tanks and utilised for non-potable water usages (e.g. toilet flushing, vehicle washdown).

> Potable water demands (e.g. drinking, laboratory) will be satisfied by bottled water, delivered to the site.

Based on the modelling contained in the Stormwater Quality, Hydrology and Water Cycle Management Plan (Section B.2.6) the following comments are provided with respect to the water cycle management strategy:

> All site water demands for surface dust control, dust suppression and process water are predicted to be satisfied by the proposed water cycle management strategy. Dam water levels/volumes are predicted to be below the dam lower limit (15% capacity) when process water would be reduced by 50% only very infrequently (three and two occasions for Stage Q1 and Q5 respectively in the 111-year period of historical climate data).

> Water levels within the dam are predicted to be at or near the dam crest level for the majority of the time.

> The majority of water inputs into the dam and pond are from surface flows. Surface flows pumped from the quarry pit catchment (and pumped to the dam) contributes the most inflow volume into the dam.

> Overflow from the dam is the largest output of water from the dam.

> Approximately half of all flow volume entering the sediment basin will be treated (through detention and settlement and/or flocculation) and discharged via pumping, with approximately half of all flows from the sediment basin overflowing into the creek.

> The water balance modelling predicts that (for the multiple ten year periods assessed), the quarry dam is anticipated fill to 15% capacity (sufficient to satisfy all quarry dam water demands for Stage C1) within less than a year following construction. The average time taken for the dam to commence over-flowing to the downstream environment was (for the periods assessed) was approximately three years.

It is noted in the Stormwater Quality, Hydrology and Water Cycle Management Plan that the results presented for the Q1 phase assumes that the infrastructure has been installed to pump water from the quarry pit (collected from a sump within the invert of the quarry pit) to the quarry dam. Water balance model results indicate that if this infrastructure is not installed, the ability to satisfy site water demands is significantly reduced. Furthermore, it is likely that this infrastructure will be required to prevent excessive inundation and overflows from within the quarry pit.

2.2.10.2.1 Water Requirements

Table B-5 of the Stormwater Quality, Hydrology and Water Cycle Management Plan contained in Appendix B of the Water Resources and Floodplain Management report details water balancing water requirements and is reproduced below as **Table 2-4**. :

Table 2-4 Operational Phase

INPUTS	
Direct Rainfall	Direct rainfall input a function of daily rainfall and waterbody area (dependent on daily volume and bathymetry).
Surface Flows	Calculated by catchment model (see Section B.2.3.2 of the Stormwater Quality, Hydrology and Water Cycle Management Plan contained in Appendix B of the Water Resources and Floodplain Management report). Flows from quarry pit (and catchment) assumed to be pumped to quarry dam.
Groundwater Flows	Assumed to be zero. AGE (2012) predicts that groundwater inflow to the quarry pit at Stage Q5 will be approximately 8.4litres/second, but that the majority of groundwater inflow to the pit will occur as diffuse seepage in the pit walls from joints and fractures, and will be evaporated before reaching the pit floor and collection sump.
OUTPUTS	
Evaporation	Evaporation data obtained from Hinze Dam BOM Station (Ref: 040584), with evaporation based on waterbody area (dependent on daily volume and bathymetry) and pan coefficient of 0.7 applied.
Water usage from quarry dam	Water used from quarry dam for (i) process water; (ii) C&S plant dust suppression and (iii) surface dust suppression. Water usage from the quarry dam is as follows: > Process water demand for Stages C1, Q1 and Q5 is 44, 294 and 294m^3/day respectively. If volume within quarry dam is below 15% capacity, process water usage is reduced by 50%. > C&S plant dust suppression water demand is 2m^3/day. > Surface dust control water demand for Stages C1, Q1 and Q5 is 71, 119 and 220m^3/day respectively. However, surface dust suppression does not occur on any day with more than 5mm or rainfall or more than a total of 10mm of rainfall in preceding two days. > Water usage only occurs on days Monday to Saturday (quarry does not operate on a Sunday).
Controlled discharge from sediment basin	Stormwater detained within the 'settling volume' of the sediment basin is assumed to be flocculated and pumped out at a rate to empty the total settling volume capacity within five days.
Overflow	At the end of each modelling time step, any volume in excess of the volume at the quarry dam or sediment basin spillway weir level is assumed to overflow (before the commencement of the next modelling timestep).

The water balance model has been utilised to assess the following (for the 111-year historical climatic period):

> Variation in water levels within the quarry dam and sediment basin;

> Ability of the proposed water cycle management strategy to satisfy the water demands for surface dust control, dust suppression and process water; and

> Assess the water balance of the site (e.g. quantity and distribution of water flowing in and out of the quarry dam and sediment basin).

The water balance model confirms that the operational needs of the quarry will be achieved.

In instances where there are unseasonably dry periods, water can be trucked into the site to maintain the water level of the quarry dam to sustain operational requirements.

2.2.11 Progressive Site Rehabilitation

A Landscape Rehabilitation Plan has been prepared by Cardno Chenoweth and is submitted in **Appendix N** of the overall EIS document. The plan details proposed rehabilitation within areas of disturbance and the rehabilitation of buffer areas.

Areas within the buffer will be progressively rehabilitated. The purpose of the rehabilitation will be to improve the overall ecological condition and quality of habitat. Further several areas of targeted rehabilitation will be undertaken for the following purposes:

> **Riparian restoration.** Three target areas on alluvial soils have historically been cleared of trees and support variable, often sparse, regeneration of native species along with abundant weeds. The Mid catchment waterway is particularly degraded owing to activity of recreational 4WDs, dumping and the establishment of dense weeds. Portions of the waterways that are not damaged support many of the threatened plant species of Lot 105. Dedicated restoration in these areas provides an opportunity to enhance connectivity, enhance the microclimate for significant flora species, extend the range of significant flora species within the site, provide shade to the waterway, improve bank stability and enhance koala habitat. Given the level of degradation in places it will be necessary to rely on planting (ecological reconstruction) of the riparian fringe. Enhancement to koala habitat can be achieved outside of the riparian fringe through the establishment of koala feed trees. Care will be necessary to retain existing native species where they occur in these areas;

> **Fauna crossing at entry point.** This area will require planting of a navigable batter to facilitate nocturnal fauna movements over the proposed entry road. Additional supplementary planting is proposed between the proposed cutting and the adjacent forest where there has been historic disturbance. While planting will facilitate the movement of ground dwelling fauna it is probable trees will be too spaced to allow for the movement of gliders. It is therefore proposed that additional 'furniture' is installed in this location;

> **White-bellied sea-eagle buffer**. The proposed setback provided to the White-bellied sea-eagle nest limits views from the nest into the proposed pit and plant site. It may however be necessary to enhance the screening in the shrub and sub canopy layers through planting both uphill and to the east of the nest tree;

> **Former dam near quarry edge.** This area of approximately 3,600 m^2 is located close to the quarry rim and is likely to be drained as part of the quarry construction. If so, it is proposed that the area is replanted with koala food trees;

> ***Vegetation Management Act 1999* Offset.** Management of this area will not differ from the surrounding vegetation. There is however an expectation that there will be at least 1 weed treatment per year for the first 3 years of management.

> **Noise barrier screening.** A noise barrier is proposed that is 6m high and 150m long setback approximately 6m off the northern boundary. While existing vegetation in this area will aid in the screening of the barrier it is proposed that supplementary planting is included in a 2-4m band at the immediate edge of the property where there are existing gaps in vegetation along with a 2-3m wide planting immediately in front of the barrier.

Progressive rehabilitation of the quarry benches will be undertaken to assist primarily with mitigating potential visual amenity impacts. Rehabilitation within the disturbance footprint has several purposes associated with visual amenity, the provision of glossy-black cockatoo feed trees and other habitat, and improving slope stabilisation. Rehabilitation will follow quarry construction, beginning with the entry roadworks and following the progression of and stabilisation and revegetation (where appropriate) of fill batter slopes.

Rehabilitation within the disturbance footprint is further defined according to the permanence of the final landscape works. In the Establishment Stage, rehabilitation works associated with stabilisation of road verges and earthen dam bunds are effectively 'terminal'.

Rehabilitation within the disturbance footprint also includes the 'non-terminal' works. These are primarily concerned with temporary quarry bench screening by a variety of vegetative and non-vegetative methods. Explanations of the two classifications are as follows:

> Final (terminal) works. Final works will be undertaken in areas where there are terminal earthworks such as the access road batters, dam bund walls and final quarry benches.

> Interim (non-terminal) works. Interim works will be undertaken on non-terminal quarry benches and faces may require specialist contractors depending on the rehabilitation method selected.

Where there is significant visual exposure of non-terminal benches during the course of quarrying and construction (notably the benches created by the establishment of the ROM pad in Phase D4 and the progressive exposure of benches during construction phases C1-C2 and quarrying phases Q2-Q4), it is proposed that benches be progressively rehabilitated and exposure mitigated in a 'mosaic' pattern as determined by the pit development schedule. Although specific timeframes are not available at this early stage, it is anticipated that benches will be available for various rehabilitation for time periods during the course of quarrying activities.

Activity on most non-terminal benches will be limited to shortest possible timeline for active faces. Inactive faces on the same bench will be temporarily screened/softened utilising a combination of vegetative and non-vegetative techniques.

Using this progressive exposure and rehabilitation technique, a visual 'mosaic' will be created of rehabilitated benches of various ages. Continuous benches will therefore be 'interrupted' by vegetation and other screening techniques, while quarry pit development continues in selected locations (as may be determined by market demands and the resource extraction plan).

At the completion of quarrying, the quarry site will be decommissioned, plant dismantled and final rehabilitation planting/seeding will commence. Non-active parts of the quarry will be gradually rehabilitated during the preceding phases and particularly the more visually exposed benches. However the bulk of rehabilitation will occur after quarry phase Q4. As extraction rates are dependent on economic activities, a decommissioning date cannot be defined, however it is generally anticipated that the quarry will have a life of at least 40 years.

Overall, no specific post-decommissioning end use for the site has yet to be considered, due to the timelines involved. One key reason for this is that the planning parameters for the site and surrounding area that may exist in 40 years cannot be qualified or pre-empted at this point in time. The determination of an appropriate end use for Lot 105 would be dependent upon the application of the appropriate town planning ideals that are applicable at the relevant time.

It is acknowledged that the EIS does include a Lake Quality Management Plan that indicates a lake as an 'end use' for the proposed quarry pit. The nomination of this 'end use' is one means of utilising the quarry pit once the quarry operations cease. Again, the planning parameters relevant in 40 years may dictate another suitable 'use' for the quarry pit.

2.2.12 Decommissioning and End Use

At the completion of quarrying, the site will be decommissioned and the fixed plant will be dismantled and removed from the site. The means for the disposing of wastes and dismantling of the fixed plant will be dictated by the relevant environmental and legislative requirements that are in place in 40 years. These requirements cannot be qualified at this point time. It is noted that a similar process will be undertaken for the proponent's West Burleigh Quarry in 6.5 to 9 years, depending on market conditions. This process will be undertaken in accordance with the relevant legislative and environmental requirements, and may provide a valuable insight in how a similar process would be undertaken for the Gold Coast Quarry once quarrying activities cease.

Given that this is not anticipated to occur for at least 40 years, depending on market conditions, nomination of an end use for Lot 105 is premature at this point in time.

2.2.13 Lake Water Quality Management Plan

A Lake Water Quality Management Plan (LWQMP) has been prepared by Lambert & Rehbein and is submitted in **Appendix O** of the overall EIS document. It is noted that the ToR specified the requirement to prepare the LWQMP.

The LWQMP has been prepared in accordance with guidelines provided by the Queensland Department of Natural Resources and Mines. The guidelines used include guidelines for water storages and for mine pit lakes. It is noted be noted that the utilisation of the quarry pit as a lake at the completion of quarrying activities only represents one possible 'end use'. The town planning parameters in place in 40 years may afford other end use options for the subject site and in particular the quarry pit.

Approximately 14 years after operations cease, a quarry lake approximately 700 m long, 400 m wide and 90m deep with a volume of more than 9,000 mega litres will be likely to have formed in the quarry pit. The surface area of the full lake will be between 17 and 21 hectares and the lake will lie within a basin formed by the quarry rim, with a total catchment of 32 hectares.

The quarry pit will be allowed to fill with rainwater. Modelling predicts that the pit will take about 14 years to fill to overflowing. However the lake will rapidly increase in depth in the first few years and will rise to within about 20 m of overflowing within approximately 8 years.

Should the lake not meet water quality objectives, it will be necessary to conceptually model the lake to determine the source of the issue and whether there are any potential courses of action that could lead to improvement of water quality. Quantitative modelling of the physical and chemical behaviour of the lake could be undertaken as it is important to know the functional characteristics of the lake in detail when designing water quality improvement programs.

The management plan includes details relating to:

> Monitoring objectives;

> Monitoring locations and frequency; and

> Reporting.

It is to be noted that the utilisation of the pit for a lake only represents one potential end use that could be undertaken on Lot 105 once the quarrying operations have ultimately ceased.

2.3 Description of Site Features

2.3.1 Topography

The levels of Lot 105 range from between RL 10m AHD in the eastern portion of the property to approximately RL 150m AHD in the north-western portion of Lot 105. The plan in **Attachment E** describes the existing topography of Lot 105.

2.3.2 Geology

The geological assessment indicates that approximately 315 million years ago, near the end of the Carboniferous period, the deep-water sediments present in the area of Lot 105 were compressed and crumpled from a squeezing together of the crustal plates after subduction ceased. They were folded (crumpled) and slightly recrystallised (or metamorphosed) to form steeply inclined strata of meta-sedimentary rocks. Eventually, they were thrust up above sea level, probably to form high mountainous terrain. These formations, named the Neranleigh-Fernvale Beds, are now exposed on the site and form the high ridgeline to the immediate west of the Gold Coast.

The four main rock types of the Neranleigh–Fernvale beds are listed below. They are hard, chiefly meta-sedimentary rocks and greenstone which are now folded and generally steeply inclined:

> Argillite (hardened and slightly recrystallised mudstone or shale). Dark grey to black, very fine grained, bedding or banding commonly visible, grades into an inferior type of slate. Closely fractured in many exposures, gives shallow pale soils. Some slate has been used for decorative walls on the Gold Coast.

> Greywacke (hardened and slightly recrystallised coarse-grained sediment of mixed composition). Dark grey, hard, with grains of quartz and feldspar and fragments of other rocks. Large angular fragments of black shale from surrounding sediments common in places. Forms thick bands with few traces of individual beds and, where exposed, has a blocky appearance, gives shallow, pale, rocky soils. It is an important source of crushed rock aggregate for construction uses.

> Quartzite (recrystallised chert). White to light grey, in places pink, very hard and tough, very fine grained. Where black and little recrystallised, could still be called Chert. Banded in places, massively blocky in others. Closely fractured, gives a reddish soil. It has been worked in quarries for road gravels.

> Greenstone (recrystallised basaltic volcanic rocks). Greenish-grey, fine grained, blocky appearance in exposures with few traces of original flows. Gives chocolate soils on weathering.

Lot 105 is dominated by meta-greywacke of the Neranleigh-Fernvale Beds. This geological unit hosts the majority of extractive industry resources in the area. The principal rock types on the site are meta-greywacke and argillite and both rock types area variably exposed in subcrop and sporadic outcrop across the site. By volume, greywacke accounts for approximately 85-90% of the extractive resource on site.

2.3.3 Description of the Resource

The extent of measured, indicated and inferred quarry resource associated with the proposed quarry equates to 79 million tonnes (inclusive of the development of the plant and infrastructure area). The EIS has confirmed that the resource on Lot 105 is:

> hard;

> strong;

> durable;

> finely re-crystallised;

> non-porous;

> essentially unweathered;

> lightly altered;

> variable secondary mineral content ranging between 10 and 30%; and

> predicted to be suitable for use in most high specification quarry products including unbound pavement materials, asphalt and concrete aggregates.

The extraction rates for the material out of the pit will be entirely dictated by the market conditions. In any case, the plant has been designed to cater for a maximum extraction rate of 2 million tonnes of material per year.

2.3.4 Description of Vegetation and Environmental Features

The majority of the subject land is covered with vegetation much of which represents advanced regrowth. There are small cleared areas within the site that have resulted from recent land uses. The following table (**Table 2-5**) provides an overview of the vegetation and environmental features / values of the subject land:

Table 2-5 Overview of Results from Mapping and Field Investigations

Environmental Feature / Value	Comment
Important habitats of species listed under the Nature Conservation Act 1992 (NC Act) and/or the EPBC Act as presumed extinct, endangered, vulnerable or near threatened.	A total of 8 flora species and 2 fauna species were recorded on Lot 105 as being threatened. These recordings were confirmed as part of the on-site surveys. Feeding resource trees associated with glossy black cockatoos were discovered on Lot 105.

Environmental Feature / Value	Comment
Regional ecosystems listed as 'endangered' or 'of concern' or 'least concern' under state legislation, and/or ecosystems listed as presumed extinct, endangered or vulnerable under the EPBC Act.	Endangered and Least Concern regional ecosystems have been mapped on Lot 105. Lot 105 does not contain any ecosystems listed as presumed extinct, endangered or vulnerable under the EPBC Act.
Good representative examples of remnant regional ecosystems or regional ecosystems that are described as having 'medium' or 'low' representation in the protected area estate as defined in the Regional Ecosystem Description Database (REDD).	Lot 105 does contain remnant regional ecosystems that are of a 'low' representation.
Sites listed under international treaties such as Ramsar wetlands and World Heritage areas.	No Ramsar wetlands or World Heritage areas are associated with Lot 105.
Sites containing near threatened or bio-regionally significant species or essential, viable habitat for near threatened or bio-regionally significant species.	A total of 8 flora species and 2 fauna species were recorded on Lot 105 as being threatened. These recordings were confirmed as part of the on-site surveys.
Sites in, or adjacent to, areas containing important resting, feeding or breeding sites for migratory species of conservation concern listed under the Bonn Convention, and/or bilateral agreements between Australia and other countries.	Lot 105 is utilised as a nesting site for the migratory, EPBC listed white-bellied sea eagle. Lot 105 is not adjacent to any sites or areas containing important resting, feeding or breeding sites for migratory species.
Sites adjacent to nesting beaches, feeding, resting or calving areas of species of special interest, for example, marine turtles, dugong and cetaceans.	Lot 105 is not located adjacent to any nesting beaches, feeding, resting or calving areas for species such as marine turtles, dugong and cetaceans.
Sites containing common species that represent a distributional limit and are of scientific value or which contains feeding, breeding, resting areas for populations of echidna, koala, platypus and other species of special cultural significance.	Koalas are known to utilise Lot 105 for habitat / feeding purposes. Though not identified during field surveys, it is expected that the echidna would also exist on Lot 105.
Sites containing high biodiversity that are of a suitable size or with connectivity to corridors, including the Springbrook to Burleigh Heads bioregional corridor and to protected areas to ensure survival in the longer term; such land may contain:	Lot 105 is identified as being within the Burleigh Heads to Springbrook bioregional corridor. Approximately 70% of Lot 105 will be retained as a vegetated buffer. This area will be rehabilitated and restored to assist with maintaining the existing corridor values. This work will focus on the restoration of the watercourse area south and south-east of the disturbance footprint.
> Natural vegetation in good condition or other habitat in good condition (e.g. wetlands).	The largest patch of remnant 12.11.23 vegetation will be retained on Lot 105.
> Degraded vegetation or other habitats that still support high levels of biodiversity or act as an important corridor for maintaining high levels of biodiversity in the area.	Approximately 70% of Lot 105 will be retained as a vegetated buffer. This area will be rehabilitated and restored to assist with maintaining the existing corridor values.
A site containing other special ecological values, for example, high habitat diversity and areas of high endemism.	Other than Lot 105's inclusion in the Burleigh Heads to Springbrook bioregional corridor, the known threatened species and the white-bellied sea eagle's nest, Lot 105 does not contain any other special ecological values.
Ecosystems that provide important ecological functions such as:	
> Wetlands of national, state and regional significance.	No wetlands of national, state and regional significance are situated within the disturbance footprint on Lot 105. However, there are man-made dams that support habitats for aquatic flora and fauna. There are several State-mapped wetlands within approximately 2km of the project area.
> Riparian vegetation.	Areas of riparian vegetation exist along the watercourses identified

Environmental Feature / Value	Comment
	on Lot 105.
> Important buffer to a protected area.	Not applicable
> Important habitat corridor between areas.	Approximately 70% of Lot 105 will be retained as a vegetated buffer. This area will maintain habitat values for fauna.
Declared fish habitat areas and sites containing protected plants under the *Fisheries Act 1994*.	Lot 105 is not identified as being within a declared fish habitat area, nor does it contain protected plants under the *Fisheries Act 1994*.
Sites of palaeontologic significance, such as fossil sites.	There were no sites of palaeontologic significance discovered on Lot 105 as part of the completion of the Flora and Fauna Technical Report or the Aquatic Ecology Assessment.
Sites of geomorphological significance, such as lava tubes or karst.	The geological work that has been completed for Lot 105 identified no areas of geomorphological significance.
Protected areas that have been proclaimed under the NC Act and *Marine Parks Act 1982* or are under consideration for proclamation.	In terms of the *Marine Parks Act 1982*, there are no protected areas or areas under consideration for proclamation in relation to Lot 105. With respect to the NC Act, there are no proclaimed areas of protection in the vicinity of Lot 105.
Areas of major interest, or critical habitat declared under the NC Act or high nature conservation value areas or areas vulnerable to land degradation under the *Vegetation Management Act 1999 (VM Act)*.	No areas of major interest or critical habitat declared under the NC Act were discovered on Lot 105.
The marine environment and wetlands.	Lot 105 does not contain, nor is it adjacent to any marine environments. There are no wetlands within the disturbance footprint; however, there are man-made dams that support habitats for aquatic flora and fauna. There are several State-mapped wetlands within approximately 2 km of the project area
Wildlife breeding or roosting areas.	Lot 105 is utilised as a nesting site for the migratory, EPBC listed white-bellied sea eagle.
Any significant habitat or relevant bird flight paths for migratory species.	Lot 105 is known to be a nesting site for the migratory White-bellied sea eagle Other migratory fauna species that have been previously recorded on Lot 105.
Bat roosting and breeding caves, including existing structures such as audits and shafts.	No bat roosting and breeding caves were identified on Lot 105.
Habitat of threatened plants, animals and communities.	A total of 8 flora species and 2 fauna species were recorded on Lot 105 as being threatened. These recordings were confirmed as part of the on-site surveys.

2.4 Water Resources

2.4.1 Description of Waterways

Lot 105 is characterised by steeply undulating topography ranging between approximately 10 m AHD and 150 m AHD. There are three main catchments on Lot 105, including: the Northern Catchment which ultimately drains to a series of brackish lakes before discharging to the Nerang River; and the Mid and Southern Catchments which ultimately drain to Tallebudgera Creek. The Southern Catchment is not be impacted by the proposed disturbance footprint while direct and indirect impacts are expected to both the Northern and Mid Catchments.

Waterways occur in each of the three catchments on the site, all of which are typically dry, with flow only anticipated to occur during and following significant rainfall events.

The only sources of permanent water on site are a farm dam and an artificial perched lake, both of which are located in the Northern Catchment. The farm dam is the proposed location of the quarry water storage dam (which will be situated within the disturbance footprint).

Lot 105 contains a number of waterways. The distinction between a waterway and a watercourse, as that term is defined for the purposes of the *Water Act 2000*, is important in the context of the project and its regulatory framework. An assessment of all of the waterways on Lot 105 to determine the presence of defined watercourses was therefore undertaken by BMT WBM.

The assessment established that two (2) watercourses are present on Lot 105, as shown on **Figure 2-1** below:

> an ephemeral, third order stream that traverses the site to the south of the disturbance footprint (**southern watercourse**);

> an ephemeral, second-order stream that traverses the site downstream of the northern limit of the disturbance footprint (**north-eastern watercourse**).

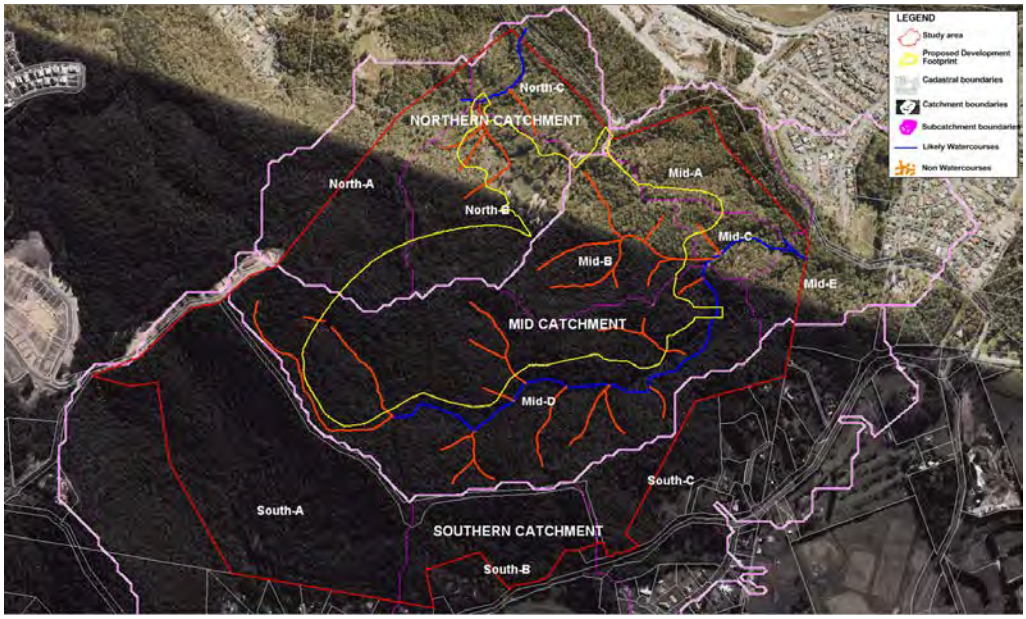

Figure 2-1 Watercourses (Source: BMT WBM, 2013)

The Department of Natural Resources and Mines (DNRM) has confirmed the findings of the Watercourse Determination report with respect to the watercourses that have been identified. The confirmation letter provided by DNRM is also contained in **Appendix DD** of the overall EIS document. The Watercourse Determination Report prepared by BMT WBM (**Appendix CC** of the overall EIS document) provides additional detail in respect of the two watercourses, and all of the other waterways, on Lot 105.

The disturbance footprint has been specifically designed and sited to preserve both the southern and north-eastern watercourses on Lot 105. The only points at which the disturbance footprint intersects with either watercourse are the discharge points to the respective watercourses.

2.4.2 Description of Groundwater

Aquifers

There are two broad aquifer systems that occur in the area surrounding the site:

> a fractured rock aquifer system of the Neranleigh-Fernvale Beds which extends under the entire site and is dominant in the surrounding area, consisting of an upper 10m to 20m weathered and open fracture zone (regolith) containing the prime groundwater resource, perched on fresh rock of very low permeability with a tight"\, sparse joint system.

> a restricted Quaternary alluvial system associated with the Tallebudgera Valley to the immediate south of the site.

The Neranleigh-Fernvale Beds can be described as an aquifer of very low to low permeability. This was confirmed by iron staining, indicating groundwater flow, on joints in the upper 10 metres to 20 metres and tight, non-stained joints, in the deeper fresher rock.

In summary it is concluded that the upper 10 metres to 20 metres weathered zone, where the fractures are open, has a hydraulic conductivity of about 2 x 10^{-6} m/s; the hydraulic conductivity decreasing from about 5 x 10^{-7} m/s to 5 x 10^{-8} m/s as the rock becomes fresher, harder and denser with depth. In plain terms, the groundwater in the upper 10 m to 20 m zone is essentially perched on the underlying fresh rock mass.

Further comments in relation to the above are provided in Section 10.2 of the Groundwater Impact Assessment contained in **Appendix FF** of the overall EIS document.

Groundwater Flow, Recharge and Discharge

The Groundwater Impact Assessment Report provides an overview of the groundwater recharge, flow and discharge characteristics relevant to Lot 105. Reference is to be made to Section 10.3 of the Groundwater Impact Assessment Report contained in **Appendix FF** of the overall EIS document.

The groundwater system identified within Lot 105 and the surrounding area depends primarily on rainfall for recharge. Based on anecdotal data from the West Burleigh Quarry, minor groundwater seepage is observed in the pit walls, generally after heavy rainfall and primarily in the upper 20m to 30m section, which includes the weathered zone and upper part of the fresher rock. However at depth, where the rock is fresh and the joints are tight, seepage is not observed.

The water table gradient is quite steep reflecting the low permeability of the rock mass and also that the regolith of the site is saturated after heavy rainfall. Groundwater in the regolith is essentially perched on the underlying fresh, very low permeability rock mass.

Groundwater flows from the ridge areas towards the creeks primarily through open fractures in the weathered material and along the interface with fresh rock. Groundwater discharge to the creeks (baseflow) maintains creek flow for some time. However, pools in the creek bed are reported to be ephemeral, indicating that the regolith drains reasonably quickly, as would be expected given the steep topography, and that discharge to the creeks and alluvium diminishes, and may stop, during drier periods.

2.4.3 Potential Impacts and Mitigation Measures – Surface Water / Stormwater

2.4.3.1 Surface Water / Stormwater

The potential impacts of the project were assessed using a risk assessment approach. Chapter 4 of the Water Resources and Floodplain Management report outlines the potential impacts of the project in respect of surface water and the mitigation measures which are proposed to ensure those impacts are avoided, minimised or managed.

The potential impacts of the project in relation to surface water fall into three categories:

> floodplain management impacts

> receiving water hydrologic impacts

> receiving water quality impacts

A project of this nature has the potential to adversely impact properties in the surrounding area by increasing the risk or impacts of flood events. Flood risk can be increased through changes to either the volume of surface water runoff generated at the site or the rate that surface water runoff leaves the site. The potential flood risk impacts of the project, together with the mitigation measures which are proposed to address and manage those impacts, are set out separately at Section 4.1.1. of the EIS.

Section 4.4 of the Water Resources and Floodplain Management Report outlines that surface water runoff from the proposed development has the potential to impact receiving waters downstream from the site. The

elements of the project which have the potential to generate adverse hydrologic or water quality impacts on receiving waters can be broadly categorised as:

> changes to the hydrologic characteristics of receiving waters, including:
  - the reduction of flows for all waterways downstream of the disturbance footprint within the Northern and Mid Catchments with the exception of waterways downstream of the quarry dam where flows are predicted to increase.
  - reductions in dry season flows downstream of the disturbance footprint, except immediately downstream of the sediment basin. With this reduction in flows, the duration of 'low flow spells' (i.e. when daily flow does not exceed the 50th percentile daily flow for the existing site) increases at these sites.
  - an increase in dry weather flows in waterways downstream of the sediment basin. The probability of low flow spells (relative to the existing case) will also decrease at these sites.
> vegetation clearing and mulching;
> earthworks associated with the construction of the plant site, access roads and quarry dam;
> earthworks including excavation and stockpiling of overburden and quarrying of rock;
> overflow or dewatering (controlled release) of the sediment basins and quarry dam;
> operation of the quarry and associated plant and equipment;
> potential wastewater overflows; and
> bushfire and vegetation management activities.

The Stormwater Quality, Hydrology and Water Cycle Management Plan presented at Appendix B to the Water Resources and Floodplain Management Report, together with Section 4.4. of the Water Resources and Floodplain Management Report, outline the mitigation measures which are proposed to address each of the potential hydrologic and water quality impacts on receiving waters. The potential impacts and mitigation measures are summarised below.

It is also to be noted that the hydrologic management principles have been incorporated into the design of the project. In particular, the project footprint has been configured to minimise the extent to which the project footprint extends into existing waterway areas.

The integrated approach to water management proposed for the project (and described in 4.1 of the Water Resources and Floodplain Management Report) also significantly reduces changes to downstream hydrology. In particular, the harvesting and use of stormwater from the quarry dam will significantly reduce the extent of flow increases that would otherwise be observed in the waterway discharging to the north-east of the project boundary. The harvesting of roof runoff from the site will (albeit to a lesser extent given the relatively small amount of roof area on the site) will also decrease changes to downstream hydrology (by retaining runoff from roof areas for small/frequent flow events that would be unlikely to produce runoff in the existing/undeveloped site).

Overall, the project has adopted a management hierarchy approach which promotes avoidance as the most preferred management option and disposal as the least preferred management option. The management measures determined in accordance with the hierarchy aim to reduce the risk of each potential impact to an acceptable level. A demonstrated commitment to best practice is evident in all aspects of the design and operation of the proposed development that relate to the management of water quality and quantity. A summary of the key management measures according to the management hierarchy (shown in Figure 4-1 of the technical report) and best practice philosophy is provided in Table 4-1 of the Water Resources and Floodplain Management report (replicated below in **Table 2-6**):

Table 2-6 Summary of Management Measures

Management Option	Description of Key Management Measures
Avoid	The proposed disturbance footprint has been designed so as to avoid approximately 155 ha (70%) of the site. This land is proposed to be voluntarily set aside, and not developed, as conservation area. Within this proposed conservation area, a range of offset rehabilitation activities are proposed to repair the land from historic agricultural use and damage from off road vehicles. The disturbance footprint also entirely avoids any impacts to one of the three catchments on the site.
Reduce	Existing sediment loads are proposed to be reduced by rehabilitating the degraded waterways and tracks within the conservation area. A range of rehabilitation activities are therefore proposed to repair the land from historic agricultural use and damage from off road vehicles. These rehabilitation activities may be subject to further licencing approvals under the Water Act unless the nature and extent of works determines them exempt. To reduce the volume of potential future sediment loads discharging from the site (and minimise flood risk), it is recommended that all vegetation and overburden removal is undertaken in accordance with the Erosion and Sediment Control Plan (ESCP) and, as far as practical, outside of the west season. Any disturbed areas which are not subject to extractive industry use should be stabilised in accordance with the ESCP, which has been prepared separate to this document (by others). The proposed disturbance footprint has been designed so as reduce the direct impact of the proposed disturbance footprint on waterways. Reference is to be made to **Appendix W** in order to view the Erosion and Sediment Control Plan that has been prepared by Lambert & Rehbein.
Recycle, Reuse, Recover	The proposed quarry has a high water demand. Rather than using potable mains water to meet that demand, a *recycle, reuse, recover* philosophy has been adopted. Modelling has indicated that all site water demands for surface dust control, dust suppression and process water are predicted to be satisfied by the proposed water cycle management strategy. That is, 100% site water demands are expected to be met by recovery and reuse of stormwater. Any runoff of this water from the quarry pit is recycled back to the quarry dam to be reused. Stormwater has therefore been treated as an important water resource rather than a waste steam.
Treat	The treatment of sediment loads is a critical component of the proposed water management strategy for the site. Sediment loads will primarily be treated via a best practice Erosion and Sediment Control Plan (ESCP) which will form part of the overall Environmental Management Plan (EMP). The treatment of sediment laden stormwater will by default also assist in the removal of a range of other potential pollutants. The water management strategy includes the following treatment measures: > Pit storage – providing significant opportunity for the storage of stormwater flows from the quarry catchment, allowing suspended material to be settled (prior to pumping retained waters to the quarry dam). > Quarry dam – providing a stormwater treatment function by allowing further settlement of suspended material and by harvesting stormwater flows (and pollutant loads) for subsequent use on site (e.g. for dust suppression). > Rock channels – conveying flows from the plant area and providing some pre-treatment of flows prior to discharging into the sediment basin. > Sediment basin – retaining stormwater flows to facilitate sediment removal, prior to discharging treated flows to the downstream waterway. > Additional soil erosion and sediment control best management practices. With the beneficial use of harvested flows (from the quarry dam catchment, and pumped flows from the quarry pit), stormwater pollutant loads within these harvested flows are prevented from discharging into downstream waterways thereby providing additional water treatment.
Dispose	Disposal has been adopted as the least-preferred method of water treatment as dictated by the management hierarchy adopted for the site. The only water proposed to be disposed of includes: > water which overtops the quarry dam during/ following major rainfall events. > water which overtops the sediment basin during/ following major rainfall events. > water which is treated in the sediment basin and control released. > environmental flows in waterways which will not be impacted by the proposed disturbance footprint. It is noted that due to the “avoid”, “reduce” and “reuse” strategies discussed in this table above,

Management Option	Description of Key Management Measures
	environmental flows are still maintained to the downstream receiving waterways so that there is not an over-use of water resources. Where water is disposed (e.g. over-topping of quarry dam and sediment basin during major rainfall events), some sediments and associated pollutants within this water will also be disposed (and conveyed downstream). Nevertheless, the quarry operations will still be required satisfy relevant discharge requirements.

The integrated approach to water management adopted by the project includes preparation and implementation of a Stormwater Quantity Management Plan and a Stormwater Quality, Hydrology and Water Cycle Management Plan (refer to **Appendix CC** of the EIS). The management plans have been prepared in accordance with the Gold Coast City Council's Land Development Guidelines and Water Sensitive Urban Design Guidelines, together with the Queensland Urban Drainage Manual, as appropriate.

Modelling has been undertaken as part of the EIS to assess the surface water pollutant loads that are predicted to leave the site under both the existing site conditions and the conditions of the proposed development.

The modelling assessed three phases of the project's development: Phase C1 of the Construction Stage and Phases Q1 and Q5 of the Quarrying Stage. These three phases were selected for detailed assessment as they are suitably representative of the project, illustrate the diverse range of conditions that will exist over the course of the project and represent worst case scenarios in terms of potential impacts.

The pollutant modelling focussed on total suspended solids (TSS) loads because:

> TSS is likely to be the key pollutant from the site in its existing state and with the proposed quarry operations;

> TSS is readily modelled using existing software packages;

> TSS can be readily monitored pre-development as well as during construction and operation; and

> TSS is important from both ecological and social perspectives in downstream receiving waterways.

The modelling indicates that, because the project will implement a Stormwater Quality, Hydrology and Water Cycle Management Plan and a Stormwater Quantity Management Plan, no adverse impacts on humans, flora or fauna as a result of sediment, acidity, salinity or other pollutants are likely to be generated by the project. In actual fact, the project is expected to decrease stormwater the pollutant loads discharging from Lot 105, thereby improving the quality of surface water from existing conditions.

Whist the potential for changes to the concentration of pollutants in downstream receiving waters is acknowledged, it is not considered necessary to include modelling of receiving water quality in the EIS given the expectation that stormwater pollutant loads will be reduced as a result of the project.

2.4.3.2 Monitoring Program

Section 5 of the Water Resources and Floodplain Management Report recommends the implementation of a detailed monitoring regime for water quality. The monitoring program for water quality that has been proposed which involves two phases:

1. Phase 1 - Predevelopment (baseline) water quality monitoring designed to characterise the baseline (or background) water quality conditions in the receiving waterways prior to commencement of development activities.
2. Phase 2 - Construction / operational phase water quality monitoring designed to assess the effectiveness of management strategies for protecting water resources during the construction/operation phase of the project (in accordance with the requirements of the TOR).

For each of these above described phases, the monitoring program describes the objective of each phase, identifies monitoring sites and details the proposed monitoring methodology. The following table (**Table 2-7**) summarises the recommended Phase 2 monitoring program:

Table 2-7 Phase 2 Monitoring Response Matrix

Aims	1. To assess the effectiveness of management strategies for protecting water resources. 2. Ensure that any non-compliance with respect to water quality is identified. 3. Inform timely, responsive management practices when non-compliance is detected.
Design Objective	1. To establish a relationship between TSS and turbidity so that immediate management decisions based on site-based turbidity readings (rather than laboratory TSS values), can be made (see Section 5.1.3.2 for a further discussion on this issue). 2. To ensure that controlled discharges from the quarry dam and sediment basin (not including overflows), meet minimum concentration-based discharge criteria (see Section 5.1.3.2 for further discussion on discharge criteria). 3. To identify the degree to which discharges to receiving waterways are responsible for receiving water quality values that are inconsistent with baseline conditions. 4. To inform appropriate flocculation rates. 5. To ensure monitoring is undertaken in accordance with correct protocols.
Pre-developed Condition	The pre-developed condition is to be established via a baseline monitoring program in accordance with the details provided in this monitoring plan.
Required Design, Maintenance and Construction Phase	> All erosion and sediment control systems are required to be designed, installed and maintained in accordance with a detailed Erosion and Sediment Control Plan (ESCP) and Staged Clearing Plan. > This ESCP is required to be prepared by a Certified Professional in Erosion and Sediment Control (CPESC). > The plan is to include detailed monitoring requirements including methodology and monitoring locations. > A suitably qualified person is to oversee all clearing/removal of topsoil and overburden. > Monitoring is undertaken as specified in the ESCP and in accordance with ongoing site instruction of the CPESC/delegated Boral representative.
Performance Indicators	> The level of total suspended solids in any stormwater discharged from the site during the construction phase does not exceed the objectives in > Table 2-6 or other more current best practice standards current at the time. > Clearing is undertaken only on the stage/stages being developed within the timeframes specified in the Staged Clearing Plan.
Corrective Actions	In the event of exceedance of the nominated trigger values in discharge from the site, the following corrective actions should be undertaken within 24 hours: > Inspect all relevant ESC measures within the catchment to determine where excessive sediment is being generated. > Erosion and sediment control practices are to be reviewed and corrective actions undertaken immediately in accordance with the recommendation of the person responsible. These actions may include for example: – Install additional ESC measures (e.g. additional filter fences, check dams in drainage lines etc.). – Increase the maintenance frequency of relevant ESC measures to maximise their effectiveness in trapping sediments (e.g. de-silt sediment basin more frequently to increase their effective capacity). > If required, undertake a program of flocculation of waters retained in sediment basin to settle out suspended sediments then dewater and remove accumulated sediment.

The program also identifies best practice water quality objectives for ensuring management strategies are effectively implemented. These strategies are described in Section 5.1 and Section 5.2 of the Water Resources and Floodplain Management report.

Section 5.3 of the technical report describes how the water quality monitoring regime is intended to be incorporated into the EMP. For the most part, the erosion and sediment control plan will describe how the key monitoring program recommendations will be incorporated into appropriate sections of the EMP. The Water Resources and Floodplain Management report does provide important advice to inform the erosion and sediment control measures thereby linking the monitoring program with the erosion and sediment control plan. It also provides recommendations for accounting for the link between changes in hydrology and potential impacts to downstream ecology.

The EMP prepared by Lambert & Rehbein is presented at **Appendix TT** of the EIS document. It is to be noted that the ToR required the preparation of a draft EMP. It is acknowledged that the EMP document as prepared for the EIS will evolve to reflect future conditions issued by SEWPaC various State agencies.

2.4.3.3 Residual Impacts

A best practice approach to water management has been adopted by the project. However, the following residual impacts to surface water hydrology are anticipated:

> increased volume and frequency of runoff and decreased baseflow, altering the hydrology of downstream waterways, impacting on waterway ecosystems and increasing erosion risk.

> changed hydrology of downstream areas, impacting on aquatic ecosystems and increasing erosion risk (in areas receiving more flows than existing).

As both of the residual impacts relate to downstream receiving waters, and not the project area itself, the mitigation proposed is to monitor downstream receiving waters. In the event that impacts are observed, additional mitigation and management actions are proposed and will be implemented in accordance with the Environmental Management Plan for the project.

Additional information is provided at Section 6 of the Water Resources and Floodplain Management Report contained in **Appendix CC** of the overall EIS document.

2.4.3.4 Hydrological Impacts

In order to ensure the protection of key ecological values, the locations for the hydrological assessments were based on discussions with the project environmental scientists and ecologists involved in the assessment of both the terrestrial and aquatic ecology.

To ensure that the most suitable locations were selected, all parties involved in the consultation had first undertaken site assessments and therefore possessed an appreciation of the site and its values. The eleven locations identified for the hydrological assessments are illustrated below:

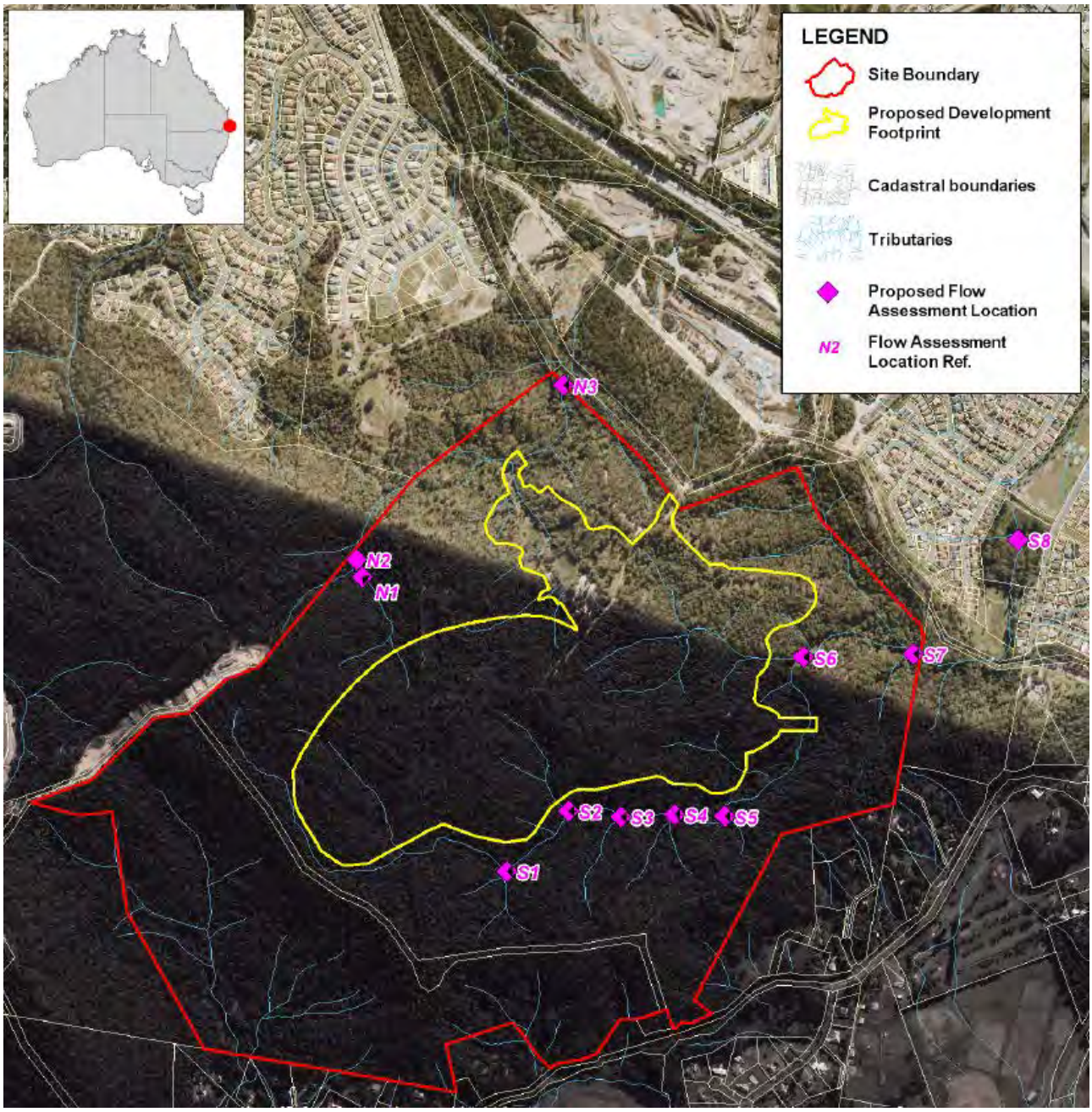

Figure 2-2 Locations for Hydrological Assessment (Source: BMT WBM, 2013)

The project is anticipated to reduce flows for almost all assessment locations (with the exception of site N3). With this reduction in flows, the duration of 'low flow spells' (i.e. when daily flow does not exceed the 50th percentile daily flow for the existing site) increases at these sites. This decrease in flows at these sites is due to the reduced catchment extent (associated with the project) draining to these locations.

The project is predicted to increase dry weather flows at Sites S6 to S8. The probability of low flow spells (relative to the existing case) will also decrease at these sites. These changes are due to the modifications in catchment conditions (e.g. reduced vegetation cover and soil permeability) upstream of these sites – and associated decreased rainfall and runoff interception, infiltration and evapotranspiration (and subsequently increased runoff rates) per unit area.

The increase in flows predicted at site N3 is due to the project effectively increasing the catchment area draining to this location – as the project involves runoff from the quarry pit area being pumped to the quarry dam (which overflows to the waterway and eventually N3). Under existing conditions, the majority of the quarry pit area drains towards the south (and not towards N3) and this area is also densely vegetated. The effective dam catchment (including the quarry pit area and land that will flow via gravity into the dam) also

has significantly reduced vegetation cover and soil permeability (relative to the existing site), which further increases flows to the dam.

Despite the increase in flows predicted at site N3, the dry season flow and low flow spell duration curves show a similar pattern between the existing site and stage Q5. This is likely because the increased flows associated with increased catchment extent being at least partially off-set by the reduced flows associated with water extraction from the quarry dam.

Reference is to be made to Section B.4 of Appendix B in the Water Resources and Floodplain Management Report.

2.4.3.5 Hydrological Impacts on Ecological Aspects

The Stormwater Quality, Hydrology and Water Cycle Management Plan contained in Appendix B of the Water Resources and Floodplain Management report provides a discussion on potential impact on ecological aspects as a result of changes in hydrology:

> The Flora and Fauna Technical Report confirms that the risk to terrestrial species associated with the predicted changes to hydrology is moderate or medium risk level. This report also recommends monitoring locations along the drainage lines that support threatened plant species.

> It will be necessary to monitor the health of vegetation at selected locations to ensure that there is no significant drying of vegetation. It will also be necessary to assess whether there is any scour or significant increase in adjacent soil moisture.

> In the instance where there is scour and an increase in soil moisture, then water releases from the sediment basin may need to be reduced. Mitigating drying may require providing water upstream (e.g. water from the quarry pit sump), but this might only be triggered if the ecological values are under stress due to quarrying activities and beyond natural fluctuations.

> The Aquatic Ecology Assessment states that the project is unlikely to impact on any listed vulnerable or endangered aquatic species or ecological communities, as listed under State or Commonwealth legislation, or habitats of conservational significance, if appropriate mitigation measures are put in place.

The Flora and Fauna Technical Report and the Aquatic Ecology Assessment also address this issue. These reports are submitted in **Appendix X** and **Appendix BB** respectively of the overall EIS document.

2.4.4 Potential Impacts and Mitigation Measures – Groundwater

The project is expected to have a minor impact on the regional groundwater system. Section 13.0 of the Groundwater Impact Assessment outlines the potential impacts on the groundwater regime as a result of the proposed quarry development (refer to **Appendix FF** of the overall EIS document). In summary, the potential impacts that are identified in the technical report include:

> **Impacts on existing bores and wells.**

The cone of depression in the water table is predicted will extend for up to 1.64km from the proposed quarry after 30-40 years. The closest registered bore is RN124068, located in the Gold Coast City Council sports field, approximately 0.8km to the south-east of the proposed quarry. The bore is shallow, low yielding and completed in the regolith which appears to form a perched aquifer on the fresh rock. The Groundwater Impact Assessment details that as drawdown from quarry dewatering will primarily be in the fresh rock there should be no or minimal impact on this particular bore.

The next closet bores are at the extremity of the radius of influence and should not be impacted as a result of the proposed quarry development.

> **Impacts on creeks and Groundwater Dependant Ecosystems (GDEs)**

The prime source of groundwater discharge to the creeks is from the regolith aquifer which will be removed over the area of the quarry footprint. Removal of the regolith and lowering of the water table in the rock mass due to dewatering of the quarry pit has the potential to impact ecosystems along the creeks, both flora and fauna that are partially dependent on groundwater discharge. The Groundwater Impact Assessment details that the flora and fauna impact assessment has found that *"none of the ecosystems present within the study area are identified as communities that are dependent on*

groundwater". It can therefore be concluded that the potential impact on GDE's is not an issue. Reference is to be made to the Flora and Fauna Technical Report for additional comments in relation to the flora and fauna communities investigated on Lot 105. This particular technical report is contained in **Appendix X** of the overall EIS.

During and post quarry operations groundwater discharge to the creeks will continue from the regolith in the catchments to the south, west and north of the disturbance footprint and therefore some groundwater discharge to the creeks should continue throughout and post quarry operations. In addition, pools in the creeks will continue to be maintained to some extent from surface runoff. It is therefore considered in the Groundwater Impact Assessment that although quarry operations will reduce groundwater discharge to the creeks, the pools and saturated alluvium will continue to exist, but as a result of the quarry operations may not last as long into the dry season. The potential for this is only within the predicted zone of influence, which is approximately 1.64 km around the pit.

As previously discussed in the EIS, the pools in the creeks are ephemeral and therefore should there be any unidentified ecosystems associated with the pools, they are likely to be only partially dependant on groundwater discharge and can survive during dry conditions.

Further to the above, and in response to the supplementary queries raised by the Coordinator-General's Office, the following has been noted with respect to GDEs:

> While vegetation fringing drainage lines is likely to 'use' groundwater resources owing to its proximity of the discharge point of water draining from the regolith, it is not dependant on this resource owing to its ephemerality and availability of other resources (i.e. soil moisture). The structure and floristic makeup of vegetation in the drainage lines are shaped by multiple biotic and abiotic inputs, not water alone. By definition, vegetation in the drainage lines are not groundwater dependant ecosystems (GDEs). On this basis assessment against Stages 2 and 3 of the Australian groundwater-dependent ecosystems toolbox (SKM, 2011) have not been conducted as Stage 1 concludes vegetation communities associated with the drainage lines are not GDEs.
>
> Downstream areas outside of the study area would be subject to the same unreliability of groundwater as those in the study area. Therefore it is unlikely these would be dependent on the surface expression of groundwater from the arising from the study area. Notwithstanding this, AGE had indicated that the regolith in the catchments to the south, west and north of the quarry footprint would continue to discharge to the drainage lines throughout and post quarry operations.
>
> There are no proposed mitigation measures for GDEs as no GDEs dependant on groundwater from the study area have been identified within or downstream of the study area. However, the EIS proposes to monitor the health of vegetation in the mid catchment waterway and provide mitigation only if required. Specifically the following is noted:
>
> > *Monitoring is fundamental to determining whether a mitigation response is required. Natural systems are dynamic. By way of example, the current study documented the natural attrition of threatened plant species within the Mid Catchment Waterway. It will therefore be necessary to undertake monitoring over time and take into account climatic conditions to ensure it accurately charts changes that can be attributed to the proposed development. The following monitoring actions are proposed for species within drainage lines and waterways along with the appropriate mitigation response.*
> >
> > - *Monitor the population of threatened species specifically within the Mid Catchment and Northern Catchment Waterways upon commencement of earthworks. Information attained prior to clearing will assist in establishing the baseline condition. Information collected will include the number of individual threatened trees, a description of the health and vigour of individual threatened trees, a count of the number of trees/shrubs on which the Ribbon root orchid occurs and an estimate of the overall Ribbon root orchid population.*
> > - *For threatened species in the Mid-catchment Waterway upstream of the proposed sediment pond and in the Northern catchment - if there is a decline in the health of trees or abundance of Ribbon root orchid over 5 successive years that can be attributed to quarrying activities (e.g. changes in hydrology) then implement the following mitigative steps (1) supplement flows in the waterway to mimic the pre-clearing state; (2) if Ribbon root orchid continues to decline translocate a limited number of specimens to the Southern Catchment waterway to establish a separate population.*

- *For threatened tree species in the Mid-catchment Waterway downstream of the proposed sediment pond - if there is a decline in the health of trees over 5 successive years that can be attributed to quarrying activities (e.g. changes in hydrology) then manage the volume of water received by the vegetation.*

The 'changes in hydrology' noted in the proposed monitoring refers to potential reductions in surface flows resulting from a change in the surface area of the catchment. The primary objective of the monitoring and the proposed adaptive management response is to ensure the health of threatened plant species' is maintained. Despite the possibility that there will be no impacts on threatened plant species because of the buffers provided and much of the catchment will be retained, a precautionary approach will be adopted whereby monitoring aims to detect and respond to declining health where it can be attributed to a change in hydrology. This approach is regarded as adequate because:

- there are no GDEs;
- the risk of impacts on the species is only regarded as medium;
- monitoring to be conducted during the life of the quarry targets threatened species and health will be measured against baseline (pre-quarry) conditions;
- there will be an achievable response if required to mimic pre-clearing conditions surface flow conditions; and
- there is a supplementary approach of translocating the ribbon root orchid to an unaffected drainage line within Boral's holdings that supports host species in similar densities to the mid catchment waterway.

> **Impact of Groundwater quality**

During the Quarrying Stage groundwater within the depression zone will flow to the pit and any water that collects within in-pit sumps will then be pumped into the surface water management system. The data collected at the site indicates that the groundwater in the deeper fractured rock aquifer is fresh to slightly brackish with low levels of selected trace metals. The presence of the trace metals is expected to be due to dissolution of minerals in the aquifer matrix and the metals are therefore naturally occurring. It is expected that little if any groundwater will be stored in on-site storages as, rather than collecting in sumps at the base of the pit, most groundwater inflow will be evaporated from the pit walls due to the predicted slow rate of seepage. In summary it is assessed that there will be no impact on groundwater quality.

> **Other Groundwater Users**

It is recommended that details of the GCCC bore located to the south of the site be collated prior to commencement of operations as this is the only bore that may be impacted, although as discussed, this is considered highly unlikely. Details and data obtained should include (but not necessarily be limited to) the status of the bore and it use, construction details, water level and a baseline water quality data set. The remaining existing groundwater bores within the predicted 1.64 km impact zone are at the extremity of the Q5 impact zone and are therefore unlikely to be impacted for an estimated 44 years. The impact in terms of drawdown, should it occur, would be minimal, that is within the natural range of groundwater fluctuation.

Section 15.0 of the Groundwater Impact Assessment confirms the groundwater management and monitoring measures that are proposed to be undertaken. These are detailed as follows:

> **Groundwater Management**

Based on anecdotal evidence from the West Burleigh Quarry and that the Neranleigh-Fernvale Beds are a very poor aquifer of low permeability and storage capacity, it is likely that there will be only minor groundwater seepage into the proposed quarry pit, most of which will be evaporated from the pit walls rather than collecting in the sump at the base of the pit. Management and storage of groundwater inflow during quarrying operations will therefore not be an issue.

> **Groundwater Monitoring**

A groundwater management and monitoring plan has not been designed as it is considered based on the studies undertaken that groundwater is not a significant resource on Lot 105 and immediate surrounding area on which groundwater users (human or GDEs) are dependent, and that the impacts of

the quarry on the groundwater regime are minimal. The potential for groundwater related environmental or social impact to occur as result from the development is therefore considered in the Groundwater Impact Assessment to be negligible.

3 Potential MNES

SEWPaC maintains the EPBC Protected Matters Search tool, which can be used to identify MNES that are predicted to occur in proximity to a selected locality based on habitat modelling. In order to identify EPBC-listed species and ecological communities that could be affected directly or indirectly as a consequence of the proposal, an EPBC Protected Matters Search for the Study Area was undertaken on 1 June 2012 (refer Attachment B). The search area was specified as a 6 km radius surrounding a central point within the Study Area, and the results are described as follows.

3.1 Potential Threatened Ecological Communities

The EPBC Protected Matters Search identified one threatened ecological community that may occur within the Study Area, namely, 'Lowland Rainforests of Subtropical Australia' that is listed as *Critically Endangered*. The key diagnostic characteristics of the listed community, as detailed in the Commonwealth conservation advice on Lowland Rainforest of Subtropical Australia (SEWPaC 2012a), are as follows.

> Distribution of the ecological community is primarily in the New South Wales North Coast and South Eastern Queensland bioregions, according to Interim Biogeographic Regionalisation for Australia version 6.1 (2004).

> The ecological community occurs on: soils derived from basalt or alluvium; or enriched rhyolitic soils; or basaltically enriched metasediments.

> The ecological community generally occurs at an altitude less than 300 m above sea level.

> The ecological community typically occurs in areas with high annual rainfall (>1300 mm).

> The ecological community is typically more than 2 km inland from the coast.

> The structure of the ecological community is typically a tall (20 m–30 m) closed forest, often with multiple canopy layers.

> Patches of the ecological community typically have high species richness (at least 30 woody species from a list of potential species specified in the listing advice).

> The ecological community must meet a range of condition and size criteria outlined in the listing advice.

It is relevant to note that this community was listed under the EPBC Act on 25 November 2011, such that the listing post-dates the decision on referral for the Gold Coast Quarry project (i.e. 21 December 2010). Nevertheless, the ecological survey sought to determine the presence of this ecological community within the Study Area, as discussed in subsequent sections of this report.

3.2 Potential Threatened Species

A total of 57 threatened species that have the potential to occur within the Study Area was identified by the EPBC Protected Matters Search. Descriptions of the distribution, ecology and habitat preferences of each threatened species identified by the EPBC search are provided as Attachment C parts 1 and 2. These descriptions are primarily sourced from SEWPaC's Species Profile and Threats (SPRAT) Database, with supplementary information sourced from additional references as cited.

Based on the known habitat requirements of species, the likelihood that a particular species utilises the habitats of the Study Area was subsequently assessed so as to more accurately determine species potentially affected by the proposal. The likelihood of occurrence assessment involved placement of each species into one of the following categories.

> **Known:** The species has been positively recorded by a qualified ecologist during past 30 years.

> **Likely:** Suitable habitat for the species is supported by the Study Area and proximate records exist.

> **Possible:** Suitable habitat for the species is supported by the Study Area, but no recent records from the Study Area or proximate areas exist.

> **Unlikely:** Suitable habitat for the species is not supported by the Study Area, and no recent records from the Study Area or proximate areas exist.

An index of confidence is applied to the assessment being:

> **High** – personal observations or records from other reputable sources (for example, 90% certainty);

> **Medium** – information from sources of reasonable/mixed reliability (location accuracy / taxa identification) (for example, 70% certainty); and

> **Low** – information from sources of unknown reliability (for example, 50% certainty).

The likelihood of occurrence assessment for each species is provided as part of Attachment C under the column titled "Predicted Likely Presence prior to survey".

Descriptive profiles for threatened species known to occur on site, together with those identified by SEWPaC's decision on referral notice, are provided as follows. Note that the known presence of EPBC-listed threatened species within the Study Area is discussed further in Section 4 herein, and potential impacts to these MNES are discussed in Section 6.

3.2.1 *Diploglottis campbellii* (Small-leaved Tamarind)

Diploglottis campbellii is listed as *Endangered* under the EPBC Act, and is also *Endangered* pursuant to the Queensland *Nature Conservation Act 1992* (NC Act).

Current Distribution

Diploglottis campbellii has been recorded from the coastal lowlands between the Richmond River in north-eastern New South Wales, to Mudgeeraba Creek in south-east Queensland. Within Queensland, this species is only known from the Moreton bioregion (Bostock and Holland 2010).

Habitat Requirements

Diploglottis campbellii is confined to warm subtropical rainforests, including forest types that vary from lowland subtropical rainforest to drier subtropical rainforest (NSW DEH 2012a). This species occurs on basalt-derived soils and also on poorer soils such as those derived from quartz monzonite (NSW DEH 2012a).

Description

Diploglottis campbellii is a large tree that grows to 30 m tall. It has greyish-brown bark with vertical cracks. Leaves are divided into four to eight leaflets, and new leaves are softly hairy at first. Small clusters of greenish-white flowers are borne amongst the leaves. The fruits are creamy-brown and usually three-lobed, with each seed surrounded by yellow or deep pink flesh.

Populations within the Study Area

Field surveys within the Study Area did not identify the presence of *D. campbellii*. Records from the Queensland Herbarium (2012) indicate that the closest herbarium record for *D. campbellii* is at Tallebudgera approximately 1.5 km south of the Study Area.

3.2.2 *Endiandra hayesii* (Rusty Rose Walnut)

Endiandra hayesii (Rusty Rose Walnut) is listed as *Vulnerable* under the EPBC Act, and is also *Vulnerable* pursuant to the NC Act.

Current Distribution

Endiandra hayesii is known from north-eastern NSW and south-eastern Queensland. Records of this species are clustered in the Border Ranges and Nightcap Ranges area, and at a few scattered near-coastal locations, with the Clarence River as the southern limit (Harden 1990). In Queensland, *E. hayesii* is reported to occur at Burleigh Heads, Tallebudgera and Springbrook National Park (Barry and Thomas 1994).

Habitat Requirements

Endiandra hayesii occurs on poorer soils derived from sedimentary, metamorphic, or acid volcanic rocks, in vegetation communities that include subtropical and warm temperate rainforests. The altitude varies from near sea level to 800 m.

Description

Endiandra hayesii is typically a small tree, although it can sometimes grow to 35 m in height. It has grey to grey-brown bark, which is smooth or slightly scaly. Leaves are dull and hairy leaves, and flowers are small, white to pale green, and are held in small clusters. The fruit are fleshy and are shiny purplish-black when ripe (Floyd 1989).

Populations within the Study Area

Field surveys within the Study Area did not identify the presence of *Endiandra hayesii*. Records from the Queensland Herbarium (2012) indicate that the closest herbarium record for *E. hayesii* is at Tallebudgera approximately 1.5 km south of the Study Area.

3.2.3 *Endiandra floydii* (Floyd's Walnut)

Endiandra floydii (Floyd's Walnut) is listed as *Endangered* under the EPBC Act.

Current Distribution

Endiandra floydii is known from NSW and south-eastern Queensland. The northern-most occurrence of this species is known from Pimpama, Queensland (Recovery Plan, 2004).

Habitat Requirements

Endiandra floydii occurs on soils derived from metamorphics, sometimes with basalt nearby, occasionally recorded from alluvium or sand. It is found in subtropical rainforest or wet sclerophyll forest, often with *Lophostemon confertus* or sometimes *with Araucaria cunninghamii*. The altitude varies from near sea level to 430 m.

Description

Endiandra floydii is a small to medium size tree. It has grey bark, which is sometimes fissured or flaky. Leaves are hairless, glossy dark green and slightly paler on the underside, New growth is distinctive pinkish/brown. Flowers are small, creamy to pale green, and are held in clusters in the leaf axils. The fruit are black, large and ellipse shaped with a maximum diameter of 30mm (SEWPaC, 2013a).

Populations within the Study Area

Field surveys within the Study Area did not identify the presence of *Endiandra floydii*.

3.2.4 *Gossia fragrantissima* (Sweet Myrtle)

Gossia fragrantissima (Sweet Myrtle) is listed as *Vulnerable* under the EPBC Act, and is *Least Concern* pursuant to the NC Act.

Current Distribution

Gossia fragrantissima is known to occur in south-east Queensland, and in north-eastern New South Wales south to the Richmond River. Within Queensland, all records of this species are from the Moreton bioregion (Bostock and Holland 2010).

Habitat Requirements

Gossia fragrantissima grows in dry subtropical and riverine rainforest, and is mostly found on basalt-derived soils (NSW DEH 2012b).

Description

Gossia fragrantissima is a shrub or small tree that grows up to 7 m in height. The bark is rough, brown and fissured, and young shoots are sparsely hairy. Leaves are broad-lanceolate to elliptic, with a glossy upper surface and glabrous lower surface. Flowers are small, white and fragrant, and fruit are yellow to orange.

Populations within the Study Area

Field surveys within the Study Area did not identify the presence of *G. fragrantissima*. Records from the Queensland Herbarium (2012) indicate that this species is not known to occur in the immediate vicinity of the Study Area. The closest herbarium record for *G. fragrantissima* is approximately 6 km south of the Study Area.

3.2.5 *Hicksbeachia pinnatifolia* (Monkey Nut)

Hicksbeachia pinnatifolia (Monkey Nut) is listed as *Vulnerable* under the EPBC Act, and is also *Vulnerable* pursuant to the NC Act.

Current Distribution

Hicksbeachia pinnatifolia occurs from Tamborine Mountain in south-east Queensland, to the Bellinger and Nambucca Valleys in north-east New South Wales (Floyd 1989).

Habitat Requirements

Hicksbeachia pinnatifolia occurs in and on the margins of subtropical rainforest, and sometimes extending into wet sclerophyll forest (Stanley and Ross 1986), from near sea level to 700 m altitude (Weston 1988).

Description

Hicksbeachia pinnatifolia is a small tree that grows up to 12 m high, usually with one or more unbranched stems arising from the rootstock (Floyd 1989). The adult leaves are pinnate, 34–90 cm long, and pinnae are leathery in texture and have wavy margins. Flowers are pungently fragrant and are aggregated in conflorescences, and sepals are maroon to cream while fruit are red. *Hicksbeachia pinnatifolia* flowers sporadically throughout the year, mostly from August to October.

Populations within the Study Area

Field surveys within the Study Area did not identify the presence of *H. pinnatifolia*. Records from the Queensland Herbarium (2012) indicate that this species is not known to occur in the immediate vicinity of the Study Area. The closest herbarium record for *H. pinnatifolia* is from Bilambil, approximately 11 km south of the Study Area.

3.2.6 *Marsdenia coronata* (Slender Milkvine)

At the time of the retrieving the Protected Matters Search the species *Marsdenia coronata* (Slender Milkvine) was listed as *Vulnerable* under the EPBC Act, and is also *Vulnerable* pursuant to the NC Act. As of the 15 May 2013 the species is no longer listed under the EPBC Act (SEWPaC, 2013b). As such the species is no longer addressed in this report. Notwithstanding this, the location of a single specimen recorded on site is illustrated in **Figure 1**.

3.2.7 *Syzygium hodgkinsoniae* (Smooth-barked Rose Apple)

Syzygium hodgkinsoniae (Smooth-barked Rose Apple) is listed as *Vulnerable* under the EPBC Act, and is also *Vulnerable* pursuant to the NC Act.

Current Distribution

Syzygium hodgkinsoniae is known to occur from the Richmond River in north-eastern New South Wales to Gympie in south-east Queensland, with a disjunct occurrence in north Queensland (Floyd 1989).

Habitat Requirements

Syzygium hodgkinsoniae inhabits riverine rainforest on rich alluvial or basaltic soils (SEWPaC 2012b).

Description

Syzygium hodgkinsoniae is a small tree that grows to a height of 11 m, and has a cylindrical or irregular habit. The leaves are dark green above, paler beneath, borne in opposite pairs and are oval to lance-shaped, with a short, blunt tip. The bark is dark brown and smooth. The flowers are white with a honey fragrance and the fruits are bright red and fleshy (Floyd 1989).

Populations within the Study Area

Field surveys within the Study Area did not identify the presence of *S. hodgkinsoniae*. Records from the Queensland Herbarium (2012) indicate that this species is not known to occur in the immediate vicinity of the Study Area. The closest herbarium record for *S. hodgkinsoniae* is from Mudgeeraba, approximately 7 km north-west of the Study Area.

3.2.8 *Syzygium moorei* (Durobby)

Syzygium moorei (Durobby) is listed as *Vulnerable* under the EPBC Act, and is also *Vulnerable* pursuant to the NC Act.

Current Distribution

Syzygium moorei is known to occur along sections of the Richmond, Brunswick and Tweed Rivers in north-eastern New South Wales, as well as at three sites in Upper Mudgeeraba Creek and Upper Tallebudgera Creek in south-east Queensland (Floyd 1989).

Habitat Requirements

Syzygium moorei inhabits warm, protected, fertile soils in riverine and gully rainforests at low altitudes (Floyd 1989).

Description

Syzygium moorei is a tree that grows up to 40 m in height and has a dense canopy. Leaves are thick, dark green and glossy, borne in opposite pairs and are oval to elliptical usually with a rounded tip. Bark varies in colour from red-brown to light or pink-grey, with soft papery scales. Flowers have pink to red stamens, which are clustered on older leafless branches and often on the trunk, and fruit are white and fleshy (Floyd 1989).

Populations within the Study Area

Syzygium moorei is known to occur within the Study Area, external to the proposed footprint. Gold Coast Botany originally recorded this species within and downstream from the Study Area in 2005. Subsequent surveys by Cardno Chenoweth in 2012 confirmed that a total of 8 *S. moorei* individuals are present within a waterway in the southern portion of the Study Area (refer **Figure 1**) including the individuals located immediately east (downstream) from the Study Area. No specimens are within the proposed disturbance footprint, the nearest specimen is located approximately 103m from the edge of the proposed disturbance footprint.

3.2.9 *Taeniophyllum muelleri* (Ribbon Orchid)

Taeniophyllum muelleri (Ribbon Orchid) is listed as *Vulnerable* under the EPBC Act, and is *Least Concern* pursuant to the NC Act.

Current Distribution

Taeniophyllum muelleri occurs in Queensland from Cape York Peninsula, south to the Wilson River in New South Wales.

Habitat Requirements

Taeniophyllum muelleri grows on shrubs and trees in rainforests, sheltered areas of open forests, humid gullies and streamside vegetation (Jones 2006).

Description

Taeniophyllum muelleri is a leafless epiphytic or lithophytic orchid that forms tangled colonies on trees or shrubs. Roots are thin, green, and round in cross-section, and leafless stems are 0.1 cm long (Jones 1994). Inflorescences are comprised of five to twelve yellowish-green flowers (Jones 1994).

Populations within the Study Area

Taeniophyllum muelleri was recorded in 2 drainage lines within the Study Area, with individual plants or colonies being located on 13 host plants (refer **Figure 1**). The populations are located external to the proposed disturbance footprint with the nearest specimens located approximately 50mfrom the edge of the proposed disturbance footprint.

3.3 Potential Migratory Species

The controlling provision under the EPBC Act that is relevant to the Gold Coast Quarry project was identified as sections 18 and 18A, namely, listed threatened species and communities. Listed migratory species were not triggered under the controlling provisions but have nonetheless been considered in this assessment in the interest of completeness.

Descriptions of the distribution, ecology and habitat preferences of each migratory species identified in the EPBC search are provided as Attachment C part 3 along with an assessment of their likely use of the Study Area.

Based on the above, ecological surveys targeted species that had potential to utilise the habitats of the Study Area. The known presence of EPBC-listed migratory species within the Study Area is discussed in Section 4, and potential impacts to MNES are discussed in Section 6.

It is known that a pair of White-bellied sea-eagles (*Haliaeetus leucogaster*) nest within the Study Area. The location of the nest tree is illustrated in **Figure 1**.

3.4 Potential Wetlands of International Importance

The EPBC Protected Matters Search indicated the presence of one wetland of international importance in close proximity to the Study Area, namely, the Moreton Bay Ramsar site. While not a controlling provision, consideration was given to this MNES. The Study Area mostly drains to the Tallebudgera Creek catchment which does not drain in to Moreton Bay and no part of the Study Area drains directly to the Ramsar site which is located approximately 20 km to the north. Studies by BMT WBM (refer to the Appendices of the EIA) indicate that "…*the project (and associated stormwater quality management strategy) will likely decrease stormwater pollutant loads discharging from the site (relative to the existing site)*". Accordingly, the proposal is highly unlikely to impact the Moreton Bay Ramsar site and therefore this MNES has not been considered further by this report.

4 Survey Methods

Detailed technical surveys were undertaken to determine the ecological values of the Study Area, including the presence or absence of EPBC-listed species and communities that had potential to use the habitats of the Study Area. The methods employed to assess fauna, flora and ecological communities were selected based on Commonwealth and/or State guidelines.

Flora and fauna field surveys were primarily conducted over two periods so as to encompass seasonal variation, namely, a winter/dry season during July/August 2012, and a summer/wet season survey during November/December 2012. Each survey event was undertaken by two ecologists. Additional site visits conducted in the intervening period provided an opportunity to collect further data.

4.1 Ecological Communities

Mapping and assessment of vegetation communities within the Study Area was undertaken in accordance with the Queensland Herbarium's method described by Neldner *et al.* (2005). Specifically, the survey included a combination of secondary (transect) and quaternary (rapid) level sampling procedures, as described below. This method enabled collection of data concerning the floristic structure and composition of vegetation communities so as to determine whether the Study Area supports any vegetation analogous to the EPBC-listed threatened community. The flora component of the field survey was undertaken over a 5 day period during each of the two survey events.

4.1.1 Secondary Sites

Secondary sites were used for classification and detailed descriptions of vegetation communities. Secondary sites consisted of a 50 m by 10 m plot located along the contour within vegetation communities that displayed homogeneity in terms of floristics, structure and age. On rare occasions, the plot was located across the contour in an endeavour to avoid areas where there was a change in the ecosystem. A Mobile Mapper GPS was used to record the geographical coordinates of the extent of each secondary site. In accordance with Neldner *et. al*. (2005), data collected within each secondary site included:

> identities of representative flora species present;

> median height of the ecologically dominant layer (using a hypsometer);

> percentage canopy cover (within an extension of the plot encompassing a total length of 100 m);

> basal area of woody stems (using the Bitterlich stick method); and

> abundance of all woody species in terms of stem counts.

A total of 11 secondary sites were assessed during the surveys.

4.1.2 Quaternary Sites

Quaternary sites were primarily used as a record of field traverses and to verify vegetation mapping, as well as to record the presence of flora species not captured through secondary site. The location of each quaternary site was recorded with a GPS, and data that was collected at each quaternary site included the identities of dominant canopy species and the median height of the ecologically dominant layer.

A total of 166 quaternary sites were assessed during the surveys.

4.2 Flora Species

Detailed floristic data for the Study Area was captured as part of the vegetation mapping process, as described above. Where potential habitat for a threatened flora species was encountered, targeted and thorough searches for the relevant species were undertaken.

Species were targeted on the basis of review of preferred habitat types and correlation of this with habitats mapped and encountered in the field. The Study area was slowly traversed for the purposes of an 'educated walk'[2] and searched for the presence of threatened species identified by data searches for which habitat potentially occurred on site. Particular attention was given to ecotones, moister areas and patches where dry vine scrub species occurred.

4.3 Fauna Species

Each of the two fauna trapping events involved survey over a five day / four night period. Four transects were established for the fauna survey, including two transects within the proposed footprint and two transects external to the proposed footprint. The precise localities of transects were selected so as encompass representation habitat types located in the Study Area. At each of the four transects, a variety of fauna survey techniques were undertaken and are described as follows.

4.3.1 Diurnal / Nocturnal Bird Searches

Dedicated bird watching was undertaken for 20 minutes per transect every morning at dawn chorus. Specifically, two observers walked along the length of transect and stopped for a period of 5 minutes at the beginning, centre and end of the transect. Birds species present during each period were detected through direct observation as well as calls. Identities of bird species that were opportunistically sighted or heard during other survey activities were also recorded.

Nocturnal birds were searched for as part of spotlighting and call playback activities.

For EPBC-listed threatened bird species that are expected to occur within the Study Area locality, further detailed survey was undertaken in accordance with SEWPaC's *Survey guidelines for Australia's threatened birds* (SEWPaC 2010a). In particular, survey for *Neochmia ruficauda ruficauda* (Star Finch (eastern)) was undertaken following the sighting of an individual during a site visit. The purpose was primarily to ascertain whether the individual was an aviary escapee or part of a larger population located outside of its known range. Specifically, the survey method followed SEWPaC guidelines including:

> *Area searches or transect-point surveys in suitable habitat, such as rank grasses in riparian areas with pandanus or corypha palm. Also check within flocks of other finches. Detection by calls and sighting. Targeted searches and subsequent watches of waterholes may also be useful in the dry season.*

4.3.2 Targeted Amphibian Surveys

For EPBC-listed threatened amphibian species that are expected to occur within the site locality, detailed survey was undertaken in accordance with SEWPaC's *Survey guidelines for Australia's threatened frogs* (SEWPaC 2010b). In particular, survey for the following species was undertaken as per the recommended methods that are reproduced as follows.

***Litoria olongburensis* (Wallum Sedge Frog)**

> Using a combination of spotlight surveys on foot and call detection. Accompanied by habitat assessment by appropriately experienced personnel.

***Mixophyes fleayi* (Fleay's Frog) and *Mixophyes iteratus* (Giant Barred Frog)**

> Spotlighting while walking transect along stream or creek. Most suitably in riparian rainforest and wet sclerophyll forest. Detection by larvae presence.

At the time of the seasonal surveys, ponds were scarce along gullies. Ponds that were present were assessed for frog activity during diurnal hours and spotlight surveys. A supplementary survey was undertaken following rains associated with ex-tropical cyclone Oswald on the 4/2/2013.

[2] Many ecological surveys refer to the 'random meander' technique documented by Cropper (1993) to describe the approach to flora surveys. A term that more aptly describes the technique utilised during surveys is an 'educated walk' (Garrard *et. al*., 2008). Species are targeted based on the known habitat requirements, a broad understanding of site topography, geology and other landscape features (e.g. waterways) and the experience / expertise of the surveyor.

4.3.3 Ground Searches

Ground searches were undertaken at each transect as part of morning and afternoon survey activities. This entailed the following:

> Active searches for cryptic fauna (such as reptiles) were undertaken including turning over logs, turning over rubbish piles, disturbing woodpiles, lifting loose bark on trees, investigating hollow logs and disturbing leaf litter;

> Tracks, scats, animal remains, movement pathways, feeding signs and any other traces of animal presence were recorded when observed. Where practical, scats and other traces were collected and sent to Barbara Triggs for further analysis; and

> Trees were closely observed for scratch marks, nests, hollows to determine their value as habitat and their frequency of usage.

Ground searches were not limited to transect lines and were undertaken opportunistically throughout the site.

4.3.4 Elliott Trapping

Four nights of Elliot trapping were undertaken during each of the two survey events. This involved placement of an Elliot trap at 10 m intervals along a 200 m transect, totalling 20 Elliot traps at each of the four transects. The Elliot traps that were used were B-size (33 cm x 10 cm x 8 cm). Traps were positioned in a secure and sheltered position, and were insulated by placing leaf litter on top of the trap. All traps were baited with a mixture of peanut butter, oats, honey and vanilla with five of the traps additionally baited with a piece of salami. The traps were checked each morning and the species identity of any captured individuals recorded. Traps were subsequently closed and re-opened again each afternoon.

4.3.5 Pitfall Trapping

Four nights of pitfall trapping were undertaken during each of the two survey events. At each of the four transects, the pitfall line consisted of four transects along which three 10 litre buckets or three 20 litre buckets were spaced at 3 to 7 m intervals. Leaf litter, sticks, wood debris was placed in the bottom of each bucket to provide cover or floating devices for any captured fauna, together with cotton wool to provide insulation for any captured fauna. Pitfall traps were checked daily in the morning, midday, early evening and during spotlighting. Traps were closed when inclement weather prevented the safe use of the traps.

4.3.6 Hair Funnel Trapping

At each of the four transects, ten hair funnels were places in trees and on the ground along the Elliott trap transects. The hair funnels were baited with a mixture of peanut butter, honey and oats. Hair funnels were left in situ over the five day / four night period of the survey, after which they were collected and inspected for animal hairs. Funnels containing hairs were submitted to a specialist consultancy (Barbara Triggs) for analysis.

4.3.7 Transect Spotlighting

Four nights of spotlighting was undertaken were undertaken during each of the two survey events. One hour of nightly spotlighting was undertaken by two observers at each of the four transects, making use of head-torches and a spotlight. Identities of fauna species detected through direct sighting or calls were recorded.

4.3.8 Call Playback

Following transect spotlighting, call playback was undertaken each night at one of transects. This involved broadcasting calls of the below-listed species for a period of three minutes, followed by a three minute listing period to detect any responses.

> Sugar Glider (*Petaurus breviceps*)

> Squirrel Glider (*Petaurus norfolcensis*)

> Yellow Bellied Glider (*Petaurus australis*)

> Koala (*Phascolarctos cinereus*)

> Powerful Owl (*Ninox strenua*)

> Barking Owl (*Ninox connivens*)

4.3.9 SM2BAT+ Bat Detection

Microchiropteran bat activity was assessed on trapping nights using a SM2BAT+ detection unit fitted with an ultrasonic microphone. A potential flyway was located in close proximity to one of the four transects, and the SM2BAT+ unit left to record bat activity for the duration of the night. The unit was retrieved each morning, and moved to a different transect for recording the following night. Recordings were sent to a bat echolocation specialist (Greg Ford) for analysis.

4.3.10 Camera Trap

Over the duration of each survey event, a motion-sensing camera trap was placed at various locations that had been selected on their potential to yield passing fauna. In order to attract fauna, the area in front of the camera was baited with meat or a mixture of peanut butter, oats, honey and vanilla.

4.3.11 Habitat Assessment

Habitat assessments were undertaken within each vegetation community type, and where changes in vegetation structure were noted. Habitat assessments were undertaken using a standard pro-forma so as to facilitate a robust and repeatable assessment of habitat values. At each habitat assessment location, habitat characteristics were assessed for a 20 m radius and included habitat integrity, structural diversity, fauna refuge availability (i.e. tree hollows) and waterway types.

5 Survey Results

Results of the ecological field surveys that were undertaken within the Study Area are provided below. Results of studies that have previously been undertaken within the Study Area were considered as part of this assessment. Note that further detail is provided in the flora and fauna technical report (refer to the Appendices of the EIS).

5.1 Ecological Communities

The field survey recorded four distinct vegetation community types within the Study Area, all of which were described to be open forests dominated by various Eucalypts. No vegetation communities within the Study Area were found to be analogous to any EPBC-listed threatened ecological community.

A plot survey was undertaken to assess the species composition within an area that supported rainforest species on alluvium. It was found that this area supported a predominance of sclerophyll species within the canopy.

An assessment was also undertaken to determine whether any of the prevailing vegetation associations represent Groundwater Dependant Ecosystems (GDEs). The Australian Groundwater-Dependant Ecosystems Toolbox (SKM, 2011) is composed of 2 parts:

> Part 1 – Assessment Framework; and

> Part 2 – Assessment Tools.

Section 3 of Part 1 outlines the hierarchical structure of groundwater-dependant ecosystem (GDE) assessments in three stages.

> **Stage 1** focus on gaining a baseline understanding of where potential GDEs exist, classification of ecosystem type and conceptualisation of the ecohydrogeologic setting.

> **Stage 2** assessments build on this information to characterise the likely reliance of the ecological asset on groundwater (e.g. describe timing of use of groundwater).

> **Stage 3** involves creating a detailed and quantified understanding of how the biotic state of GDEs can change as abiotic (e.g. groundwater) conditions change.

To determine whether any of the ecosystems of the Gold Coast Quarry site constitute a GDE an assessment was made against stage 1. The table below summarises the approach to Stage 1 as outlined in Part 1 of the Assessment Framework:

Stage 1

Question	Approach	Tools	
1.1 Where are the ecosystems that potentially use groundwater?	Conceptualisation and landscape analysis, site specific information	i. ii. iii.	T1 Landscape Mapping T2 Conceptual Modelling GDE Atlas
1.2 What is the broad type of GDE and functional grouping?	Comparison to standard guidelines and frameworks	i. ii. iii.	ANAE Classification GDE Atlas GDE Typology

We have structured our response to the questions by providing individual answers by applying each of the tools outlined in the right hand column of the table. However, this step-by-step analysis should not obscure the basic elements of the soil-water-plant system on this site i.e. that the hillsides have shallow regolith soils which hold little water and drain quickly, and the gullies are narrow with only seasonal flows.

Application of Stage 1 Tools

1.1 (i) Tool 1 'Landscape Mapping' can be applied through GIS approaches or Remote Sensing. Tool 1 largely assumes there is an understanding of which ecosystems in an area constitute GDEs or relies being

able to predict the presence of possible GDEs based on assessment of the landscape elements indicators (e.g. water table depth, geomorphology).

For the purpose of the EIS GIS mapping of vegetation and regional ecosystems was prepared at a scale of 1:10,000. Regional Ecosystem mapping requires inputs of geology (to define land zones) and vegetation (floristics determined from aerial image interpretation and ground truthing). This assessment indicated that most of the vegetation aligning the drainage line to the south of the proposed void is regrowth and those portions that are remnant are either:

> Regional Ecosystem 12.3.11 "*Eucalyptus siderophloia*, *E. tereticornis*, *Corymbia intermedia* open forest on alluvial plains usually near coast". The Regional Ecosystem Description Database (Queensland Herbarium, 2013) indicates that this ecosystem can contain palustrine wetlands (e.g. in swales), but no wetlands were identified during site surveys; or

> Regional Ecosystem 12.11.5a "Open forest of *Eucalyptus tindaliae*, *Eucalyptus carnea* +/- *Corymbia citriodora* subsp. *variegata*, *Eucalyptus crebra*, *Eucalyptus major*, *E. helidonica*, *Corymbia henryi*, *Angophora woodsiana*, *C. trachyphloia* …Occurs on Palaeozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics". The Regional Ecosystem Description Database (Queensland Herbarium, 2013) does not identify the presence of wetlands in this ecosystem. No wetlands were identified during site surveys.

The AGE study prepared as part of the EIS identified that the water table is located around 20m below the surface and is associated with the regolith (i.e. areas of metastediment that coincide with areas of 12.11.5a). The dominant structural elements of these ecosystems are the Eucalypts and Corymbias. The root systems of these genera are generally located in the top 0.5-1m of the soil profile (Jacobs, 1955), but can extend to water tables at depth e.g. approx. 3m (Flakiner *et. al.* 2006). However, given the depth of the water table and the normal shallow nature of eucalypt and corymbia root systems, areas of 12.11.5a of the study area cannot be GDEs. The AGE study also notes that the alluvial deposits are shallow and its associated water table drains quickly. So while ecosystem associated with alluvium (i.e. 12.3.11) is dominated by species that have root systems that are likely to intersect the alluvial water table, given its propensity to drain quickly the ecosystem cannot be regarded as dependant on this water source.

1.1 (ii) Tool 2 'Conceptual modelling' is a tool that relies on numerous inputs and can be presented as varying outputs. Some of the vegetation characteristic of drainage lines occurs in these localities owing to an interaction of abiotic and biotic factors. While groundwater discharging from the regolith (as described by AGE in the EIS) helps support this gully vegetation, it is not the sole contributor and at times may be entirely absent as an input. That is, the ecosystems are not dependant on groundwater and rely on water inputs from rain and drainage line flows as well as groundwater. Also, water is only one contributor to the structure and floral composition of vegetation within the drainage lines. Soils, topography, buffering of surrounding vegetation, absence of fire etc. are likely to play equal or greater role in the determining the structure and composition particularly given propensity for the regolith to rapidly drain.

1.1 (iii) The GDE Atlas mapping indicates that there are no GDE reliant on surface or subsurface expression of groundwater within the study area. Mapping of inflow dependant (ID) ecosystems illustrates that the site has a very low likelihood of supporting this type of ecosystem with much of the site regarded as "Unlikely to be ID". While the site falls into an area mapped as having ecosystems not analysed for "GDE, Subterranean (Cave & Aquifers)" site based studies undertake by AGE for the EIS indicate that:

> *"The groundwater system identified within the Project area and surrounds depends primarily on rainfall for recharge, with rainfall infiltrating the regolith, that is, the upper weathered zone."*

> *"..the groundwater in the regolith is essentially perched on the underlying fresh, very low permeability rock mass."*

> *"Groundwater flow is from the ridge areas towards the creeks primarily through open fractures in the weathered material and along the interface with the fresh rock. Groundwater discharge to the creeks (baseflow), maintains creek flow for some time, however pools in the creek bed are reported to be ephemeral, indicating that the regolith drains reasonably quickly, as would be expected given the steep topography, and that discharge to the creeks and alluvium diminishes and may stop during drier periods."*

> *"During and post quarry operations groundwater discharge to the creeks will continue from the regolith in the catchments to the south, west and north of the quarry footprint and therefore some groundwater discharge to the creeks should continue throughout and post quarry operations."*

The groundwater entering drainage lines is therefore episodic and unreliable for vegetation fringing these areas. That is, while some of the vegetation may utilise this resource there cannot be dependency on it owing to its ephemerality.

1.2 (i) The Aquatic Ecosystems Toolkit (Aquatic Ecosystems Task Group, 2012) is composed of four modules of which Module 2 is the 'Interim Australian National Aquatic Ecosystem (ANAE) Classification Framework'. The ANAE Framework (Aquatic Ecosystems Task Group, 2012) identifies aquifer systems as 'Unconsolidated aquifer', 'Porous sedimentary rock aquifers', 'Cave/Karst' or 'Fractured rock aquifers'. The metrics and thresholds provided in the framework are broad and imply that fractured rock aquifers can be regarded as an aquatic ecosystem even if the resident time for the water can be measured in minutes. Importantly, the module also provides a definition of a GDE which is consistent with the Australian groundwater-dependant ecosystems toolbox being:

> "*Natural ecosystems that require access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis so as to maintain their communities of plants and animals, ecological processes and ecosystem services*."

While vegetation of the study area's drainage lines are likely to utilise ground water draining through the regolith to meet some of their water requirements on an intermittent basis, they are unlikely to be dependent on it to the point where the water is necessary to "maintain their communities of plants and animals, ecological processes and ecosystem services". The presence of groundwater in the regolith is strongly linked to rainfall. When water resources are available from the regolith they are also likely to be available soil moisture (derived from rainfall and surface flows). Therefore, in order to maintain their current structure they are unlikely to "require" access to ground water.

1.2 (ii) as per 1.1 (iii) above.

1.2 (iii) The GDE typology identifies 3 types being '1. Aquifer and cave ecosystems', '2. Ecosystems dependant on the surface expression of groundwater' and '3. Ecosystems dependant on subsurface presence of groundwater'. Vegetation of the study area's drainage lines does not equate with the first 2 typologies, but might be considered under 3. However, the vegetation in these areas does not 'depend' on the water fully, seasonally or episodically. The presence of groundwater in the regolith is strongly linked to rainfall. When water resources are available from the regolith they are also likely to be from soil moisture (derived from rainfall and surface flows). There is likely to be little difference in the availability of water from soil moisture or groundwater and as such there is unlikely to be any time at which the vegetation is entirely dependent on groundwater to avoid impacts on its condition.

Therefore, while vegetation fringing drainage lines is likely to 'use' groundwater resources owing to its proximity of the discharge point of water draining from the regolith, it is not dependant on this resource owing to its ephemerality and availability of other resources (i.e. soil moisture). The structure and floristic makeup of vegetation is the drainage lines are shaped by multiple biotic and abiotic inputs, not water alone. By definition, vegetation in the drainage lines are not groundwater dependant ecosystems (GDEs). On this basis assessment against Stages 2 and 3 have not been conducted as Stage 1 concludes vegetation communities associated with the drainage lines are not GDEs.

Downstream areas outside of the study area would be subject to the same unreliability of groundwater as those in the study area. Therefore it is unlikely these would be dependent on the surface expression of groundwater from the arising from the study area. Notwithstanding this, AGE had indicated that the regolith in the catchments to the south, west and north of the quarry footprint would continue to discharge to the drainage lines throughout and post quarry operations.

5.2 Threatened Flora Species

Vegetation communities within the Study Area were comprised of a diverse suite of flora species, with a total of 348 flora species recorded over the duration of the study. Eight of these flora species are of conservation significance pursuant to the Queensland *Nature Conservation Act 1992*, including 2 *Vulnerable* species and 6 *Near Threatened* species.

Two flora species that constitute MNES were documented within the Study Area, namely *Syzygium moorei* (Durobby) and *Taeniophyllum muelleri* (Ribbon Orchid), all of which are *Vulnerable* species under the EPBC Act. All occur outside of the proposed disturbance footprint. Closest specimens of these threatened species occur between 50 – 103m from the edge of the proposed disturbance footprint.

No other EPBC Act threatened plant species are predicted to occur within the Study Area.

5.2.1 *Syzygium moorei* (Durobby)

Gold Coast Botany originally recorded *Syzygium moorei* within the Study Area in 2005. Subsequent surveys by Cardno Chenoweth in 2012 confirmed that a total of 8 *S. moorei* individuals are present within a waterway in the southern portion of the Study Area. A map identifying the location of *S. moorei* within and immediately adjacent to the Study Area is provided as **Figure 1**.

With regard to the regional context of this species, the field survey documented the presence of a small *S. moorei* population to the immediate east of the Study Area. This population is located within vegetation that is contiguous with that supported by the Study Area, as illustrated in **Figure 1**. Records from the Queensland Herbarium (2012) indicate that the closest herbarium record for this species is located approximately 900 m east of the Study Area, with further records from approximately 1.5 km south of the Study Area. The precise size and extent of *S. moorei* populations in the surrounding landscape is currently not known. However, the Commonwealth conservation advice on *S. moorei* notes that this species has been recorded from three sites in Queensland, with specific numbers of *S. moorei* individuals estimated to be 20 to 30 individuals at Upper Mudgeeraba Creek, 24 individuals in the gullies of Upper Mudgeeraba Creek, and 15 large paddock remnant trees (SEWPaC 2012c).

5.2.2 Taeniophyllum muelleri (Ribbon Orchid)

Taeniophyllum muelleri (Ribbon Orchid) was recorded in 2 drainage lines, with field surveys in 2012 identifying individuals on 13 host plants. This species was confined to a moist riparian gully within the Study Area. A map identifying the precise localities of *T. muelleri* site is provided as **Figure 1**.

Previous studies within the Study Area and surround have not documented the presence of *T. muelleri*. Furthermore, records from the Queensland Herbarium (2012) for a search area defined as 6km surrounding the Study Area did not identify the presence of *T. muelleri*. The Census of the Queensland Flora (Bostock and Holland 2010) identifies nine records for *T. muelleri* within the Moreton bioregion.

5.3 Threatened Fauna Species

The Study Area was found to support a diverse suite of fauna, with a total of 101 native fauna species recorded over the duration of the study. This included 69 bird species, 11 reptile species, 12 mammal species and 9 amphibian species.

Two species recorded fauna species within the Study Area are regarded as 'vulnerable' pursuant to the Queensland *Nature Conservation Act 1992* being the Koala (*Phascolarctos cinereus*) and the Glossy-black cockatoo (*Calyptorhynchus lathami*).

With regard to koala is relevant to note that this species was listed under the EPBC Act on 2 May 2012, such that the listing post-dates the decision on referral for the Gold Coast Quarry project (i.e. 21 December 2010).

One Grey-headed Flying-fox (*Pteropus poliocephalus*) was recorded feeding in the Study Area during the 2012 survey. This species is listed as *Vulnerable* under the EPBC Act. No roosting sites are mapped by the Queensland Parks and Wildlife in close proximity to the Study Area (DERM 2011).

Review of the habitat requirements of EPBC species identified in the Protected Matters Search (refer to **Attachment C, part 1**), confirmed that there is potential for the Threatened fauna listed in **Table 5-1** to occasionally utilise the habitats of the Study Area. Also tabulated is information about the abundance of the species in the Study area and current levels of protection/management afforded to the species.

Table 5-1 Threatened fauna predicted to utilise the habitats of the Study Area

Species	EPBC Status	Likely presence based on findings of survey	Population/ Abundance in the Study Area	Current Level of Protection and Requirements of Recovery/management plans
Birds				
Lathamus discolor Swift Parrot	E, Marine	Possible (Medium)	Unknown - Feeding resources are present within the Study Area. This species has been identified within 6km of the Study Area in Wildnet searches. It is more likely to be a transient than resident species.	Saunders and Tzaros (2011) have prepared the "National Recovery Plan for the Swift Parrot *Lathamus discolor*". Curtis *et. al.* (2012) also notes the following relevant management plans/actions relating to the species: > Department of the Environment and Heritage (2005) 'Threat abatement plan for beak and feather disease affecting endangered psittacine species'. Commonwealth of Australia, Canberra. > Garnett ST and Crowly GM (2000) 'The action plan for Australian birds 2000'. Environment Australian, Canberra. > Garnett ST, Szabo JK and Dutson G (2011) The Action plan for Australian Birds 2012. CSIRO publishing, Melbourne. > Threatened Species Scientific Committee (2001) 'Threat abatement plan for dieback caused by the Root-rot Fungus "*Phytophthora cinnamomi*". Commonwealth of Australia, Canberra. > Threatened Species Scientific Committee (2001) 'Key threatening process: Loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases. > Advice to Minister for the Environment and Heritage on Public nomination of Key Threatening Process under the Environment Protection and Biodiversity Conservation Act 1999'. Commonwealth of Australia, Canberra.
Anthochaera Phrygia (syn: *Xanthomyza phrygia*) Regent Honeyeater	E,MT	Possible (Medium)	Unknown - Feeding resources are present within the Study Area. It is more likely to be a transient than resident species.	Menkhorst (1999) prepared the Recovery Plan for the species. Curtis *et. al.* (2012) also notes the following relevant management plans/actions relating to the species: > Garnett ST and Crowly GM (2000)' The action plan for Australian birds 2000'. Environment Australia, Canberra. > Garnett ST, Szabo JK and Dutson G (2011) The Action Plan for Australian Birds 2010. CSIRO publishing, Melbourne. Curtis *et. al.* (2012) note there is a full-time Recovery Coordinator is employed and hosted by Birds Australia and that volunteer regional operations groups are operating at key locations implementing on-ground actions to protect and enhance containing 'significant habitat'.

* - E = Endangered; V = Vulnerable; MM = Migratory Marine; MT = Migratory Terrestrial; & MW = Migratory Wetland under the *Environmental Protection and Biodiversity Conservation Act 1999*

5.4 Migratory Species

5.4.1 Known Migratory Species - Overview

Tabulated below (**Table 5-2**) are the migratory species recorded within the Study area during the current survey and/or by DDW Fauna (2005) along information about the abundance of the species in the Study area and current levels of protection/management afforded to the species.

Table 5-2 Migratory species known to utilise the habitats of the Study Area

Species	EPBC Status	Population/ Abundance in the Study Area	Current Level of Protection and Requirements of Recovery/management plans
Haliaeetus leucogaster White-bellied sea-eagle	MT, Marine	A single nest recorded on site representing one of an estimated 13 breeding pairs from a 70km stretch of coastline (O'Donnell & Debus, 2012). Further discussion regarding the White-bellied sea-eagle follows,	While there are no National or Queensland based recovery plans for the species management recommendations have been made for Victorian and Tasmanian populations of this species (Threatened Species Section, 2006) including amongst other actions: > Increase the proportion and number of nests found prior to land development on all tenures, including, but not restricted to forestry operations and land clearance. > Reduce the proportion of nests subject to disturbance. > Identify human-induced causes of breeding failure and mitigate against such causes. > Increase breeding success. > Increase the number and/or density of active territories. > Development and apply protocols for effective eagle management during all land development. > Monitor the implementation and effectiveness of management prescriptions. > Implement prescriptive nest reserve for conserving nesting habitat. > Identify new threats and implement strategies for their, mitigation. > Reduce the occurrence of eagle mortalities and injuries (in number and proportion), > Protect known nesting sites, and suitable buffer zone around nests, from human and habitat disturbance on public land through appropriate land management practices.
Rhipidura rufifrons Rufous Fantail	MT, Marine	Unknown - Feeding resources are present within the Study Area. This species has been identified within 6km in Wildnet searches. It is more likely to be a transient than resident species.	There are currently no recovery/management plans for this species
Merops ornatus Rainbow Bee-eater	MT, Marine	While feeding and nesting resources are available in the Study Area it is anticipated that the overall population of the species is relatively low.	The Rainbow Bee-eater is currently considered to be a low priority for management. The population size and population trends have not been quantified, but the population size is assumed to be reasonably large, and there is little documented evidence of population declines. Further research is required to determine the population size and population trends, and to determine threats and their actual or potential impacts, before any management programs can be implemented meaningfully, (SEWPAC, 2012).
Monarcha melanopsis Black-faced Monarch	MT, Marine	While feeding and nesting resources are available in the Study Area it is anticipated that the overall population of the species is relatively low.	There are currently no recovery/management plans for this species

5.4.2 Known Migratory Species – White-bellied sea-eagle

The existence of the White-bellied sea-eagle (*Haliaeetus leucogaster*) nest was known from earlier studies by DDW Fauna (2005).

Observations of the nest site were scheduled for throughout the study period. Tabulated below (**Table 5-3**) are observations made at the nest site during and prior to the current study. Each observation period from 2010-2012 took between 15-30 minutes to complete.

Table 5-3 Observations of White-bellied sea-eagle nest

Date	Notes
2005	White-bellied sea eagle observed on nest by DDW Fauna
8/10/2010	Activity not observed at site.
21/6/2012	No activity recorded. A Currawong (*Strepera graculina*) was observed in and around the nest throughout the observation. Nest appeared to have less structure than observed in 2010.
23/7/2012	One adult White-bellied sea eagle present on nest. Remained on nest during observation. The structure of the nest had improved since the June 2012 observation.
24/7/2012	No individual present. Down observed below the nest.
25/7/2012	After 5min of observation the White-bellied sea eagle returned to the nest.
8/10/2012	No bird activity observed. A fragment of a Flying fox skull, abundant down and egg fragments identified as those of a White-bellied sea eagle were collected beneath the nest.
20/11/2012	Individual seen and heard in the proximity of the nest.
28/11/2012	No activity recorded.
4/2/2013	No activity recorded. While tree had lost branches as a consequence of ex-tropical cyclone Oswald the eagle's next remained intact.

Site observations confirmed the nest was in use in 2012 and that it is probable that young were fledged based on the presence of down, egg fragments and feeding signs beneath the nest. **Plate 1** illustrates a White-bellied sea eagle above the nest tree (**Plate 2**).

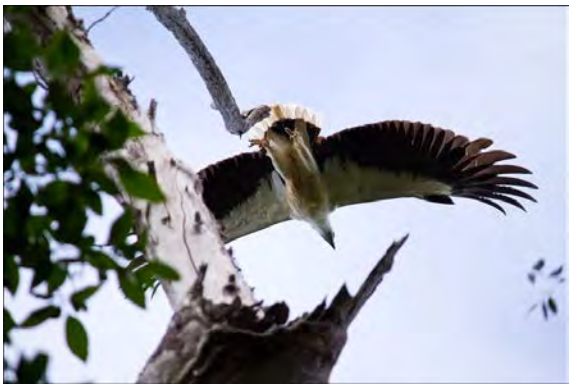

Plate 1: White-bellied sea-eagle

Plate 2: The White-bellied sea-eagle nest.

O'Donnell and Debus (2012) studied the nest characteristics of 10 known nests of 9 pairs of White-bellied sea-eagles in the Gold Coast and Tweed Coast area. **Figure 2** illustrates the approximate location of these 10 known locations in addition to 2 addition sites discussed in the paper. With the 2 additional nest sites it was speculated that there were 13 pairs in the region, but researchers acknowledged there may have been more given some areas had not been thoroughly surveyed. The research was conducted in 1998 and hence the results were 14 years old at the time of publication. Therefore it is unclear whether the regional population remains static.

Within their range breeding pairs often use several nests in rotation (Morcombe, 2004; DSEWPaC, 2012d), but frequently use the same nesting sites throughout their life (Dennis *et. al*., 2011). Given the correlation between breeding pairs and nests quantified in the O'Donnell and Debus study (2012), it is probable there is only one nest utilised by the individuals observed in the Study Area, but further studies would be necessary to support this assertion. Of the 10 known sites identified, the nest within the region, the nest within the current Study Area appears to be identified as "Tallebudgera Valley Ridges" (**Figure 2**).

The species lives for 15 -30 years, reaches breeding age at around 6 years (DSEWPaC, 2012d) and therefore potentially breed for 14-24 years. Nest sites have specific characteristics (Debus, 2008; O'Donnell and Debus, 2012; FPA, 2006; Emison & Bilney, 1982) relating to location in the landscape, location within a tree, size of tree, proximity of perch or outlook trees etc. Presumably, the selection of, and continued use of, a nest site relies on several of these characteristics aligning. Given the O'Donnell and Debus (2012) study identified the Tallebudgera Valley Ridges site as an active nest in 1998, then the breeding pair observed during the current study are either a different pair that have selected the site owing to its particular attributes or they are the same pair that are >14 years into their breeding life.

5.4.3 Predicted Migratory Species

Review of the habitat requirements of EPBC species identified in the Protected Matters Search (refer to **Attachment C, part 1**), also confirmed that there is potential for the Migratory fauna listed in **Table 5-3** to occasionally utilise the habitats of the Study Area. Also tabulated is information about the abundance of the species in the Study area and current levels of protection/management afforded to the species.

Table 5-4 Migratory fauna species that are predicted

Species	EPBC Status	Likely presence based on findings of survey	Population/ Abundance on the Study Area	Current Level of Protection and Requirements of Recovery/management plans
Birds				
Ardea alba White Egret	MM, MW	Likely (High)	Unknown - Feeding resources are present within the Study Area. It is more likely to be a transient than resident species.	There are currently no recovery/management plans for this species
Ardea ibis Cattle Egret	MM, MW, Marine	Likely (High)	Unknown - Feeding resources are present within the Study Area. This species has been identified within 6km in Wildnet searches. It is more likely to be a transient than resident species.	There are currently no recovery/management plans for this species
Lathamus discolor Swift Parrot	E, Marine	Possible (Medium)	Unknown - Feeding resources are present within the Study Area. This species has been identified within 6km in Wildnet searches. It is more likely to be a transient than resident species.	Saunders and Tzaros (2011) have prepared the "National Recovery Plan for the Swift Parrot *Lathamus discolor*". Curtis *et. al.* (2012) also notes the following relevant management plans/actions relating to the species: > Department of the Environment and Heritage (2005) 'Threat abatement plan for beak and feather disease affecting endangered psittacine species'. Commonwealth of Australia, Canberra. > Garnett ST and Crowly GM (2000) 'The action plan for Australian birds 2000'. Environment Australian, Canberra. > Garnett ST, Szabo JK and Dutson G (2011) The Action plan for Australian Birds 2012. CSIRO publishing, Melbourne. > Threatened Species Scientific Committee (2001) 'Threat abatement plan for dieback caused by the Root-rot Fungus "*Phytophthora cinnamomi*". Commonwealth of Australia, Canberra. > Threatened Species Scientific Committee (2001) 'Key threatening process: Loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases. > Advice to Minister for the Environment and Heritage on Public nomination of Key Threatening Process under the Environment Protection and Biodiversity Conservation Act 1999'. Commonwealth of Australia, Canberra.

Species	EPBC Status	Likely presence based on findings of survey	Population/ Abundance on the Study Area	Current Level of Protection and Requirements of Recovery/management plans
Hirundapus caudacutus White-throated Needletail	MT, Marine	Possible (High)	Unknown - Feeding resources are present within the Study Area. This species has been identified within 6km in Wildnet searches. It is more likely to be a transient than resident species.	Due to the limited nature of any threats to the species and its mobility, there are no threat abatement or recovery actions either underway or proposed, (SEWPAC, 2012)
Myiagra inquieta Restless Flycatcher	MT	Possible (High)	Unknown - Feeding resources are present within the Study Area. This species has been identified within 6km in Wildnet searches. It is more likely to be a transient than resident species.	There are currently no recovery/management plans for this species
Anthochaera Phrygia (syn: *Xanthomyza phrygia*) Regent Honeyeater	E,MT	Possible (Medium)	Unknown - Feeding resources are present within the Study Area. It is more likely to be a transient than resident species.	Menkhorst (1999) prepared the Recovery Plan for the species. Curtis *et. al.* (2012) also notes the following relevant management plans/actions relating to the species: > Garnett ST and Crowly GM (2000)' The action plan for Australian birds 2000'. Environment Australia, Canberra. > Garnett ST, Szabo JK and Dutson G (2011) The Action plan for Australian Birds 2010. CSIRO publishing, Melbourne. Curtis *et. al.* (2012) note there is a full-time Recovery Coordinator is employed and hosted by Birds Australia and that volunteer regional operations groups are operating at key locations implementing on-ground actions to protect and enhance containing 'significant habitat'.

* - E = Endangered; V = Vulnerable; MM = Migratory Marine; MT = Migratory Terrestrial; & MW = Migratory Wetland under the *Environmental Protection and Biodiversity Conservation Act 1999.*

6 Relevant Impacts to MNES

Impacts of the proposed action on environmental values of the Study Area were identified, including direct and indirect impacts in both the short- and long-term. These impacts are discussed as follows, noting that specific impacts to MNES are described in Section 6 herein, and adaptive management response strategies that avoid or reduce impacts are identified in Section 7.

6.1 Land Clearing

Land clearing is required in order to facilitate construction and operation of the quarry. While the disturbance footprint covers 65ha, only 63ha of this supports vegetation that will be cleared, which equates to 29% of the total area of the Study Area. The difference between the 65ha and the 63ha relates to the total area within the proposed disturbance footprint that is currently devoid of vegetation. That is, the 2ha difference accounts for existing cleared areas, tracks and farm dam surfaces. The total proposed disturbance footprint is identified on **Figure 1**.

Direct and indirect impacts associated with land clearing within the Study Area include the following.

6.1.1 Loss of Biodiversity

Land clearing within the Study Area has the potential to lead to a loss of biodiversity as a result of reduced habitat for native species in the locality. Specifically, land clearing will result in a direct loss of individual plants, together with displacement of a variety of fauna species that currently use the Study Area for feeding, resting and roosting. However, it is unlikely that the proposal will compromise the long-term persistence of biodiversity at a local or regional scale given the proposed buffer and adjacent areas of vegetation.

Clearing will not result in the direct loss on any EPBC Act threatened species of plant or animal identified during site surveys.

6.1.2 Habitat Fragmentation and Edge Effects

Land clearing has the potential to result in habitat fragmentation, with potential impacts including reduced population size, reduced habitat extent and increased habitat isolation. Furthermore, habitat fragmentation has the potential to increase edge effects associated with the boundary between retained vegetated habitats and cleared areas. Edge effects may include loss of soil moisture, increased wind, dust and noise impacts, changes to species composition and abundance, increased predation and competition, and increased weed invasion, thereby degrading habitat values.

The proposed impact area is located central to the site and hence vegetation will be retained within a continuous band of over 150ha of vegetation. The minor exception to this will be the existing fire trail network and proposed site access road. It is acknowledged that edge effects are likely to occur in association with the proposal, and appropriate environmental management will be necessary to reduce such impacts. It is not anticipated that edge effects will impact threatened species; Murcia (1995) found that most edge effects disappear at approximately 50m from the edge. The closest specimen to the edge of proposed clearing is a tree supporting *Taeniophyllum muelleri* which are separated by a distance of 50m of vegetation that will be subject to restoration.

6.1.3 Corridor Connectivity

Ecological corridors facilitate movement of species and maintenance of genetic diversity among populations. The Study Area is located within the Springbrook to Burleigh Heads bioregional corridor which has been mapped as a corridor of State significance (DERM, 2006).

While the proposed disturbance footprint results in the removal of 63ha of vegetation of variable integrity, a total of 152ha will be retained within the buffer area. Of the vegetation within the buffer, the127ha that is not remnant under PMAV will be subject of restoration. With the exception of areas proximate to the site entry, the footprint is located approximately 100-560m from the Subject Area boundary.

Movement opportunities remain within the proposed buffer for the species known or predicted to utilise the Study Area. Further, habitat types that are not otherwise represented in the proposed buffer will be lost from the Study Area. However, attention will be necessary at site entry where the proposed access road has the potential to reduce connectivity associated with the buffer.

6.1.4 Hydrological Impacts

The loss of vegetation on site has the potential to impact surface hydrology. In particular, land clearing has the potential to lead to an increased risk of erosion and sedimentation. In this regard, an erosion and sediment control plan for the project has been prepared in accordance with the *Soil Erosion and Sediment Control – Engineering Guidelines for Queensland* (Institution of Engineers Australia 1996), and is provided in **Appendix W** of the EIS.

6.2 Water Resources and Pollution

Section 2.4 of this report provides a full description of water resources, potential impacts on these and the mitigation measures to be employed to address any potential impacts. This section provides a targeted assessment of potential impacts on MNES.

6.2.1 Surface Water

A minor decrease in flows is anticipated downstream from the project as a result of the reduced catchment extent. Additionally, water consumption from the dam will occur during the construction and operational phases of the project, thereby potentially resulting in a reduction in flows discharged from the dam. Further details regarding the purpose and approximate volumes of water consumption is provided in the environmental flows assessment that has been prepared for the project by BMT WBM (refer to the **Appendix CC** of the EIS). Changes to environmental flows have the potential to impact ecological values that are supported by downstream riparian habitats, including EPBC-listed threatened species. While there will be changes in hydrology it is not anticipated that they will have a significant effect on riparian vegetation within the Study Area. This said, it will be necessary to monitor the health of threatened flora and mitigate if changes in species health are attributable to changes in hydrology.

6.2.2 Groundwater

Changes in surface and groundwater flows may adversely affect the available moisture to varying degrees throughout the life of the project. An assessment against the Australian Groundwater-Dependant Ecosystems Toolbox (SKM, 2011) confirmed there are no GDEs present within the site.

None of the ecosystems or EPBC Act scheduled flora species are dependent on groundwater for their survival (Hatton & Evans, 1998).

6.2.3 Water Quality

Construction and operation of the proposed quarry has the potential to impact water quality as a result of accidental or inappropriate release of contaminants or pollutants, as well as increased suspended sediment levels as a result of vegetation clearing and earthworks. The BMT WBM study (refer to Section 2.4 and the **Appendix CC** of the EIS) identifies that changes in stormwater quality will be mitigated to decrease pollutant loads that are discharged to waterways. The note that "…*the project (and associated stormwater quality management strategy) will likely decrease stormwater pollutant loads discharging from the site (relative to the existing site)*" .The stormwater quality management strategy is provided in the **Appendix CC** of the EIS.

Given the proposed management approaches it is not anticipated there will be indirect impacts on EPBC Act threatened flora or fauna within or external to the site.

6.3 Exotic Species

6.3.1 Weed Species

A number of weed species is known to occur within the Study Area. The project has the potential to increase weed abundance and facilitate weed dispersal. Specifically, construction traffic and bulk earthworks have the potential to disperse existing weed species into new areas of the Study Area as well as introduce new weed species, and ground disturbance associated with the project can create opportunities for establishment of weed infestations. In turn, increased weed abundance may have negative economic and social effects, as well as negative impacts on biodiversity through displacement of native flora species and reduced resources for native fauna species. Management of existing weeds through the recommendations of the Rehabilitation Plan is an important aspect of managing the risk to threatened EPBC Act flora species.

6.3.2 Feral Fauna

Feral fauna species are known to occur within the Study Area, and have the potential to increase in abundance as a result of the proposal. For example, project activities may create pathways that facilitate feral fauna dispersal, increase the availability of water, or provide additional food resources in the form of inappropriately managed project wastes. In turn, an increased abundance of feral fauna could lead to increased competition with and predation of native fauna, as well as increased habitat degradation. Implementation of environmental management measures will be necessary to ensure that the proposal will not lead to an increase in populations of feral fauna species.

6.4 Fauna Mortality

The project has the potential to result in injury or death of fauna as a result of factors such as inappropriate clearing methods, entrapment in excavations or the dam, vehicle strike, increased predation, or displacement and starvation as a result of vegetation clearance.

7 Impact Assessment for MNES

Project activities may potentially cause adverse impacts on MNES during the construction and operation of the project. The Australian Government has developed *Matters of National Environmental Significance Significant Impact Guidelines v1.1* (2009) to assist with determination regarding whether or not a proposed action will significantly impact an MNES. For each MNES known to occur within the Study Area, the significance of impacts was assessed against the relevant impact criteria prescribed by the guideline.

With regards to cumulative impacts, it is to be noted that the proponent and EIS project team are not aware of any other actions that have been taken, or are being taken, or that have been approved in the region, such that no cumulative impacts to MNES within the Study Area are anticipated. All known consequential impacts have been assessed. That is, known road upgrades associated with the entry to the site from Old Coach Road were included as part of the disturbance footprint. It is also noted that some road works will be required north of the site with respect to the access to the Pacific Motorway. All of these works will be contained in road reserve area and will therefore not impact on MNES. No other consequential impacts are proposed or are likely to occur. All works are within the proposed disturbance footprint, inclusive of the access intersection and associated works.

7.1 Threatened Ecological Communities

As the Study Area was thoroughly traversed during vegetation mapping surveys and no vegetation communities within the Study Area were found to be analogous to any EPBC-listed threatened ecological community, it can confidently be concluded that the proposal will not impact any threatened ecological community. Similarly there are no known EPBC-listed threatened ecological communities to occur in the immediate vicinity of the site as evident in vegetation mapping included as **Figure 3**.

7.2 Threatened Flora Species

7.2.1 ***Syzygium moorei* (Durobby)**

An assessment of the proposal against the *Matters of National Environmental Significance Significant Impact Guidelines v1.1* was undertaken for *S. moorei*. The assessment (below) indicated that the proposal will not have a significant impact on *S. moorei*.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

> **lead to a long-term decrease in the size of an important population of a species**

None of the 8 *S. moorei* individuals within and immediately adjacent to the Study Area will be removed as a consequence of the proposal. All gullies located within the proposed footprint were thoroughly searched for *S. moorei* and no individuals were found, such that it is unlikely that any unrecorded *S. moorei* individuals exist within the proposed footprint. While there is no clearing proposed of *S. moorei*, the altering of hydrological regimes has the potential to change the microclimate of waterways along which *S. moorei* grows. However, an environmental flows assessment by BMT WBM (refer to the **Appendix CC** of the EIS) indicated that such changes will be relatively minor and hence it is unlikely that the proposal will to modify the habitat to the extent that persistence of the *S. moorei* population may be impacted.

> **reduce the area of occupancy of an important population**

> The proposed footprint does not encompass the area occurrence of *S. moorei* within the Study Area, such that it can be concluded that the area of occupancy will not be reduced by the proposal.

> **fragment an existing important population into two or more populations**

Vegetation clearing associated with the proposal will not fragment *S. moorei* habitat.

> **adversely affect habitat critical to the survival of a species**

No critical habitat for *S. moorei* has been formally recognised.

> **disrupt the breeding cycle of an important population**

No factors that would likely impact the breeding cycle of *S. moorei* have been identified.

> **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

Syzygium moorei is dependent on moist habitats, such that alteration of environmental flows associated with construction and operation of the quarry has the potential to impact *S. moorei* through changes to the microhabitat. However, an environmental flows assessment that was prepared by BMT WBM (refer the **Appendix CC** of the EIS) indicated that changes will be minor and hence the proposal is not likely to modify or decrease the quality of *S. moorei* habitat. This said, it will be necessary to monitor the health of threatened flora and mitigate if changes in species health are attributable to changes in hydrology. Further analysis of this risk is provided in the risk assessment in Section 6.4 below.

> **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**

The proposal is not likely to result in establishment of invasive species. Implementation of weed management protocols and the Rehabilitation Plan (refer to the **Appendix N** of the EIS) will ensure that invasive species are not introduced or dispersed in association with project activities.

> **introduce disease that may cause the species to decline**

Myrtle Rust is known to occur on site. *Syzygium moorei* is included in the known hosts of this pathogen (DAFF 2012). Myrtle rust has been located within the Study Area immediately upstream of the *Syzygium moorei* population affecting a specimen of *Rhodamnia maideniana*. Accordingly, management measures should be implemented so as to ensure that Myrtle Rust is not spread as a result of the project. In particular, vehicle and equipment hygiene practises are to be implemented for movements proximate to the *Syzygium moorei* population, and regular monitoring is to be undertaken to ensure early detection of Myrtle Rust affecting the species.

> **interfere substantially with the recovery of the species**

The project will not interfere with the recovery of *S. moorei*.

7.2.2 Taeniophyllum muelleri (Ribbon Orchid)

An assessment of the proposal against the *Matters of National Environmental Significance Significant Impact Guidelines v1.1* was undertaken for *T. muelleri*. The assessment (below) indicated that the proposal will not have a significant impact on *T. muelleri*.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

> **lead to a long-term decrease in the size of an important population of a species**

All *T. muelleri* individuals that have been recorded within the Study Area are located external to the proposed footprint. All gullies located within the proposed footprint were thoroughly searched for *T. muelleri* and no individuals were found, such that it is unlikely that any unrecorded *T. muelleri* individuals exist within the proposed footprint. Therefore, it can confidently be concluded that no *T. muelleri* individuals will require removal in association with the project. While there is no clearing proposed of *T. muelleri*, the altering of hydrological regimes has the potential to change the microclimate of waterways along which *T. muelleri* grows. However, an environmental flows assessment by BMT WBM (refer to the **Appendix CC** of the EIS) indicated that such changes will be minor and hence it is unlikely that the proposal will to modify the habitat to the extent that persistence of the *T. muelleri* population may be impacted. This said, it will be necessary to monitor the health of threatened flora and mitigate if changes in species health are attributable to changes in hydrology.

> **reduce the area of occupancy of an important population**

> The proposed footprint does not encompass the area occurrence of *T. muelleri* within the Study Area, such that it can be concluded that the area of occupancy will not be reduced by the proposal.

> **fragment an existing important population into two or more populations**

Vegetation clearing associated with the proposal will not fragment *T. muelleri* habitat.

> **adversely affect habitat critical to the survival of a species**

No critical habitat for *T. muelleri* has been formally recognised.

> **disrupt the breeding cycle of an important population**

No factors that would likely impact the breeding cycle of *T. muelleri* have been identified.

> **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

Taeniophyllum muelleri is dependent on moist habitats, such that alteration of environmental flows associated with construction and operation of the quarry has the potential to impact *T. muelleri* through changes to the microhabitat. However, an environmental flows assessment that was prepared by BMT WBM (refer to the Appendices of the EIS) indicated that changes will be minor and hence the proposal is not likely to modify or decrease the quality of *T. muelleri* habitat. This said, it will be necessary to monitor the health of threatened flora and mitigate if changes in species health are attributable to changes in hydrology. Further analysis of this risk is provided in the risk assessment in Section 6.4 below.

> **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**

The proposal is not likely to result in establishment of invasive species. Implementation of weed management protocols and the Rehabilitation Plan (refer to the Appendices of the EIS) will ensure that invasive species are not introduced or dispersed in association with project activities.

> **introduce disease that may cause the species to decline**

The proposal is not likely to introduce a disease that may cause *T. muelleri* to decline.

> **interfere substantially with the recovery of the species**

The project will not interfere with the recovery of *T. muelleri*.

7.3 Threatened Fauna Species

No EPBC-listed threatened fauna species were recorded during the technical surveys within the Study Area, although potentially suitable habitat for the 2 species listed in **Table 4-1** was encountered. An assessment of the proposal against the *Matters of National Environmental Significance Significant Impact Guidelines v1.1* was undertaken for the group of threatened fauna species that may occur on site. The assessment indicated that the proposal is not likely to have a significant impact on threatened fauna species, and is provided as follows.

An action is likely to have a significant impact on a critically endangered, endangered or vulnerable species if there is a real chance or possibility that it will:

> **lead to a long-term decrease in the size of an important population of a species**

In terms of reduced available habitat, the proposed buffer and extensive tracts of native vegetation surround the Study Area provide habitat with characteristics similar to that proposed for removal, such that a decrease in the size of any threatened fauna species population is unlikely. With regard to direct fauna mortality, best practice environmental management measures will be implemented, specifically including sequential clearing practices.

> **reduce the area of occupancy of an important population**

The proposed buffer and extensive tracts of native vegetation surround the Study Area and provide habitat with characteristics similar to that proposed for removal. As such, the extent of clearing that is

required for the proposal is unlikely to reduce the area of occupancy of any threatened fauna populations as large areas of suitable habitat will persist in the local landscape.

> **fragment an existing important population into two or more populations**

Vegetation clearing associated with the proposal will not fragment populations of threatened species. Rather, habitat connectivity across the local landscape will be managed through the retention and management of the 152ha buffer that occupies 2/3 of the Study Area.

> **adversely affect habitat critical to the survival of a species**

No critical habitat for any EPBC-listed threatened species has been formally recognised within the Study Area.

> **disrupt the breeding cycle of an important population**

No factors that would likely impact the breeding cycle of any threatened fauna species have been identified in association with the proposal.

> **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

Extensive tracts of native vegetation surround the Study Area, and provide habitat with characteristics similar to that proposed for removal. As such, the extent of clearing that is required for the proposal is unlikely to result in the decline of any threatened fauna species as large areas of suitable habitat will persist in the local landscape.

> **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**

The proposal is not likely to result in establishment of invasive species. Implementation of weed management protocols and the Rehabilitation Plan (refer to the Appendices of the EIS) will ensure that invasive species are not introduced or dispersed in association with project activities.

> **introduce disease that may cause the species to decline**

The proposal is not likely to introduce a disease that may cause any threatened fauna species to decline.

> **interfere substantially with the recovery of the species**

The project will not interfere with the recovery of any threatened fauna species.

7.4 Migratory Species

The controlling provision under the EPBC Act that is relevant to the Gold Coast Quarry project was identified as sections 18 and 18A, namely, listed threatened species and communities. Listed migratory species were not triggered under the controlling provisions but have nonetheless been considered in this assessment in the interest of completeness.

Four EPBC-listed migratory species have been recorded within the Study Area (see **Table 4-2**), and it is possible that an additional six species may periodically utilise the habitats of the Study Area (see **Table 4-3**). An assessment of the proposal against the *Matters of National Environmental Significance Significant Impact Guidelines v1.1* was undertaken for the group of listed migratory species that may occur on site. Following is a targeted assessment of the White-bellied sea-eagle followed by a broader assessment for all other migratory species. The assessments indicate that the proposal will not have a significant impact on listed migratory species.

WHITE-BELLIED SEA-EAGLE

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

> **substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species**

To adequately assess this criterion it is first necessary to understand whether the Study Area constitutes 'important habitat'. An assessment of 'important habitat' follows:

- *a. habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species.*
  - > The habitat on site does not represent an ecologically significant proportion of the population of the species.
- *b. habitat that is of critical importance to the species at particular life-cycle stages.*
  - > The nesting tree is of critical importance to the species at a particular life-cycle stage.
- *c. habitat utilised by a migratory species which is at the limit of the species range.*
  - > The species is wide spread in coastal parts of Australia.
- *d. habitat within an area where the species is declining.*
  - > O'Donnell & Debus (2012) speculate that the population within the Tweed Coast and Gold Coast may be declining.

On the basis of this assessment the nesting tree represents important habitat. The nesting tree will remain intact and retained within the proposed buffer area under a covenant or similar protective mechanism – foraging and other roosting habitat are located outside of the study area. The tree is separated from the proposed development footprint by at least 30m horizontally and 30-40m vertically (see **Figure 4**). The area supporting the nest will not be substantially modified by altering fire regimes, nutrient cycles or hydrological cycles. Vistas from the nest into quarry operations will be minimal and distant (approx. 250m) (see **Figure 4**) and these views will be screened where possible. The tree will not be isolated from the balance of the White-bellied sea-eagle's habitat by the development proposal.

> **result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species**

The proposal will not result in the introduction of an invasive species that will be harmful to the important habitat of the species. Management of the buffer will reduce the extent of existing pest species on site.

> **seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.**

An 'ecologically significant proportion' of the population is defined as "*Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates)*." SEWPaC (2012) conservatively estimates the Australian population of White-bellied sea-eagle to be 500 breeding pairs, but acknowledges that this is likely to be an under estimate. By applying the conservative estimate, the breeding pair utilising the nest on site accounts for 0.2% of the national population, which does not represent an ecologically significant proportion. Hence, the proposal will not seriously disrupt the lifecycle of an ecologically significant proportion of the population.

OTHER MIGRATORY SPECIES

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

> **substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species**

The proposed buffer and extensive tracts of native vegetation surround the Study Area and provide habitat with characteristics similar to that proposed for removal. As such, any migratory species that inhabit the Study Area are unlikely to experience adverse impacts associated with habitat loss or modification as large areas of suitable habitat will persist in the local landscape.

> **result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species**

The proposal is not likely to result in establishment of invasive species. Implementation of weed management protocols and the Rehabilitation Plan (refer to the Appendices of the EIS) will ensure that invasive species are not introduced or dispersed in association with project activities.

> **seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.**

No factors that would likely impact the breeding cycle of migratory species have been identified in association with the proposal.

7.5 Risk Assessment for Scheduled Species

As outlined in Sections 7.2 and 7.3 there is little risk that scheduled flora or fauna species will be directly impacted by the proposal. Despite this, the proposal has the potential to indirectly impact some of the species known to occur within the Study Area.

7.5.1 Risk Assessment Matrix

A standard risk assessment matrix (**Table 7-1**) has been used for the purpose of assessing risks associated with the project.

Table 7-1 Risk Assessment Matrix

RISK MATRIX	CONSEQUENCES				
PROBABILITY	Catastrophic Irreversible Permanent (5)	Major Long Term (4)	Moderate Medium Term (3)	Minor Short Term Manageable (2)	Insignificant Manageable (1)
Almost Certain (5)	(25) Extreme	(20) Extreme	(15) High	(10) Medium	(5) Medium
Likely (4)	(20) Extreme	(16) High	(12) High	(8) Medium	(4) Low
Possible (3)	(15) High	(12) High	(9) Medium	(6) Medium	(3) Low
Unlikely (2)	(10) Medium	(8) Medium	(6) Medium	(4) Low	(2) Low
Rare (1)	(5) Medium	(4) Low	(3) Low	(2) Low	(1) Low

7.5.2 Risk Assessment for Threatened Flora Species

Table 7-2 below identifies potential indirect impacts on threatened plant species.

Table 7-2 Potential Impacts on Significant Flora Species

Impact	Prediction of impact *(Is the impact unknown or unpredictable? Is the impact positive? What is its magnitude? What is its extent? What is its duration? Is it reversible? How frequent is the impact?)*	Predicted Significance of impact (unmitigated)
a) Threatened species were not recorded during the survey	▪ Threatened species are primarily associated with the waterways and drainage lines.	Probability (1) x Consequences (1) = (1) Low
b) Changes to the microclimate that supports threatened species.	▪ Several threatened species occur along drainage lines within the study area. The Mid Catchment waterway and a drainage line within the North Catchment waterway, in part, drain from the proposed disturbance footprint and support threatened species. Species including Durobby (*Syzygium moorei*) in part present owing to the occurrence of alluvial soils and the sheltered nature of the waterway. Jones (2006) noted the Ribbon root orchid (*Taeniophyllum muelleri*) grows as	Probability (3) x Consequences (3) = (9) Medium

Impact	Prediction of impact *(Is the impact unknown or unpredictable? Is the impact positive? What is its magnitude? What is its extent? What is its duration? Is it reversible? How frequent is the impact?)*	Predicted Significance of impact (unmitigated)
	single plants or colonies on shrubs and trees in rainforest, sheltered areas of open forest, humid gullies and stream side vegetation. The microclimate in these gullies that creates the conditions that facilitates the growth of epiphytic species(e.g. humidity and reduced light penetration) is the result of a complicated interaction of abiotic factors including topography, surface and groundwater flows, evaporation (Catterall *et. al*., 2007) and aspect (Specht & Specht, 1999) with biotic factors such as evapotranspiration (Catterall *et. al*., 2007) and reduced light resulting from dense vegetative growth (Catterall *et. al*., 2008). The proposed development will not change the alluvial soils, topography, aspect and sheltered nature of these gullies owing to the provision of a minimum 30m setback. However, changes in surface and groundwater flows may adversely affect the available moisture to varying degrees throughout the life of the project. Work by BMT WBM indicates that changes to surface flows to the North Catchment will be minimal, but changes to the Mid Catchment waterway will be greater with reduced flows upstream of the proposed sediment basin and potentially higher flows downstream. AGE Groundwater & Environmental also note that over time, inputs from groundwater discharge will be reduced. ▪ Proposed significant restoration and exclusion of 4wd access to the Mid-catchment Waterway will result in a positive change to the microclimate.	
c) Dust resulting from construction and operational activities.	▪ Dust has the potential to affect plant species, and more specifically threatened flora during construction periods and long periods without rain. The level of dust resulting from traffic movement and other quarrying activities has been calculated by Katestone Environmental and found to be negligible for the areas where threatened plant species have been recorded.	Probability (3) x Consequences (1) = (3) Low
d) Introduction of new weeds or pathogens in construction materials and planting stock or through vehicle movements OR spread or existing weeds/pathogens	▪ Weed seed can be carried in construction materials such as sand, soil and mulch. Depending on the nature of an introduced weed species, the impact can be unpredictable and potentially difficult to reverse if left unmanaged. ▪ Existing weeds can be inadvertently spread through unhygienic vehicle practices. ▪ Pathogens such as *Phytophora* and myrtle rust can be introduced in soils and planting stock. The negative impact of such pathogens would be difficult to reverse.	Probability (3) + Consequences (4) = (12) High

Impact	Prediction of impact *(Is the impact unknown or unpredictable? Is the impact positive? What is its magnitude? What is its extent? What is its duration? Is it reversible? How frequent is the impact?)*	Predicted Significance of impact (unmitigated)
	▪ Existing myrtle rust within the Study Area has the potential to spread to other species within the Myrtaceae including the Durobby (*Syzygium moorei*).	
e) Uncontrolled public access to remnant vegetation	▪ Uncontrolled access has the potential to impact threatened plant species through direct destruction (e.g. cutting, driven over) or indirect (e.g. triggering erosion). The impact during operation will be limited to small areas and likely reversible.	Probability (2) x Consequences (2) = (4) Low
f) Inappropriate burning regimes	▪ Inappropriate burning regimes have the potential to affect the significant species. However, most threatened plant species occur along drainage lines that are less prone to fire damage. ▪ The development proposal is unlikely to exacerbate the current impact, but can provide an opportunity to improve fire management.	Probability (2) x Consequences (2) = (4) Medium
g) Over clearing	▪ Clearing may encroach on areas to be retained.	Probability (3) x Consequences (3) = (9) Medium

7.5.3 Risk Assessment for the White-bellied sea-eagle

Table 7-3 below identifies potential indirect impacts the White-bellied sea-eagle.

Table 7-3 Potential Impacts on the White-bellied sea-eagle

Impact	Prediction of impact *(Is the impact unknown or unpredictable? Is the impact positive? What is its magnitude? What is its extent? What is its duration? Is it reversible? How frequent is the impact?)*	Predicted Significance of impact (unmitigated)
Construction and operation impacts the nesting of White-bellied sea eagles	White-bellied sea eagles are known to be sensitive to disturbance in the vicinity of their nesting sites (So & Lee, 2010; FPA, 2006). Dennis *et. al*. (2011) recommends buffer widths of up to 2km from nesting sites, a study conducted on behalf of Gold Cost City Council (Ecosure, 2008) recommended buffers of 500m from a nest site, 360-1,000m are recommended by the FPA (2006) and O'Donnell and Debus (2012) noted nests occurring no closer than 220m from human habitation (although one nest was 12m from a river's edge near that was frequented by boats and fisherman). Despite these examples there are some rare instances where this usually shy species has tolerated disturbance proximate to nest sites. In Townsville, a nest that was relocated by removing the crown of the tree in which it occurred 100m away onto a timber pole near a creek and within 20m of a warehouse carpark continued to be used for at least 6 years (Ezzy, 2010; Ecosure, 2008). So & Lee (2010) recorded a nest 10-15m above an area subject to heavy sea traffic, although the breeding pair had not successfully fledged young, most probably owing to foraging limitations. The characteristics of the nesting tree or location may also play a role in breeding success. O'Donnell and	Probability (4) x Consequences (3) = (12) High

Impact	Prediction of impact *(Is the impact unknown or unpredictable? Is the impact positive? What is its magnitude? What is its extent? What is its duration? Is it reversible? How frequent is the impact?)*	Predicted Significance of impact (unmitigated)
	Debus (2012) identified that nests tend to be located in large (1 - 2.1m Diameter at Breast Height) trees with full canopies or with some crown dieback. They also note that there is evidence that dead trees are often abandoned as nesting sites and live trees provide some shade for nestlings. However, dead trees are also known to be successfully used (So & Lee, 2010). Based on the knowledge that the species is sensitive to human disturbance the proposed disturbance footprint was remodeled to increase the setback from the known nest site. A horizontal distance of over 30m will be provided between the nest tree and the edge of disturbance in which a vegetated buffer will be retained. At the edge of disturbance a cut will ensure vehicle movements are set approximately 20-25m below the current natural ground level. Based on the maximum nesting height defined in O'Donnell and Debus (2012) of 23m the viewshed from the nest was determined. Figure 4 illustrates that from this location there are no direct views into the proposed disturbance footprint. Construction activity within 30m of the active nesting site is almost certain to disturb White-bellied sea-eagles. The impacts of quarry operations on nesting White-bellied Sea-eagles are uncertain, however it is known that post construction views of adjacent disturbance will be both limited and distant owing to the design measures, topography and existing vegetation.	

8 Avoidance and Mitigation of Impacts

8.1 Avoidance and Reduction of Impacts

The project seeks to avoid direct impacts on EPBC scheduled flora species. Specifically, the proposed footprint does not encompass:

> drainage lines and waterways that support *S. moorei* or *T. muelleri*; and

> the nest site of the White-bellied sea-eagle.

However, it is acknowledged that these MNES may be indirectly impacted by the proposal. Section 8.2 also addresses mitigation measures for indirect impacts.

8.2 Mitigation Measures

8.2.1 Specific Mitigation Measures for Threatened Flora

Specific mitigation measures for flora species are tabulated below (**Table 8-1**). The purpose of monitoring is not only to measure the success of mitigation measures, but also to facilitate an adaptive management approach whereby there is continued improved in the approaches utilised to mitigate impacts:

Table 8-1 Mitigation of Impacts on Flora Species

Potential Impact	Mitigation Measure	Efficacy of Mitigation Measure	Monitoring	Significance of Impact (unmitigated)	Significance of Residual (mitigated) Impact
a) Threatened species were not recorded during the survey	The following mitigation measures are proposed: ▪ If located on site the species is to be translocated to an equivalent location within the buffer area.	▪ Given the thoroughness of the site survey there is a high degree of confidence that all specimens have been located and avoided. In the unlikely event additional specimens are found, transplant success is anticipated to be high for *Taeniophyllum muelleri* (an epiphytic orchid species for which limbs can be translocated to similar nearby gullies). *Syzygium moorei* on occurs on alluvial soils well outside of the disturbance footprint.	▪ If translocation is necessary then a monitoring program will be devised to assess the success of translocation (i.e. determine survival and growth).	(1) Low	Probability (1) x Consequences (1) = (1) Low
b) Changes to the microclimate that supports threatened species.	The design in part mitigates the potential indirect impacts by providing buffers to the Durobby (Sy*zygium moorei*) and Ribbon root orchid (*Taeniophyllum muelleri*) all of which are located along drainage lines	▪ Existing drainage line flows have been modeled by BMT WBM. This data represents sound information that can be used to replicate pre-development flow	▪ In the case of the Ribbon Root Orchid, if translocation is necessary then	(9) Medium	Probability (3) x Consequences (2) = (6) Medium

Potential Impact	Mitigation Measure	Efficacy of Mitigation Measure	Monitoring	Significance of Impact (unmitigated)	Significance of Residual (mitigated) Impact
	and waterways. Buffers of >50m are provided to these species. It is proposed that Durobby (Sy*zygium moorei*) planting stock is established from seed to be used on site for proposed restoration. Seed will be local provenance. The species is readily established from seed (Wrigley & Fagg, 2003). Monitoring is fundamental to determining whether a mitigation response is required. Natural systems are dynamic. By way of example, the current study documented the natural attrition of threatened plant species within the Mid Catchment Waterway. It will therefore be necessary to undertake monitoring over time and take into account climatic conditions to ensure it accurately charts changes that can be attributed to the proposed development. The following monitoring actions are proposed for species within drainage lines and waterways along with the appropriate mitigation response. ▪ Monitor the population of threatened species specifically within the Mid Catchment and Northern Catchment Waterways commencing prior to the establishment of earthworks. Information attained prior to clearing will assist in establishing the baseline condition. Information collected will include the number of individual threatened trees, a description of the health and vigor of individual threatened trees, a count of the number of trees/shrubs on which the Ribbon root orchid occurs and an estimate of the overall Ribbon root orchid population. ▪ For threatened species in the Mid-catchment Waterway upstream of the proposed sediment pond and in the Northern catchment - if there is a decline in the health of trees or abundance of Ribbon root orchid over 5 successive years that cannot be attributed to years that can be attributed to quarrying activities (e.g. changes in hydrology) then implement the following	conditions. ▪ A five year monitoring period is nominated to ensure trends in vegetation condition can be adequately mapped. ▪ If required, translocation of *Taeniophyllum muelleri* is predicted to be successful. Limbs on which specimens are found can be shifted to unaffected drainage lines where similar microclimates occur (e.g. in the northwest corner of the study area).	monitoring will be required to assess the success of translocation (i.e. determine survival and growth). ▪ Other monitoring outlined in the mitigation measures. Specifically, health of *Taeniophyllum muelleri* will be determined by the count of individual plants on individual monitored trees. Health of individual Sy*zygium moorei* will be determined by: o Photo monitoring to assess canopy decline or improvement in size or density. o Other signs such as dead branches.		

Potential Impact	Mitigation Measure	Efficacy of Mitigation Measure	Monitoring	Significance of Impact (unmitigated)	Significance of Residual (mitigated) Impact
	mitigative steps (1) supplement flows in the waterway to mimic the pre-clearing state by pumping water to upstream of specimens; (2) if Ribbon root orchid continues to decline translocate a limited number of specimens to the Southern Catchment waterway to establish a separate population. ▪ For threatened tree species in the Mid-catchment Waterway downstream of the proposed sediment pond - if there is a decline in the health of trees over 5 successive years that can be attributed to quarrying activities (e.g. changes in hydrology) then manage the volume of water received by the vegetation.				
c) Dust resulting from construction and operational activities.	The following mitigation measures are proposed: ▪ An approximate 50m buffer is provided to one host tree supporting the Ribbon root orchid (*Taeniophyllum muelleri*), which represents the threatened species specimens most proximate to the disturbance footprint. ▪ Application of dust control measures as outlined in Katestone Environmental Air Quality Assessment 2013 will be used to control dust levels on site.	▪ Trees and shrubs are efficient at 'capturing' airborne dust. A wooded buffer of 50m in addition to implementing other dust control measures will result in a negligible impact of dust on threatened species.	▪ Coincide monitoring with the periods outlined in (b) above. ▪ Specifically, health of *Taeniophyllum muelleri* will be determined by the count of individual plants on individual monitored trees. ▪ Monitor in accordance with Katestone Environmental 2013 air quality indicators, objectives and guidelines.	(3) Low	Probability (3) x Consequences (1) = (3) Low
d) Introduction of new weeds or pathogens in construction materials and planting stock	The following mitigation measures are proposed: ▪ Maximise use of materials sourced on site including topsoil and mulch generated from chipping of cleared vegetation. ▪ As part of the environmental management plan measures to manage the introduction of materials or planting stock are documented. ▪ Rehabilitate disturbed areas with plant species indigenous to the area. Local provenance planting stock is preferentially used. ▪ Class 2 declared plants including Groundsel, Annual Ragweed, Giant Rat's Tail Grass and Mexican Fireweed are controlled prior to commencement to	▪ By adopting best practice hygiene practices the risk of introduction or spread of weeds and pathogens will be reduced. ▪ Note: Given Myrtle Rust is already present within the Study Area and infected plants are proximate to specimens of *Syzygium moorei* there are no mitigation measures that will guarantee the species will remain unaffected. If affected, there are currently no viable treatment methods – the Management plan for myrtle rust on the national parks estate (OEH, 2011)	▪ Condition monitoring of vegetation communities as part of implementation of rehabilitation plan.	(12) High	Probability (2) x Consequences (2) = (4) Low

Potential Impact	Mitigation Measure	Efficacy of Mitigation Measure	Monitoring	Significance of Impact (unmitigated)	Significance of Residual (mitigated) Impact
	earthworks. ▪ As part of the environmental management plan vehicle hygiene measures that aim to prevent the introduction and spread of weed seed during construction and operation are documented. Specifically these measures will include requirements for vehicle hygiene. For vehicles and personnel involved in the delivery of ecological restoration activities within 50m radius of specimens of *Syzygium moorei* follow the hygiene protocols defined in Appendix 3 of the Management plan for myrtle rust on the national parks estate (OEH, 2011). ▪ All relevant staff trained in identifying environmental and declared weeds and myrtle rust. ▪ Rehabilitate all disturbed surfaces with local native plants as per the prepared Rehabilitation Plan (Cardno Chenoweth, 2012).	prohibits the use of fungicide on plants within 10m of a stream and all *Syzygium moorei* specimens are located within 10m of streams. By improving the ecological health of the waterway through restoration activities the resilience of the system that supports *Syzygium moorei* may be enhanced.			
e) Uncontrolled public access to remnant vegetation	The following mitigation measures are proposed: ▪ Restrict access through fencing, site management and other physical barriers.	▪ The proposed measures will prevent uncontrolled access.	▪ Regular surveillance.	(4) Low	Probability (1) x Consequences (2) = (2) Low
f) Inappropriate burning regimes	The following mitigation measures are proposed: ▪ Implement the Bushfire Management Plan. Significant Environmental areas are delineated in the fire plan that incorporates fire sensitive vegetation/species.	▪ The Bushfire Management Plan recommends regimes that accord with those defined by the Queensland Herbarium.	▪ Monitor the health of vegetation adjacent to drainage lines as part of implementation of rehabilitation plan. A reduction in weeds is anticipated through rehabilitation and adequate fire management.	(4) Medium	Probability (1) x Consequences (3) = (3) Low
g) Over clearing	The following mitigation measures are proposed: ▪ During construction clearly delineate the edge of disturbance. Broad strategies to maximise retention and protect the health of retained vegetation in accordance with Boral's vegetation clearing procedures Standard Operating Procedure BCM-ENV-0013. Particularly vegetation is not to be	▪ The closest threatened species is 50m from the edge of disturbance. With implementation of proposed mitigation measures there is a very low risk that threatened species will be impacted.	▪ Regular checks of clearing limits.	(6) Medium	Probability (1) x Consequences (3) = (3) Low

Potential Impact	Mitigation Measure	Efficacy of Mitigation Measure	Monitoring	Significance of Impact (unmitigated)	Significance of Residual (mitigated) Impact
	removed or disturbed without prior approval of the site manager and regional environmental or project/development manager. The only vegetation removed should be that from an area approved for clearing and suitably marked in consultation with the Environment Manager. Vegetation removal will not occur until the protection measures have been implemented.				

8.2.2 Specific Mitigation Measures for the White-bellied sea-eagle

Specific mitigation measures for the White-bellied sea-eagle are tabulated below (**Table 8-2**). The purpose of monitoring is not only to measure the success of mitigation measures, but also to facilitate an adaptive management approach whereby there is continued improved in the approaches utilised to mitigate impacts:

Table 8-2 Mitigation of Impacts for the White-bellied sea-eagle

Potential Impact	Mitigation Measure	Monitoring	Significance of Impact (unmitigated)	Significance of Residual (mitigated) Impact
Construction and operation impacts the nesting of White-bellied sea eagles	▪ The proposed setback limits views into the proposed pit and plant site. It may be necessary to enhance the screening in the shrub and subcanopy layers through planting uphill of the nest tree. ▪ Reduce the likelihood of nest abandonment during a breeding season by adopting a similar strategy to that developed by Ecosure (pers. comm.) in the management of a White-bellied sea-eagle's nest on Curtis Island. This involved covering the nest during the nesting season to discourage use for the period while construction activities are underway. Specifically, this would apply only to the period while the cut face immediately to the north of the nest site is being constructed during Phases D1-D4 (i.e. approximately potentially for 2 breeding cycles)	▪ Monitor health of nesting tree ▪ Monitor use of the nesting tree by White-bellied sea-eagles. While it is acknowledged that disturbance will have a strong influence on continued use of the site care will be necessary in drawing this conclusion because as some nest sites that are free from human disturbance fail to fledge young and are sometimes abandoned So & Lee (2010).	(12) High	Probability (3) x Consequences (3) = (9) Medium

8.2.3 General Mitigation Measures

Best practice environmental management measures have been detailed within a draft environmental management plan (EMP) that prepared for the project so as to mitigate any potential impacts to environmental values within the Study Area. Refer to **Appendix TT** of the EIS.

Management measures will include the following actions that will not only benefit common species but also EPBC-listed species that are known or potential utilise the habitats of the Study Area.

> Ensure relevant workers, including machinery operators, are made aware of significant environmental values and associated buffers, and that these are clearly demarcated where required, this awareness and demarcation will be maintained during both construction and operational phases to ensure continuous protection of retained areas.

> Prior to vegetation removal, ensure boundaries of areas authorised for clearing are visibly demarcated to avoid impact to retained areas.

> Vegetation clearing is to be undertaken sequentially and trees are to be felled in a direction away from retained vegetation.

> Weed management will be undertaken as per the rehabilitation plan.

> Vehicle and equipment hygiene practises are to be implemented. Washdown facilities are to ensure that runoff does not transfer weed propagules to adjacent areas. Hygiene protocols to limit the spread of Myrtle Rust on site will be identified.

> Damage to retained vegetation is to be avoided.

> Project traffic is to be confined to designated roads and access tracks, where practicable.

> Retain woody debris, logs and rocks for use in rehabilitation, where practicable.

> Sediment and erosion control measures are to be installed and maintained, as appropriate.

> Appropriate international, Australian and industry standards and codes of practice for handling and storage of hazardous materials are to be followed.

> Upon the identification of any contamination of soil or groundwater that has occurred as a result of project activities, corrective actions are to be undertaken.

> Project wastes, including food scraps, are to be disposed of appropriately.

> Bushfire management is to be implemented in accordance with the project's bushfire management plan.

> Rehabilitation is to be undertaken in accordance with the project's detailed rehabilitation plan.

The proponent will be responsible for ensuring appointment of an appropriately qualified and experienced Environmental Manager to implement the EMP over the construction and operational life of the project. Furthermore, the proponent will need to undertake the mitigation measures that have been detailed above in **Table 8-1** and **Table 8-2** as well as the range of other mitigation measures identified in the various technical reports completed for the EIS. The mitigation measures, where relevant and appropriate, will be reflected in the EMP. Additionally, the draft EMP that was prepared for the EIS will be continually updated to reflect future approvals as required.

8.3 Offset Measures

Offsets under the EPBC Act are based on the residual impact to an MNES subsequent to implementation of alternative measures to avoid impacts. In this regard, no residual impacts to MNES are anticipated in association with the project such that specific offset measures under the EPBC Act are not required.

9 Monitoring and Reporting

Environmental monitoring will be undertaken as part of the project and will aim to observe and report on the performance of proposed mitigation and management measures, with a focus on facilitating early intervention and remediation of any identified non-conformances. Monitoring and reporting requirements for EPBC threatened and migratory species are outlined in **Tables 8-1 and 8-2** respectively.

The following monitoring actions will enable the adoption of an adaptive management approach for not only common species but also EPBC-listed species that are known or potential utilise the habitats of the Study Area:

> Monitor areas of clearing to ensure that boundaries are demarcated and that clearing activities are confined to the demarcated boundaries.

> Monitor areas of excavation for entrapped fauna.

> Monitor the effectiveness of weed management activities.

> Monitor the effectiveness erosion and sediment control devices.

> Monitor the success of rehabilitation works.

10 Ecologically Sustainable Development

Development and design of the Gold Coast Quarry project has incorporated ecologically sustainable development as a fundamental consideration. A specific report that details the application of each of the key principles of ecologically sustainable development to the project is provided in Chapter 9 of the EIS (page 321).

11 References

Aquatic ecosystems Task Group. 2012. *Aquatic Ecosystems Toolkit*. Department of Sustainability, Environment, Water, Population and Communities.

Barry, S.J and Thomas, G.T. (1994) Threatened Vascular Rainforest Plants of South-east Queensland: A Conservation Review. Queensland Department of Environment and Heritage.

Bostock, P.D. and Holland, A.E. (2010) Census of the Queensland Flora. Queensland Herbarium, Department of Environment and Resource Management.

Catterall, C., Lynch, R.M., Jansen, A. 2007. *Riparian wildlife and habitats*. In S. Lovett, S., and Price, P. (Eds). 2007. Principles for Riparian Lands Management. Canberra: Land and Water Australia pp. 141-158.

Catterall, C.P., McKenna, S., Kanowski, J. and Piper, S.D. 2008. *Do cyclones and forest fragmentation have synergistic effects? A before-after study of rainforest structure at multiple sites.* Austral Ecology 33, 471–484.

Cropper, S. (1993). Management of Endangered Plants. CSIRO.

Dennis, T.E., McIntosh, R.R., and Shaughnessy, P.D. 2011. *Effects of human disturbance on productivity of White-bellied sea-eagles (Haliaeetus leucogaster).* Emu, 111, 179-185.

Department of Agriculture, Fisheries and Forestry (DAFF) List of host plants affected by myrtle rust. Available from http://www.daff.qld.gov.au/4790_19789.htm. Accessed on 27 November 2012.

Department of Environment and Resource Management (DERM) (2011) Flying Fox Roost Sites. Available from http://www.ehp.qld.gov.au/wildlife/livingwith/flyingfoxes/pdf/roosts/map1.pdf. Accessed on 27 November 2011.

Department of Environmental Protection Agency (Qld), 2006. *Biodiversity Planning Assessment Southeast Queensland South Landscape Expert Panel Report.*

Department of Science, Information Technology, Innovation and the Arts. 2012. *BioCondition benchmark for regional ecosystem condition assessment Southeast Queensland*. Retrieved December 14, 2012, from http://www.ehp.qld.gov.au/ecosystems/biodiversity/biocondition_benchmarks.html

Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) (2009) Matters of National Environmental Significance Significant Impact Guidelines vers 1.1. Commonwealth of Australia.

Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) (2010a) Survey guidelines for Australia's threatened birds. Available from: http://www.environment.gov.au/epbc/publications/pubs/survey-guidelines-birds.pdf. Accessed 23 November 2012.

Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) (2010) Survey guidelines for Australia's threatened frogs. Available from: http://www.environment.gov.au/epbc/publications/pubs/survey-guidelines-frogs.pdf. Accessed 23 November 2012.

Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) (2012a) Lowland Rainforest of Subtropical Australia in Community and Species Profile and Threats Database. Available from: http://www.environment.gov.au/sprat. Accessed 23 November 2012.

Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) (2012b) *Syzygium hodgkinsoniae* in Species Profile and Threats Database. Available from: http://www.environment.gov.au/sprat. Accessed 23 November 2012.

Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) (2012c) *Syzygium moorei* in Species Profile and Threats Database. Available from: http://www.environment.gov.au/sprat. Accessed 23 November 2012.

Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) (2012d). *Haliaeetus leucogaster* in Species Profile and Threats Database, Department of Sustainability, Environment, Water, Population and Communities, Canberra. Available from: http://www.environment.gov.au/sprat. Accessed Sat, 15 Dec 2012 07:14:05

Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) (2013a) *Endiandra floydii* in Species Profile and Threats Database. Available from: http://www.environment.gov.au/sprat. Accessed 23 November 2012.

Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) (2013b). Advice to the Minister for Sustainability, Environment, Water, Population & Communities from the Threatened Species Scientific Committee (the Committee) on Amendment to the list of Threatened Species under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) for Marsdenia coronata (slender milkvine). Available from: http://www.environment.gov.au. Accessed Wed, 25 Sept 2013 09:18.

Ecosure. 2008. *Green heart reserves draft literature review*. Prepared on behalf of Gold Coast City Council.

Emison, WB. & Bilney, RJ. 1982. *Nesting habitat and nest site characteristics of the white-bellied sea eagle in the Gippsland Lakes region of Victoria, Australia*. Raptor Research 16(2):58-59.

Ezzy, L. 2010. *Boobook - journal of the Australasian raptor association. Volume 28 Number 1.*

Falkiner, RA., Nambiar, EKS., Polgase, PJ., Theiveyanathan and Stewart, LG. 2006. *Root distribution of Eucalyptus grandis and Corymbia maculata in degraded saline soils of south-eastern Australia*. Agroforestry Systems, 67:279-291.

Floyd, A.G. (1989) Rainforest Trees of Mainland South-eastern Australia. Inkata Press, Melbourne.

Forest Practices Authority. 2006. Eagle nest searching, activity checking and nest management. Fauna Technical Note No. 1, Forest Practices Authority, Hobart

Garrard, G. E., S. A. Bekessy, M. A. McCarthy and B. A. Wintle. 2008. *When have we looked hard enough? A novel method for setting minimum survey effort protocols for flora surveys*. Austral Ecology 33:986-998.

Gold Coast Botany (2005) Flora Assessment – Lot 105 SP144215 (in part) Old Coach Road, Reedy Creek, Prepared for Mark Rigby and Associates, April 2005.

Hatton, T., and Evans, R. 1998. *Dependence of ecosystems on groundwater and its significance to Australia. Occasional Paper No 12/98*. Land and Water Resources Research and Development Corporation.

Hatton, T., and Evans, R. 1998. *Dependence of ecosystems on groundwater and its significance to Australia. Occasional Paper No 12/98*. Land and Water Resources Research and Development Corporation.

Jacobs, MR. 1955. *Growth Habits of the Eucalypts*. Forestry and Timber Bureau – Department of the Interior.

Jones, D. 2012. *Ecological implications of up-grading a minor forest road: Reducing the road effect zone increases the impact. Presentation at the 2012 IENE International Conference.* Safeguarding Ecological Functions Across Transport Infrastructure, Potsdam, Germany.

Jones, D.J. (2006). A complete guide to native orchids of Australia including the island territories. Reed New Holland.

Morcombe, M. 2004. *Field Guide to Australian Birds* (revised edition). Steve Parish Publishing.

Murcia, C. (1995). *Edge Effects in fragmented forests: Implications for Conservation*. TREE. 10:58-62.

Neldner, V.J., Wilson, B. A., Thompson, E.J. and Dillewaard, H.A. (2005) Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland. Version 3.1. Updated September 2005. Queensland Herbarium, Environmental Protection Agency, Brisbane. 128 pp.

New South Wales Department of Environment and Heritage (NSW DEH) (2012a) Small-leaved Tamarind profile. Available from: http://www.environment.nsw.gov.au/threatenedspecies/. Accessed 27 November 2012.

New South Wales Department of Environment and Heritage (NSW DEH) (2012b) Sweet Myrtle profile. Available from: http://www.environment.nsw.gov.au/threatenedspecies/. Accessed 27 November 2012.

O'Donnell, W.B., and S.J.S. Debus. 2012. *Nest-sites and foraging of the White-bellied Sea-eagle Haliaeetus leucogaster on the subtropical eastern coast of Australia*. Australian Field Ornithology 29:149-159.

Office of Environment and Heritage (OEH) NSW (2011). Management plan for myrtle rust on the national parks estate.

Queensland Herbarium (2012) HERBRECS database. Queensland Herbarium, Department of Science, Information Technology, Innovation and the Arts. Data extracted on 5 June 2012.

Queensland Herbarium. 2013. *Regional Ecosystem Description Database* (REDD). Version 6.1 (February 2013) (DSITIA: Brisbane).

So, I.W. and Lee, W.H. 2010. *Breeding ecology of White-bellied sea eagle* (*Haliaeetus leucogaster) in Hong Kong – A review and update*. Hong Kong Biodiversity, Issue No. 18. Agriculture, Fisheries and Conservation Department Newsletter.

Sinclair Knight Merz. 2011. *Australian Groundwater-Dependant Ecosystems Toolbox*. National Water Commission on Key Water Issues.

Specht, R.L. and Specht, A. 1999. *Australian plant communities: dynamics of structure, growth and biodiversity*. Oxford University Press.

Stanley, T.D. and Ross, E.M. (1986) Flora of south-eastern Queensland, vol. 2. Queensland Dept of Primary Industries, Brisbane

Weston, P.H. (1988) A revision of *Hicksbeachia* (Proteaceae). Telopea 3, 234-236.

Wrigley, J.W. and Fagg, M.A. (2003). *Australian Native Plants Cultivation, Use in Landscaping and Propagation.* New Holland Press.

ATTACHMENT A

BORAL ENVIRONMENTAL RECORD ENVIRONMENTAL POLICY

Cardno
Shaping the Future

Boral Construction Materials Queensland:

Infringement Notices July 2007 – February 2013

Boral Resources (Qld) Pty. Limited (Boral Construction Materials, Queensland) has never been convicted of an offence under the *Environmental Protection Act 1994* (Qld).

The attached table outlines all infringement notices and fines received by Boral Construction Materials (BCM) Queensland, under the *Environmental Protection Act 1994* and associated legislation for the period 1 July 2007 to 19 February 2013.

Further details of each infringement can be provided if required. In all cases Boral manages the infringement notice by recording the incident details in the SiteSafe Incident Reporting System. The manager assigned to follow through with the incident is then responsible for investigating the incident, identifying the root causes and assigning and completing corrective actions to prevent the incident from occurring again. This process includes responding to the appropriate regulatory agency within the timeframe specified.

BCM QLD PENALTIES AND FINES RECEIVED DURING YEAR ENDED 30 JUNE 2008

Location	Reason	Penalty
Bowen Bridge Concrete Plant, Bowen Bridge	Uncontrolled Discharge	$1,500
Purga Quarry, Peak Crossing	Dust issue emanating beyond boundaries of site	$1,500
Narangba Quarry, Narangba	(No. 5560) Release of contaminants that may enter stormwater	$600
Ormeau Quarry, Kingsholme	Dust issue emanating beyond boundaries of site	$1,500
Stapylton Quarry, Stapylton	Mud/sediment on road	$1,500
Capalaba Concrete Plant, Capalaba	(No. 5907) Release of contaminant from the site into the roadside gutter and stormwater drain	$1,500
Capalaba Concrete Plant, Capalaba	(No. 5908) Release of contaminant from the site into the roadside gutter and stormwater drain	$1,500

BCM QLD PENALTIES AND FINES RECEIVED DURING YEAR ENDED 30 JUNE 2009

Location	Reason	Penalty
Nil recorded during 2008/09	NA	

BCM QLD PENALTIES AND FINES RECEIVED DURING YEAR ENDED 30 JUNE 2010

Location	Reason	Penalty
West Burleigh Quarry, West Burleigh	Fine for failure to submit dust monitoring report by due date.	$2,000
Gladstone Concrete Plant, Gladstone	Contravention of development condition - release of high pH / high Ca waters to adjacent mangroves from routine management of site water system.	$2,000

BCM QLD PENALTIES AND FINES RECEIVED DURING YEAR ENDED 30 JUNE 2011

Location	Reason	Penalty
Ormeau Quarry, Kingsholme	Fine for failure to report non-compliant water quality monitoring data by the required date. NB The results did not indicate any harm had been caused, the PIN was issued because data had not been reported when it should have.	$2,000

BCM QLD PENALTIES AND FINES RECEIVED DURING YEAR ENDED 30 JUNE 2012

Location	Reason	Penalty
Cairns Asphalt, Cairns	Fine for release of 'red oxide' to a waterway causing water colouration. No environmental harm occurred other than visual.	$2,000
Ormeau Quarry, Ormeau	Fine for release of sediment to a waterway; clean water from the pit was re entraining sediment from exposed rehabilitation area on its path to discharge point to Pimpama Creek.	$2,000
Pinkenba Concrete (QCrete), Pinkenba	Overflow of washout pits into a roadside stormwater drain.	$2,000

BCM QLD PENALTIES AND FINES RECEIVED FINANCIAL YEAR TO DATE 19 FEBRUARY 2013

Location	Reason	Penalty
Oakey Concrete Plant, Oakey	Environmental Protection Order to reduce raw material stockpile height, and prevent sediment from leaving site to prevent environmental nuisance.	Nil
Toowoomba Concrete Plant	Direction Notice to remove sediment from stormwater drain.	Nil

If you require further information please contact the undersigned.

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Boral Property Group

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Boral Resources (Qld) Pty. Limited - Penalties under the EPBC Act 1999

Boral Resources (Qld) Pty. Limited (Boral Construction Materials, Queensland) has never received a penalty or been convicted of an offence under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999.* Refer below to the table of penalties for the last 5 years.

Table 1 – Boral Construction Materials, Queensland - Penalties and prosecutions under the EPBC Act

Year	2008	2009	2010	2011	2012	2013 (to date)
No. of penalties or prosecutions	0	0	0	0	0	0

If you require further information please contact the undersigned.

Matthew Leon
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Boral Property Group

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8 March 2013

Environmental Policy

As an international resources-based manufacturing company, we acknowledge that our shareholders, employees and the community at large expect responsible environmental practice by Boral's businesses. We will continually work to identify and minimise environmental risk at all our operations and, wherever practicable, eliminate adverse environmental impacts.

Specifically, Boral is committed to:

- Complying with environmental legislation, regulations, standards and codes of practice relevant to the particular business as the absolute minimum requirement in each of the communities in which we operate.

- Reducing greenhouse gas emissions from our processes, operations and facilities, including appropriate use of alternative fuels and/or carbon offsets.

- Eliminating waste in all its forms, by application of LEAN manufacturing principles, leading to:
  - efficient use of energy
  - conservation of water
  - minimisation and recycling of waste production materials and energy
  - prevention of pollution; and
  - effective use of virgin and recovered resources and supplemental materials.

- Open, constructive engagement with communities surrounding our operations.

- Protecting biodiversity values at and around our facilities.

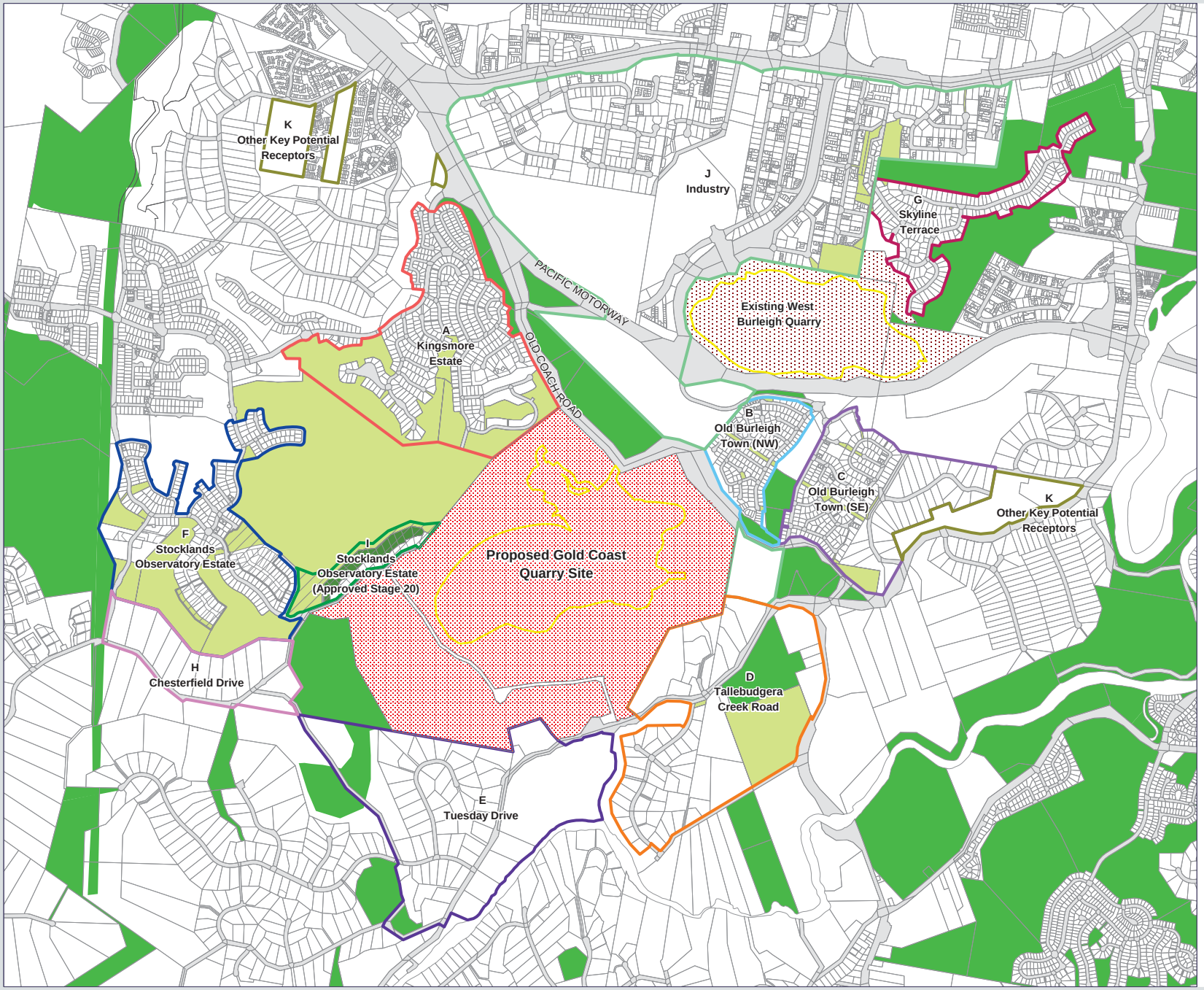
Through communication and training, our employees will be encouraged and assisted to enhance Boral's environmental performance.

Mike Kane
Chief Executive Officer and Managing Director

Gold Coast Quarry EIS

ATTACHMENT B
LOCATION MAP

Cardno
Shaping the Future



LEGEND

- PROPOSED GOLD COAST QUARRY SITE
- EXISTING WEST BURLEIGH QUARRY
- DISTURBANCE FOOTPRINT
- A - KINGSMORE ESTATE
- B - OLD BURLEIGH TOWN (NW)
- C - OLD BURLEIGH TOWN (SE)
- D - TALLEBUDGERA CREEK ROAD
- E - TUESDAY DRIVE
- F - STOCKLAND OBSERVATORY ESTATE
- G - SKYLINE TERRACE
- H - CHESTERFIELD DRIVE
- I - STOCKLAND OBSERVATORY ESTATE (APPROVED STAGE 20)
- J - INDUSTRY
- K - OTHER KEY POTENTIAL RECEPTORS (INCLUDES COMMERCIAL AND SCHOOLS)
- AREA IS APPROVED AS PER GCCC PD ONLINE BUT NOT PHYISCALLY DEVELOPED / TITLES NOT CREATED
- PRIVATE OPEN SPACE
- OPEN SPACE
- PLANNING SCHEME OPEN SPACE

N

0 200 400 600 800 metres

1:20,000 @ A3

Cardno HRP

GOLD COAST QUARRY EIS

Subject Site and Surrounds

FILENAME >	FIGURE NAME	DATE >	MAR 2013
JOB NO. >	HRP12003	AMENDED >	NA
SCALE >	1:20,000 @ A3	VERSION >	1.0
SOURCE >	© STATE OF QUEENSLAND (DEPARTMENT OF NATURAL RESOURCES AND MINES) [2012]		

MAP 1