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GOLD COAST QUARRY

ENVIRONMENTAL IMPACT STATEMENT

BORAL CONSTRUCTION MATERIALS
Build something great™

BORAL

APRIL 2013

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Executive Summary

Boral Resources (Qld) Pty Limited (the proponent), a wholly owned subsidiary of Boral Limited, is proposing to establish the Gold Coast Quarry: a new extractive industry operation on a greenfield site bordering Old Coach Rd and Tallebudgera Creek Road, at Reedy Creek on the Gold Coast.

The proponent operates over one hundred operational sites across Queensland, including thirty (30) quarries, sixty-eight (68) concrete batching plants, and sixteen (16) asphalt plants. The business is geographically diverse with operations in all major coastal centres from the Gold Coast to Cairns and westward as far as Barcaldine. The proponent has a strong track record and has held a key position supplying construction materials across South East Queensland for a number of years with numerous quarries, concrete plants and asphalt operations serving the infrastructure and construction markets from strategic locations, close to market, across the region.

The project is necessary to compensate for the scheduled winding down of the proponent's existing West Burleigh Quarry, which has sufficient reserves for only a further 6.5 to 9 years of production (depending on market conditions). It will ensure that an adequate, uninterrupted and efficient supply of construction materials remains available for critical infrastructure and construction projects in the Gold Coast region. The project will activate the last and largest known deposit of meta-greywacke quarry rock resources on the southern Gold Coast and is designated as a Key Resource Area which is of significance, not only to the City of the Gold Coast, but to the South East Queensland region and the State of Queensland.

The proposed development will operate as a quarry for the extraction and processing of hard rock (meta-greywacke) 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 the proponent's existing West Burleigh Quarry, providing an opportunity to completely replace the current quarry operations at the proponent's existing West Burleigh Quarry.

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 the proponent. In developing this proposal, the proponent has balanced the strong need to bring the resource to market with the social and environmental factors associated with extractive industry development. After taking into account a range of environmental and amenity constraints, and providing extensive separation buffers, it is estimated that a total of 79 million tonnes of resource will be made available. At a maximum production capacity of two million tonnes per annum, the project will supply the Gold Coast region with high grade construction materials for at least 40 years.

Although substantial volumes of additional resource are known to occur on the site, the proponent has voluntarily sterilised those resources in order to achieve an appropriate balance between environmental, economic and community interests. The balance that is achieved by the project is best demonstrated by the fact that the development is expected to deliver a net benefit of $502.9 million to the community, including an injection of $40.3 million to the Gold Coast economy, whilst retaining around 70% of the site in its densely vegetated state to protect its ecological and biodiversity values and enhance the connectivity of the Springbrook to Burleigh bio-regional corridor.

By providing such substantial buffers from surrounding residential areas on land that the Proponent owns and controls, and adopting other sensitive design and operational measures, the proponent has also been able to ensure that the project achieves compliance with all of the regulatory limits for noise emissions, dust emissions, blasting vibration levels, blasting overpressure levels and water quality at all residential dwellings and other sensitive receptors around the site.

In summary, recognised industry best practice and a strong commitment to the principles of ecologically sustainable development is clearly demonstrated by the proponent and in all aspects of the project.

FIGURE 1

0 200 400 600 800metres
1:20,000

LEGEND

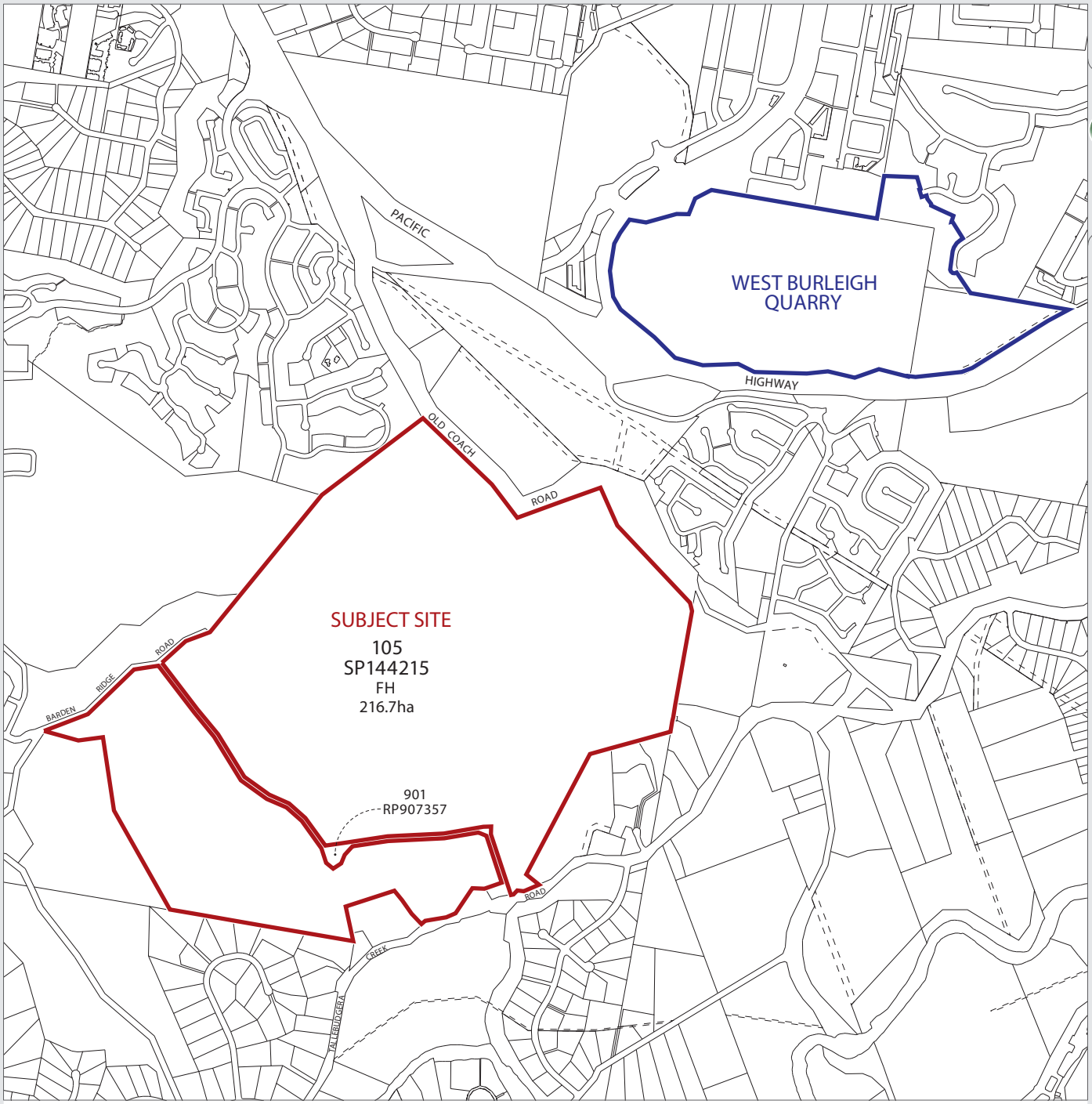
SUBJECT SITE

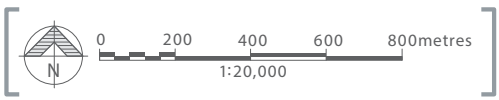
GOLD COAST QUARRY - EIS

Location Map

FILENAME >	LOCATION MAP	DATE >	JANUARY 2013
JOB NO. >	HRP10003	AMENDED >	N/A
SCALE >	1:20,000 @ A4	VERSION >	1.0
SOURCE >	UNIVERSAL PUBLISHERS - Australian City Streets (ver. 6.0)		

FIGURE 1





LEGEND

SUBJECT SITE

GOLD COAST QUARRY - EIS

Cadastral Plan

FILENAME >	CADASTRAL PLAN	DATE >	JANUARY 2013
JOB NO. >	HRP10003	AMENDED >	N/A
SCALE >	1:20,000 @ A4	VERSION >	1.0
SOURCE >	DERM: SMARTMAP: Dated 18/9/2012		

N

0 200 400 600 800metres

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LEGEND

- SUBJECT SITE
- DISTURBANCE FOOTPRINT

GOLD COAST QUARRY - EIS

Aerial Photograph

FILENAME >	AERIAL PHOTO	DATE >	JANUARY 2013
JOB NO. >	HRP10003	AMENDED >	N/A
SCALE >	1:20,000 @ A4	VERSION >	1.0
SOURCE >	NEARMAP: 5/8/2012		

FIGURE 3

The Environmental Impact Statement

This Environmental Impact Statement (EIS) has been prepared to provide a detailed and comprehensive assessment of the environmental, social, cultural and economic impacts (beneficial and adverse) of the project. The EIS also identifies mitigation measures that may be applied to effectively manage any potentially adverse impacts arising from the project.

The EIS process provides:

> for decision-makers and other stakeholders, a basis for understanding the project, the need for the project, the alternatives, the environmental values that it may affect, and the impacts that may occur and the measures to be taken to manage those impacts;

> assistance and guidance for the detailed engineering phases of the project in avoiding potential impacts where possible and identifying appropriate management measures for unavoidable impacts;

> an outline of the effects of the Project on the area, including access for groups or persons with rights or interests in the land;

> a demonstration of how environmental impacts can be managed through the protection and enhancement of environmental values. Through the EIS process, an Environmental Management Plan (EMP) which describes strategies for the management of potential impacts that may occur during establishment, development, construction and operational stages of the project;

> opportunities for input by stakeholders and decision-makers into the environmental management and monitoring programs; and

> a framework against which decision makers can consider the environmental aspects of the project in view of legislative and policy provisions, in order to determine if the project can proceed or not. Also, as appropriate, the government will set conditions of approval to ensure environmentally sound development and, where required by legislation, recommend environmental management and monitoring.

The EIS process for the project commenced on 8 December 2009 when the Initial Advice Statement (IAS) for the project was lodged with the Office of the Coordinator-General. The project was declared to be a 'significant project for which an EIS is required' under Section 26 of the *State Development and Public Works Organisation Act 1971* (SDPWO Act) on 19 November 2010.

Projects are declared as State significant because of a number of factors including:

> potential significant environmental, economic and/or social impacts;

> the need for robust environmental impact assessment;

> the need for whole-of-government coordination to ensure effects on all aspects of the environment are considered: natural; social; economic; cultural and built; and

> to provide a framework for conducting an EIS that is acceptable to other government agencies.

Coordinated projects are not a status awarded to a project by Government nor is their declaration an indication of the Queensland Government's approval or support for the project. The approval of Significant projects can be, and is, refused by the Office of the Coordinator-General under the SDPWO Act.

The declaration of the project as a Coordinated project for which an EIS is required initiated the statutory environmental impact assessment process set down by Part 4 of the SDPWO Act, including the requirement to prepare this EIS. The Office of the Coordinator-General invited relevant Australian, State and local Government representatives and other relevant authorities to participate in the process as advisory agencies.

The proponent concurrently referred the project to the Australian Government Department of Sustainability, Environment Water, Population and Communities for consideration under the *Environment Protection and Biodiversity Conservation Act 1999 (Cmwlth)* (EPBC Act) on 1 December 2010. The Australian Government confirmed the proponent's self-nomination and declared the project to be a Controlled Action under the EPBC Act. The project requires assessment against the EPBC Act given its potential impact on threatened species and communities listed under that Act.

The Office of the Coordinator-General prepared draft Terms of Reference (TOR) for the EIS which were made available for public comment for a period of six weeks between 19 February 2011 and 1 April 2011. All relevant Commonwealth, State and local Government agencies and authorities, together with any interested members of the public, were invited to participate in the preparation of the TOR for the EIS. The final TOR for this EIS were released by the Coordinator-General on 22 July 2011. A copy is provided at **Appendix A** to the EIS.

The proponent, and its team of independent, specialist consultants, has since been engaged in the preparation of this EIS for the project. Over that period, the potential environment, social and economic impacts of the project have been the subject of rigorous and detailed technical assessments which have included:

> Indigenous cultural heritage survey;

> geological drilling and resource assessment

> desktop assessments

> physical investigations of the site and the surrounding area

> seasonal field surveys of terrestrial flora, terrestrial fauna and aquatic species

> on-ground monitoring of air quality, water quality, groundwater quality and the acoustic environment

> surveys and modelling of traffic volumes

> non-indigenous cultural heritage surveys

> economic modelling and research

> stakeholder and community engagement

> risk identification and management workshops

> a comprehensive and iterative process of design refinement.

The EIS for the project was submitted for assessment by the Coordinator-General in March 2013.

The EIS will now be made fully available for review by all relevant State agencies, Gold Coast City Council and any interested member of the public. Over a notification period of six weeks, any interested person has the opportunity to make a submission to the Office of the Coordinator-General about the project. At the conclusion of the public notification period, the Coordinator-General will assess the EIS in accordance with Section 35 of the SDPWOA. As part of that assessment process, the Coordinator-General may request that the proponent provides supplementary information.

The Coordinator-General will then prepare an evaluation report for the project will take into account all relevant materials including:

> the EIS;

> all properly made submissions and other submissions accepted;

> any other material considered relevant;

> comments and advice from advisory agencies;

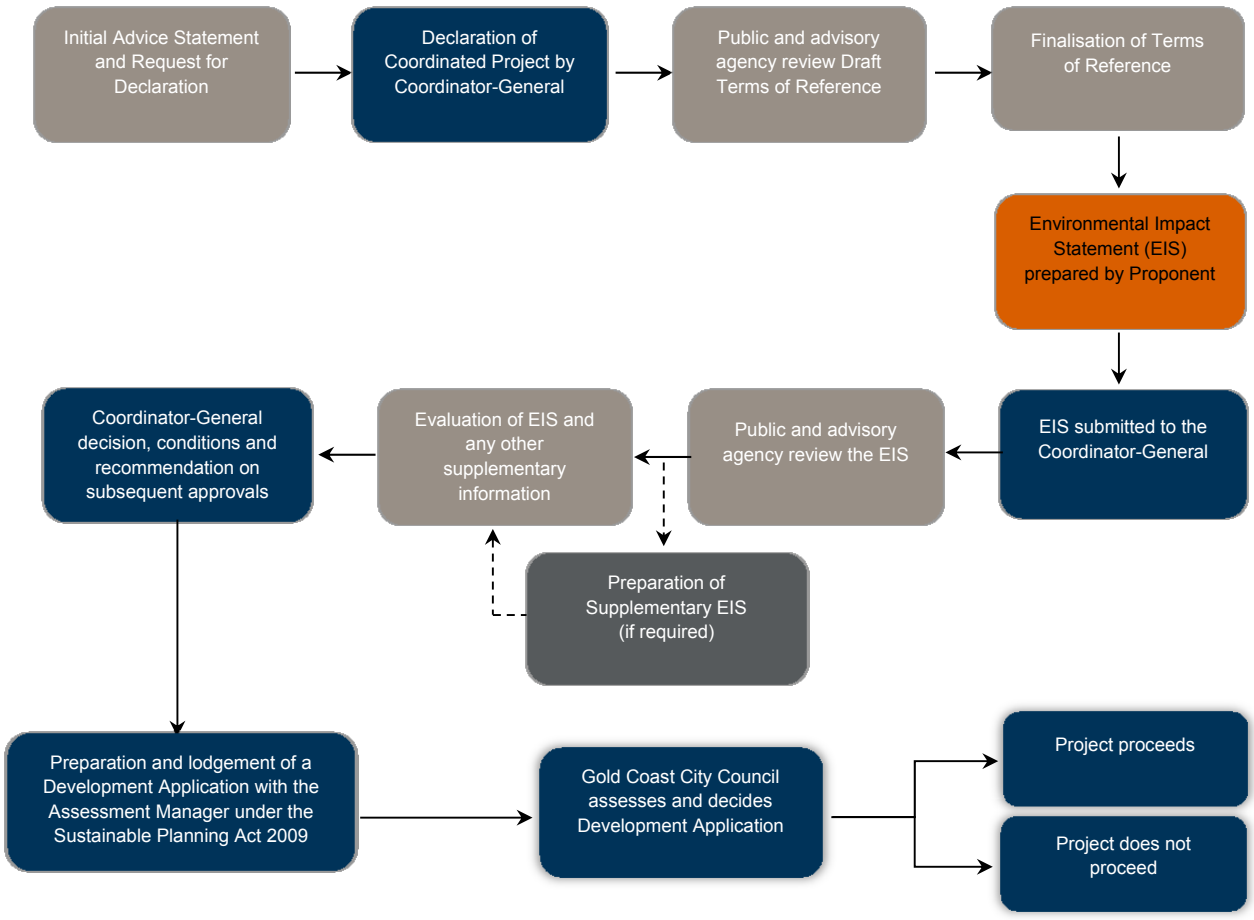
> technical reports on specific components of the project; and

> legal advice.

Once the Coordinator-General's assessment has been finalised, a final recommendation will be provided that will either require the project be refused or recommend that the project proceed to the next stage of the assessment process, subject to any conditions considered appropriate. The proponent will then be required to prepare and lodge applications for development approval from Gold Coast City Council. Gold Coast City Council will have regard to the Coordinator-General's recommendation and make the final decision as to whether the project is approved to proceed.

The following flow chart summarises the EIS process as it is outlined in Part 4 of the SDPWOA:

Figure 1: Flow Chart 1: EIS Process under Part 4 of the SDPWOA



The proponent

The proponent, Boral Resources (Qld) Pty Limited, primarily serves customers in the building and construction industries through the production and distribution of a broad range of construction materials including quarry products, pre-mix concrete and asphalt.

Within the Gold Coast region, Boral currently operates four (4) quarries (Yatala, Stapylton, Ormeau and West Burleigh), eight (8) concrete batching plants (Robina, Benowa, Labrador, Coomera, Beenleigh, Chinderah as well as two (2) Q-Crete plants) and one (1) fixed asphalt plant (West Burleigh).

One of the quarries currently operated by Boral includes the West Burleigh Quarry, which is located approximately 500m to the east of the site that is the subject of this EIS. Boral's operations in the above operation have, in more recent times, contributed to the construction of a range of major infrastructure and development projects in the Gold Coast region.

The contact details for the proponent are as follows:

Boral Property Group

Level 6 / 88 Musk Avenue

Kelvin Grove QLD 4059

Gold Coast Quarry Project Team Contact telephone number: 1800 109 401

Gold Coast Quarry Project Team Contact email address: goldcoastquarry@boral.com.au

Site details

The land that is the subject of 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 the proponent.

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.

Summary 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. The project will activate the last and largest known deposit of meta-greywacke quarry rock resources on the southern Gold Coast.

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 onto 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 conveyed 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.

The site will be developed in a sequence of discrete stages:

> Site Establishment Stage, Development Stage, and Construction Stage, each of which features a number of intermediate phases;

> Quarrying Stage, also comprising a number of indicative phases, during which the extraction area itself will be developed and worked; and

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

The following table summarises each Stage and its respective Phases:

Table 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

SITE ESTABLISHMENT STAGE	
PHASE	**WORKS UNDERTAKEN**
	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 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 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.

DEVELOPMENT AND CONSTRUCTION STAGE	
PHASE	**WORKS UNDERTAKEN**
	> 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 possible.
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 possible.
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 possible.
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 possible.

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 timeframes for the development of each respective phase of the project at this early point, but the quarry will have an operational life of at least 40 years.

Prior to the Construction Stage, the project will operate with mobile plant. The mobile plant will 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).

The proposed development does not require connection to the Council's trunk water, sewer or stormwater infrastructure systems. The project will be entirely self-sufficient with respect to these aspects.

The development will need to connect to the necessary electricity and telecommunication services.

Project design

The project has undergone a rigorous, iterative process of design development and 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 that the proponent has 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.

Recognised industry best practice and a strong commitment to the principles of ecologically sustainable development is clearly demonstrated by the proponent and in all aspects of the project.

The need for the project

There is a strong level of economic, community and planning need for the project.

Extractive resources underpin all urban and infrastructure development as they are the primary source of materials used for building future roads, bridges, railways, factories, hospitals, schools, homes, etc. The aggregate produced in the region‘s quarries is vital in satisfying society‘s growing requirements in constructing the built environment. Significant population and activity growth within the Gold Coast, and across South East Queensland, will challenge the capability of the existing local infrastructure to cater for the increasing transportation, health, community and service needs of the growing population. The EIS has clearly demonstrated that the projected population growth, the resulting demand for housing, and the need for major infrastructure and resource-dependent projects proposed for the Gold Coast region are set to continue the high level of demand for extractive resources.

Quarrying in South East Queensland has increasingly faced significant constraints in recent years. Increasingly difficult operating and approval conditions have had a direct impact on the construction and infrastructure provision sectors by restricting supply at a time of increasing demand. The existing West Burleigh Quarry reserves are almost exhausted, with an estimated 6.5 to 9 years supply remaining.

The presence of the proponent’s local quarrying operations within the southern Gold Coast corridor is vital as part of the critical delivery of recently completed and, more importantly, upcoming infrastructure projects planned for the future within this region. Indeed, the proposal would continue this critical supply of extractive material for major infrastructure projects within this region.

The exhaustion of existing reserves at the West Burleigh Quarry would result in the central and southern Gold Coast having only one significant long term resource for aggregate materials remaining in operation, located at Nerang. Extractive industry development can only occur in locations where the hard rock resource occurs naturally. Multiple geological and planning studies dating back the 1970s confirm that there are no feasible alternative locations from which the demand for construction aggregates on central and southern Gold Coast can be supplied. The refusal of the project would therefore significantly constrain the range and choice of suppliers of construction materials for the Gold Coast market and potentially undermine the delivery of critical infrastructure projects, continued urban growth and the sustainability of the construction industry.

Quarries within the Gold Coast local government area supply about 40% of South East Queensland's extractive material, with an estimated 50% of extractive material produced on the Gold Coast directed to areas beyond the Gold Coast such as the cities of Brisbane, Logan and Ipswich. With greater reliance placed on Gold Coast quarries from other areas, coupled with diminishing supply on the Gold Coast, the project provides a strategic opportunity to secure extractive materials for the Gold Coast and allow the more northern Gold Coast quarries to continue to serve the needs of the wider South East Queensland region.

Given that a significant proportion of South East Queensland's construction industry is based in the Gold Coast region and that the local economy is heavily dependent upon the property sector, the location of the project is well suited to replacing the West Burleigh Quarry and efficiently servicing the central and southern parts of the Gold Coast.

Overall, the approval of the proposed Gold Coast Quarry would result in a number of benefits, not only to the Gold Coast, but to the wider South East Queensland region. Those economic benefits include:

> lower costs of production due to increased resource availability;

> lower transport costs due to reduced transport distances;

> the creation of an effective duopoly of aggregate supply on the Gold Coast (south of Pimpama), resulting in lower pricing;

> greater availability of resources to cater for demand generated from other areas, such as Brisbane City;

> decreased air pollution and contribution to global warming due to reduced transport haulage distances.

The project will represent an investment of $140-$160 million[1] by the proponent into the economy of the Gold Coast region. It will provide a net increase in employment opportunities and will underpin continued growth in the construction industry for at least the next 40 years. An estimated total of 246 full-time equivalent (FTE) person-years will be directly required for the development and on-site construction of the project. The flow-on benefits of this employment will 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 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 operating revenue of the proposed Gold Coast Quarry is projected to be in the order of $45M per annum upon completion. The flow-on or multiplier effects to the Queensland economy are estimated to be in the order of $43.5M, with $40.3M generated within the local Gold Coast economy.

A Cost Benefit Analysis has been prepared as part of the EIS to measure whether or not the benefits derived by the community from the proposed Gold Coast Quarry outweigh the community costs associated, and if so, the extent to which they do. The Cost Benefit Analysis found that the project is expected to deliver a positive net state benefit with a Net Present Value of $594.7M. Overall, the Benefit to Cost ratio is 4.69. The project provides a positive Direct Net Benefit (to the Proponent) of $91.8M and Indirect Net Benefit (to all other stakeholders) of $502.9M.

Summary of key considerations

The EIS provides a detailed and comprehensive assessment of the economic, environmental and social impacts, both adverse and beneficial, that arise from the project. The individual technical reports which have been prepared by each specialist consultant and which set out, in full, the detailed assessment of the project are submitted as appendices to the EIS. The EIS itself provides a comprehensive summary of each technical report.

The following sections further summarise the EIS and the supporting technical reports to provide a convenient overview of the key findings of the EIS.

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

Noise

The detailed acoustical assessment prepared as part of the EIS has confirmed that the project can achieve full compliance with the relevant noise emission targets set by the *Environmental Protection (Noise) Policy 2008*.

The acoustical assessment has been based on a site evaluation which included the measurement of the current ambient noise levels, determination of source sound power levels of plant and equipment at the quarry together with prediction of the impact of noise from the quarry during pre-construction, construction and operation stages of the project.

By having regard to the current ambient noise levels, the nature of the project and adopting the most stringent set of criteria, the acoustical assessment established the following limits for noise emissions for the project:

Location	Pre-Quarrying Stages (Establishment Stage, Development Stage and Construction Stage)	Quarrying Stage
Old Burleigh Town (Location A)	43dBA	43dBA
Tallebudgera Creek Road (Location B)	43dBA	42dBA
Tuesday Drive (Location C)	33dBA	32dBA
The Observatory, Stage 20 (Location D)	38dBA	35dBA
Kingsmore Estate (Location E)	40dBA	40dBA

The acoustical assessment confirms that compliance with the relevant noise emission targets for all stages of the project is fully expected to be achieved.

The project is able to achieve compliance as a result of the sensitive design approach together with the implementation of the following straight-forward noise control measures to which the proponent has committed:

Pre-Quarrying Phases

> the strategic placement of items of major noise generating plant to maximise the beneficial shielding provided by the retained high ground

> the construction of a 3m high noise barrier along the outer rim of the sedimentation pond at Phase E3

> the construction and deployment of 5m high moveable modular barriers close to one or more of the mobile primary crushers from the commencement of Establishment Phase E2/E3

> the deployment of a 5m high moveable modular barrier located in close proximity to the single mobile primary crusher to be deployed throughout Phases C1 and C2

> the erection of a 8m high 176m long barrier / earth mound combination constructed along the high ground immediately to the west of western extent of Phase C2 together with a 6m high 111m long barrier / earth mound combination constructed along the northern edge of Phase C2 as shown in Figure G-C2-2

> Compliance with the requirements of a Construction Noise Management Plan, especially with regard to the selection, operation and maintenance of “low noise” plant and equipment.

Quarrying Phases

> the full enclosure of all fixed crushing and screening plant, with openings in the enclosures for the entry and passage of product and conveyors only.

- at, or prior to, the commencement of Phase Q5, the construction of a 6m high 150m long fixed acoustic barrier along a line parallel to and set back 6m from the common boundary with The Observatory Stage 20.
- rock drilling to be carried out using a “low noise” rock drill only which is to be operated for the minimum time feasible and, where necessary, screened using moveable modular barriers located at appropriate elevated positions between the operating drill rig and the nearest residences.
- compliance with the requirements of an Environmental Noise Management Plan, especially with regard to the selection, operation and maintenance of “low noise” plant and equipment.

The fact that the project will be fully compliant with the regulatory limits for noise emissions demonstrates that no unacceptable nuisance will affect residential dwellings or other sensitive areas over the course of the project.

Blasting

Blasting is a standard, necessary and highly-controlled component of extractive industry operations. Blasting can potentially generate two types of adverse impact: air-borne vibrations (known as overpressure) and ground-borne vibration. Both overpressure and ground vibration levels are affected by blasting parameters, local geological characteristics and the topography between the blast source and the receiving environment.

In addition to the effects on rock mass that blasting is designed to create in the quarrying process, blasting at certain thresholds can affect personal amenity and structures. It is for this reason that blasting activities are subject to stringent regulation under Queensland’s *Environmental Protection Act*.

The project has been designed to ensure compliance with the regulatory limits set down by the *Ecoaccess 2006 Guidelines* (which support the operation of the *Environmental Protection Act 1994*). These regulations effectively limit ground vibration from blasting to 5 mm/s, and overpressure levels to 115 decibels (Linear) on at least 9 out of any 10 consecutive blasts. In addition, no vibration levels are to exceed 10 mm/s and no overpressure levels are to exceed 120 decibels (Linear) at any affected residence. For the purposes of modelling, this report has used a 95 percentile criterion in order to comply with the *Ecoaccess 2006 Guidelines*. The new proposed conditions are more onerous than the existing West Burleigh Quarry.

The blasting impacts of the project will be well below the regulatory limits for human comfort and orders of magnitude below the levels that would be likely to generate structural damage. Any higher levels of vibration and overpressure will be fully contained within the boundaries of the proponent’s site.

The project is able to achieve compliance with the regulatory limits because of the separation between source and receiver that will be provided by the retention of vegetated buffers on the proponent’s land. The design of the development areas, together with the proponent’s commitment to adopt blast designs and operational procedures that have been developed in specific response to the local circumstances, also contribute to the blasting impacts being fully compliant.

Compliance with the regulatory limits effectively ensures a very low chance of damage to residential or commercial structures. Whilst there is sometimes a perception that vibration must cause damage to structures, there are no examples anywhere in the world where such damage has been substantiated. Notwithstanding, the TOR stipulates that the EIS should include an outline of the scope and methodology or pre-construction building surveys including a preliminary identification of the type and location of properties that should be surveyed. The proponent therefore proposes to offer building condition surveys to a limited number of houses in the surrounding area, prior to the commencement of works at the site, currently scheduled for 2016. The condition surveys will only be conducted if the property owners provide the necessary consent.

Blasting activities at the site will be fully compliant but will still be perceptible at some locations in the surrounding area. The proponent therefore proposes to carry out blasting on a weekly basis (that is, on average, every seven days). Blasting will generally be carried out in the middle of a regular weekday to minimise any disturbance to the surrounding area.

The vibration and overpressure impacts for each weekly event will have a duration of around two seconds, amounting to approximately 1.7 minutes of impact per year and a total of only 1 hour and 40 minutes over the 40 year operational life of the project.

Blasting at the proposed quarry will be conducted by highly trained and experienced shot-firers in strict accordance with both regulatory requirements and tested operational procedures. No explosives will be stored at the site.

The fact that the project will be fully compliant with the regulatory limits for blasting impacts demonstrates that no unacceptable nuisance will affect residential dwellings or other sensitive areas over the course of the project.

Air Quality

A review of the project identified that the most important air pollutant would be dust (considered as TSP[2], PM2.5 and PM10[3]).

The air quality impact assessment has investigated the potential effect of dust emissions arising from the project at the stage of operations with the highest potential to generate air pollutant emissions. A cumulative assessment of the Gold Coast Quarry combined with ambient dust concentrations in the wider region was conducted. The air quality assessment also conservatively quantified crystalline silica emissions from the quarry and the potential health risk associated with such emissions.

The following activities proposed by the project have the potential to result in dust emissions:

- material handling by site machinery such as bulldozers / front end loaders / scrapers
- drilling of blast holes within the pit area
- blasting within the pit area
- excavation of raw material
- processing of raw material (crushing and screening) by both mobile and fixed plant
- wheel generated dust associated with haulage of raw material and product
- wind erosion of raw material and product stockpiles
- wind erosion of exposed areas (pit and plant areas)

The proponent has adopted specific design parameters and committed to a suite of operational practices that manage the potentially adverse impacts of dust emissions. A dispersion model was developed and used to predict dust concentrations in the surrounding residential communities that may be associated with the project. The design parameters and operational practices adopted by the proponent were incorporated in the dispersion model. Dust concentrations have also been predicted in the vegetated buffer that surrounds the disturbance area of the quarry. The vegetated buffer is located on the proponent's land and was designed to maximise separation distances between the disturbance footprint and residential land-uses. A vegetated buffer will always be maintained between the quarry disturbance area and the boundaries of the site.

The key findings of the air quality assessment of the project are:

- the predicted ground-level concentrations of TSP, PM10 and PM2.5 due to the project are below the applicable regulatory limits in all residential areas and at all sensitive receptors assessed in isolation and cumulatively
- the predicted dust deposition rates due to the project are below the relevant objectives and assessment criteria in all residential areas and at all sensitive receptors due to project operations assessed in isolation and cumulatively

[2] Total suspended particles
[3] Particulate matter less than 2.5 or 10 microns, respectively

- some areas of the vegetation buffer receive high dust deposition rates when evaluated against residential amenity criteria, but these are not considered large enough to adversely affect vegetation. The majority of the vegetation buffer receives a relatively low dust deposition rate
- the predicted concentrations of respirable crystalline silica from operations of the project are less than 10% of the EPA Victoria assessment criterion in all residential areas and at all sensitive receptors
- a Queensland Government study in 2009 measured respirable crystalline silica near two quarries in the Mount Cotton community. The study found that measured concentrations of respirable crystalline silica were less than 10% of the EPA Victoria assessment criterion
- based on the findings of this assessment of the proposed Gold Coast Quarry and inference from the findings from the Queensland Government study, emissions of crystalline silica from the Gold Coast Quarry are low and present a minimal health risk.

The fact that the project will be fully compliant with the regulatory limits for air quality emissions demonstrates that no unacceptable nuisance or health impacts will affect residential dwellings or other sensitive areas over the course of the project.

Scenic amenity and visual impact

The site occupies a complex arrangement of ridges, spurs and side valleys between Old Coach Road and Tallebudgera Creek Road, south of the Pacific Motorway (M1), the existing Boral West Burleigh Quarry and a former quarry now used as the Reedy Creek Recycling Centre and industrial development. The surrounding area of West Burleigh, Tallebudgera and Reedy Creek also includes residential and rural residential development, rural properties and forested ridges, forming part of the interface between the urban and hinterland parts of the City of Gold Coast.

The existing landscape values of the study area are associated mainly with its topography and its interface between urban and hinterland areas. The main ridges extending north-east from Springbrook to the coast are identified as visually significant. In general, these ridges form broad green wedges of forested hills which characterise the interface, although several have ridge-top housing or pockets of quarrying (current or past). These ridges form the background hills and forested skylines to local views and scenic driving routes; they divide and distinguish each residential precinct, and they also provide their setting and neighbourhood identity. The site is part of one of these forested ridges, which form important landscape elements in the study area, and the southern part of Gold Coast generally. However the site is not prominently visible from public places or within view corridors identified by Council as important to the Gold Coast, with the exception of an internal ridgeline and a ridge peak outside the proposed disturbance footprint.

The viewsheds of potentially affected residential areas were analysed as part of the EIS. The key finding was that the natural topography, wide separation buffers and the distance of view from residential dwellings all contribute to significantly reducing the visual impact of the proposed development.

Additional mitigation measures are proposed to address the small extent of operational areas that will be temporarily visible over the course of the development, including:

- staged rehabilitation of terminal quarry benches and faces
- temporary rehabilitation works on some interim quarry benches and faces
- design, orientation and treatment of exposed faces
- trialing of non-vegetative measures to soften and screen exposed faces, as necessary

The combined effect of the topographical characteristics of the site, the sensitive design approach that has been adopted, and the additional mitigation measures to which the proponent has committed is that the visual impacts of the project are minor and acceptable.

Transport

The EIS includes an assessment of the project's potential to significantly increase traffic volumes or cause significant impacts on the safety and efficiency of the surrounding road network.

The Queensland Department of Transport and Main Roads (TMR) and Gold Coast City Council are currently considering a connection linking the Pacific Motorway and Old Coach Road at the Bermuda Street Interchange. Although TMR's future Bermuda Street connection is widely known and documented, it is currently unfunded and therefore the timing of its construction is uncertain. As a result, the EIS has considered two alternative road network scenarios: one road network with TMR's future Bermuda Street connection and one without.

It is important to note that TMR's future Bermuda Street connection are totally separate road improvements being independently investigated by road authorities and are not proposed or relied upon by the project.

The EIS demonstrates that the project is not anticipated to have a significant impact on the surrounding road network, irrespective of the timing of TMR's future Bermuda Street connection. That is, the project generated traffic is not anticipated to significantly impact the performance of existing or future intersections within the study road network or significantly bring forward the need for upgrade works.

A safety assessment was undertaken for the proposed site access intersection which indicated that a channelised right turn lane and an auxiliary left turn lane should be provided at the intersection. A conceptual layout for these works has been developed and is submitted as part of the EIS.

A detailed pavement assessment was also undertaken, accounting for the impacts of project traffic on the State Controlled Road network. Contributions have been calculated based the two alternative road network Scenarios.

Based on the data and analysis contained within this report, the proposed Gold Coast Quarry project is anticipated to have an insignificant impact on the safety and efficiency of the road network.

Surface Water

The EIS provides a detailed overview of the characteristics of the site and the condition of its existing water resources.

Local climatic conditions are influenced by both sub-tropical and temperate weather patterns. The surrounding region experiences moderate temperatures and an annual average rainfall of 1,491 mm/year, the majority of which falls in the wet season.

Historically, the site was used for rural purposes (particularly grazing), but with the cessation of rural activities, scattered to dense regrowth vegetation has re-established across most of the site. Patches of remnant vegetation also feature in a number of locations. Numerous four wheel drive (4WD) and off-road motorbike tracks currently traverse Lot 105 and, although most of the vegetation across the property remains unaffected by these unlawful uses, widespread damage to the site's natural assets has occurred where tracks have been formed. Damage is most evident on steep slopes and in waterways particularly in the lower parts of the catchments on the northern part of Lot 105.

The site 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).

In terms of water quality, the downstream receiving environments including, the Nerang and Tallebudgera Estuaries, are generally in good to excellent health. Water quality monitoring was undertaken on Lot 105 over a period in excess of seven months during the preparation of the EIS. Water quality monitoring of stormflow events on site was undertaken for a period of over eight months during the preparation of the EIS, and seven stormflow events were sampled during this period. The results demonstrated that stormflow concentrations of a number of water quality parameters typically fail to meet receiving water quality objectives under the existing site conditions.

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 the site:

> an ephemeral, third order stream that traverses the site to the south of the disturbance footprint

> an ephemeral, second-order stream that traverses the site downstream of the northern limit of the disturbance footprint

The disturbance footprint has been specifically designed and sited to preserve both watercourses. The only points at which the disturbance footprint intersects with either watercourse are the proposed points of discharge.

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

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

> 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 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.

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 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 the stormwater pollutant loads discharging from the site, thereby improving the quality of surface water from existing conditions.

An ongoing water quality monitoring program will continue over the course of the project.

Groundwater

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 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 m to 20 m and tight, non-stained joints, in the deeper fresher rock.

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 (the upper, open fractured zone) 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 maintains creek flow for some time. However, pools in the creek beds 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.

The project is expected to have a minor impact on the regional groundwater system. 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. As drawdown from quarry dewatering will primarily be in the fresh rock there no or minimal impact on this particular bore is expected.

  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

  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. However, the EIS has confirmed that none of the *ecosystems present within the study area are identified as communities that are dependent on groundwater"*. No adverse impact on groundwater dependant ecosystems is therefore expected.

  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 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 kilometres around the extraction area.

> 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, naturally occurring trace metals. 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.

A groundwater management and monitoring plan is not considered necessary as groundwater is not a significant resource on which either persons or ecosystems in the study area depend and the impacts of the project on the groundwater regime are minimal. The potential for groundwater-related environmental or social impact to result from the project is therefore considered negligible.

Terrestrial flora and fauna

The existing flora and fauna assemblages of the site were investigated as part of a range of studies to inform the EIS. Investigations were primarily undertaken during both dry season and wet season sampling periods to allow for seasonal differences.

Flora field work used Queensland Herbarium methodologies to capture vegetation community and species information within, and where practicable, immediately surrounding the study area.

Regional ecosystem mapping was completed at a scale of 1:10,000 for the study area. The study area was mapped as supporting areas of remnant and regrowth of 'Endangered', 'Of Concern' and 'Least Concern' regional ecosystems as well as areas of non-remnant vegetation. The study confirmed the presence of all 4 regional ecosystems previously mapped by the State.

This study confirmed the presence of 8 flora species scheduled as threatened under the N*ature Conservation Act 1992* and/or the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*. These include Silver leaf (*Argophyllum nullumense*), Long-leaved Tuckeroo (*Cupaniopsis newmanii*), Ball-fruited walnut (*Endiandra globosa*), Slender milkvine (*Marsdenia coronata*), Birdwing butterfly vine (*Pararistolochia praevenosa*), *Rhodamnia maideniana*, Durobby (*Syzygium moorei*) and Ribbon-root Orchid (*Taeniophyllum muelleri*). Significantly, none of these species were identified as occurring within areas directly impacted by the proposed disturbance footprint.

Fauna field investigations were undertaken in line with approved permits. Survey techniques used were diurnal/nocturnal bird searches, ground searches, Elliott trapping, pitfall trapping, hair funnel trapping, funnel trapping, camera trapping, spotlighting, transect counts, ultrasonic detection, call playback and habitat assessment.

Field investigations confirmed the presence of 12 native mammal species, 11 native reptile species, 9 frog species and 69 bird species. In addition 2 non-native mammal and 1 exotic amphibian species were identified.

While there is widespread evidence of koala use (scats and scratches) and individual koalas were observed on 4 separate occasions during the study, dedicated transects aimed at estimating the site's carrying capacity failed to record any individuals. Given this, a conservative estimate of 0.01 – 0.1 koalas/ha has been adopted based on areas yielding similar characteristics within the Koala Coast.

Glossy Black-Cockatoo's were recorded utilising feed resources external to the proposed development footprint. An active white bellied sea eagle nest was also confirmed during the study outside of the proposed development footprint.

The entire study area occurs within the Springbrook to Burleigh Heads Bioregional Corridor.

The proposed development avoids direct impacts on the 8 threatened flora species. While the development footprint will result in the clearing of 63ha of vegetation of mixed integrity, the proposed buffer accounts for

152ha that will be restored and managed. The proposed buffer retains the Whitebellied Sea-eagle nest and a number of known Glossy-Black Cockatoo feed trees.

Where impacts on values are unavoidable, the proponent has committed to the following mitigation measures:

> the enhancement of buffer area vegetation through restoration

> the staged and sequential clearing of vegetation over the life of the quarry

> the delivery of an ecologically equivalent vegetation offset to offset the limited, unavoidable areas in which the clearing of vegetation is required

> propagation of seed from known Glossy-Black Cockatoo trees for use in restoration plantings

> design site access to include features to facilitate wildlife movement across the break in habitat

> provision of net benefit to koalas through delivering the recommendations of the Koala Management Plan

> monitoring of indirect impacts on threatened plant species. Adverse findings will trigger mitigation responses.

The proponent has demonstrated a strong commitment to the principles of ecologically sustainable development and sensitive design in all aspects of the project. The project is fully compliant with the regulatory framework and will deliver valuable, high quality environmental outcomes on the site.

Matters of national environmental significance

The project was referred to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities under the *Environment Protection and Biodiversity Conservation Act 1999* (**EPBC Act**) and, on 21 December 2010, was determined to constitute a controlled action. The proponent self–nominated as a controlled action.

The EIS 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. (5184518A)

Field surveys identified the presence of three 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, and *Marsdenia coronata* (Slender Milkvine) was found within Eucalypt open forest. With the exception of a single feeding Grey Headed Flying Fox, no EPBC-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 the Koala was recorded in the study area, it was not scheduled as a vulnerable species at the time of the controlled action determination. Despite this, the proponent 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 on 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.

The project will not directly or indirectly affect threatened plant species on 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 regard 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.

The EIS 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.

Aquatic ecology

The aquatic habitat, plants and animals of the survey area have been assessed.

The biological values of the aquatic ecosystems within the survey area were moderate to good, and were consistent with those of other undisturbed areas in the region.

Environmental values are dictated by the ephemeral and intermittent nature of most of the waterways on the project site; residential developments, created canals and lakes and weed incursions influence the water quality and physical characteristics of watercourses downstream of the site. Waterways in the catchment were generally in moderate to good habitat condition and are characterised by:

> limited channelisation

> variety of substrate cover, and

> high bank stability.

Water quality measured in situ was poor with low pH and per cent saturation of dissolved oxygen, and high turbidity and electrical conductivity. Biodiversity was relatively low, with a low per cent cover of aquatic plants and low species richness. Fish and macroinvertebrate communities were low in diversity and comprised species that are tolerant of varying and often harsh conditions. However, the fish communities within the project area were likely to contribute to the success of downstream populations, through movement and migration.

No listed species of aquatic plants or animals, under state or Commonwealth legislation were recorded, or were likely to occur in the waterways of the project area.

The potential impacts of the project on aquatic ecology have been minimised by the proponent committing to:

> implementing best practice fuel handling and erosion and sediment control practices

> reducing runoff through stormwater harvesting, storage and reuse;

> implementing an Erosion and Sediment Control Plan

> carrying out any necessary vegetation clearing in a sequence of discrete stages

> developing a dewatering strategy for the quarry dam and a flocculation and dewatering strategy for the sedimentation pond

> installing and managing appropriate sewerage infrastructure to avoid discharge of raw or treated sewage to watercourses.

> ensuring all water released from the site meets the acceptable water quality objectives

The project is not considered likely to impact any listed vulnerable or endangered aquatic species or ecological communities, as listed under state or Commonwealth legislation, or habitats of conservational significance given the proponent has committed to implementation the recommended mitigation measures are put in place.

This EIS demonstrates that there will be a low magnitude impact to the local aquatic environments of the project, and negligible regional impacts.

Indigenous Cultural Heritage

The Project is situated within the external boundaries of the registered Gold Coast native title claim (QUD346/2006). The applicant for the native title claimants, who are the Aboriginal parties for the purposes of the ACH Act, have authorised Jabree Limited as the registered Aboriginal cultural heritage body for the native title claim area.

During the EIS, a Cultural Heritage Management Plan (CHMP) was developed pursuant to Part 7 of the *Aboriginal Cultural Heritage Act 2003*, and it has been approved by Director of Cultural Heritage on behalf of the Chief Executive of Department of Aboriginal and Torres Strait Islander and Multicultural Affairs by letter dated 13 November 2012.

In accordance with the CHMP, a cultural heritage survey, consisting of a desktop cultural heritage study, consultation, and assessment through fieldwork has been conducted, and a cultural heritage survey report prepared. Jabree Limited facilitated all aspects of the work associated with the completion of the cultural heritage survey including fieldwork, technical reporting, community consultation and provision of clearance certificates.

Jabree Limited undertook an 11day fieldwork program in November 2012, which involved a desktop review and standard and complex assessments of the project area. Jabree Limited then prepared a cultural heritage survey report that included outcomes of the fieldwork program, the desktop review, consultation and appropriate management recommendations.

During the standard assessment a total of 50 items of Indigenous Cultural Heritage were identified, representing 45% of the total assemblage recorded in 2012. The Indigenous Cultural Heritage recorded during the 2012 cultural heritage survey consisted of:

> Thirteen (13) isolated stone artefacts consisting of individual find sites of a single artefact;

> Nine (9) stone artefact scatters incorporating a group of two or more artefacts which were located on the ground or sub-surface; and

> One (1) site complex which reflects a complex of stone artefact scatters and isolated artefacts.

No occupation sites, ceremonial areas, rock art, quarries, or Indigenous scarred trees were located within the GCQP area during fieldwork. There was no impediment to the conduct of the cultural heritage survey, which was conducted with Traditional Owners present.

The cultural heritage survey documented a single site complex (B SC13) that is outside of the proposed disturbance footprint but within the project area.

The B SC13 site complex comprised 55% of the total assemblage. These sub-surface artefacts were discovered across 3 test pits and 15 shovel probes within a radius of approximately 700m^2.

All previously recorded sites were inspected during the 2012 cultural heritage survey fieldwork. While these sites were within the disturbance footprint, there was no evidence found in the 2012 cultural heritage survey of these or any other artefacts at any of the recorded locations. Further, the scarred trees were determined to be naturally occurring scars and not of Indigenous origin.

On the basis of the findings of cultural heritage survey and the results of the surface and sub-surface investigations, Jabree Limited has advised the proponent that, pending the implementation of recommendations and receiving statutory approvals, the proposed works associated with the development of the project can proceed, subject to the terms of the agreed CHMP.

Cumulative impacts

Potential cumulative impacts are those which are generated by the combined impacts on the local environment as a consequence of the project, together with other developments of a similar nature (both existing and proposed). For the purposes of the EIS, the assessment of cumulative impacts considers the impacts of existing and proposed extractive industry development in the local area.

There are no other, known, large-scale quarry proposals situated within the central or southern Gold Coast region that would cause either a beneficial or adverse cumulative impact. Since the implementation of the 2003 Gold Coast Planning Scheme, no new quarries have been established in the Gold Coast region. In fact, a number of quarries have since been closed.

Much of the known greywacke resources are inaccessible as a result of encroachment by existing development or unsuitable topography. Suitable rock for construction and urban development is a finite resource, and the future closure of existing quarries, without the establishment of new operations, will ultimately result in demand for construction aggregates exceeding the available supply.

The EIS has confirmed that the site is the last remaining, accessible opportunity to extract hard rock resources. If the project proceeds, the Gold Coast, and particularly the southern portion of the region, will have access to a high grade source of rock that will be instrumental for the purposes of future building and infrastructure construction. For example, the Council's recently released *Draft Gold Coast Transport Strategy 2031* identifies a number of major transport infrastructure projects for the southern end of the City. All of these projects will need construction aggregates that can be supplied cost-effectively. The project will be able to efficiently and effectively supply material to meet demand, which will be increasingly important once the West Burleigh Quarry ceases operation. The expected life of the project means that the southern portion of the Gold Coast will be adequately serviced with material for a number of years, which will be beneficial in the context of the future growth and development of this area. It will also assist both the Council and Queensland Government to cost-effectively deliver major infrastructure and associated upgrades.

Conversely, relying on the quarries in the northern portion of the Gold Coast, most of which service development projects in the greater Brisbane area, will impact on the extent of hard rock resource that is available to deliver projects across the City. The life of these existing quarries could be significantly shortened as a result. The EIS has demonstrated the impact of this scenario in an economic context with monopolies being created which in turn potentially increases the cost for materials for consumers.

The EIS has also demonstrated that impacts associated with the proposed development can be appropriately mitigated to ensure that compliance with regulator limits will be achieved. More specifically:

> There are no cumulative impacts in relation to acoustic impacts. The EIS has demonstrated that compliance with regulatory limits is achieved throughout the various stages of the project through the implementation of appropriate mitigation measures. Achieving compliance with the regulatory limits is based on the assessment and consideration of the existing background noise levels, which are a cumulative contributor in themselves.

> The EIS has demonstrated that there will be no cumulative impacts associated with air quality since compliance is achieved with the regulatory limits. Again, the assessment has considered background air quality levels which are a representation of the existing, baseline situation.

> There are no cumulative impacts associated with blasting with respect to vibration and overpressure. Compliance with the regulatory limits is achieved.

> There is no cumulative impact on the surrounding road network as a result of the proposed development. The EIS has demonstrated that the proposed development will not significantly impact on the surrounding road network. This determination is based on industry standard methodologies involving the consideration of background growth in traffic volumes which represents a cumulative assessment.

> In terms of scenic amenity, it is acknowledged that after 25-30 years, a limited number of quarry benches will be visible from a limited number of properties in elevated positions within Old Burleigh Town (which currently has views of West Burleigh Quarry). A cumulative impact in terms of visual amenity will not be

created given that the West Burleigh Quarry will have ceased operating and the proponent is committed to progressively rehabilitating the benches of the quarry to reduce visual impacts.

> There are no cumulative impacts associated with flooding. The EIS has demonstrated that there are no significant impacts in terms of increased offside flood levels, flows, velocities or durations.

> There are no cumulative impacts with respect to water quality. The EIS has demonstrated that any release of stored water on the site will have a no worsening impact on the downstream areas in terms of water quality. The EIS has considered the existing water quality associated with stormwater runoff from the site.

> A beneficial cumulative impact is achieved in terms of greenhouse gas emissions if the project proceeds.

> Finally, a beneficial cumulative impact is achieved in terms of economic impact. The EIS has demonstrated that over the life of the quarry it is expected to deliver a positive net State benefit with a Net Present Value of $594.7M. Overall, the Benefit to Cost ratio is 4.69. The project provides a positive Direct Net Benefit (to the proponent) of $91.8M and Indirect Net Benefit (to all other stakeholders) of $502.9M.

The EIS demonstrates that the project will not have any adverse cumulative impacts and, in fact, will deliver beneficial impacts to the broader community.

Planning and land use

The project has been assessed against all components of the statutory planning framework that regulate land use and development. The project is consistent with the intent of the higher order provisions of the planning framework: the *South East Queensland Regional Plan 2009 – 2031*, *State Planning Policy 2/07 – Protection of Extractive Resources* and the Desired Environmental Outcomes of the *Gold Coast City Council Planning Scheme*.

At the more detailed level of the *Gold Coast City Council Planning Scheme*, conflict arises between the project and the requirements of the planning scheme. That conflict is not created by the project itself but is a direct and unavoidable consequence of the planning scheme not having been amended to appropriately reflect the provisions of either the *South East Queensland Regional Plan 2009 – 2031* or *State Planning Policy 2/07 – Protection of Extractive Resources*. The inconsistency between parts of the planning scheme and the higher order statutory planning instruments ought to have been resolved through amendment to the planning scheme as far back as 2007, as required by the *Sustainable Planning Act 2009*.

Despite the fact that the lower order conflict between the project and the planning scheme is a direct consequence of the planning scheme failing to appropriately reflect State Planning Instruments, the conflict is nevertheless justified by the following planning grounds (as is required by the *Sustainable Planning Act 2009*):

> the conflict arises because the planning scheme does not appropriately reflect State Planning Instruments;

> there is a strong need for the project

> the project will activate a Key Resource Area which has been identified as being of significance at the state and regional scale

> the project will activate the last and largest known hard-rock resource on the southern Gold Coast

> the proposed development will comply with all regulatory limits under the *Environmental Protection Regulation 2008* (relating to noise, air quality, blasting and water quality)

> the retention of approximately 70% of the site as vegetated buffer will maintain and enhance the environmental and biodiversity values of the site – an outcome that would unlikely be achieved if the site were developed for urban development in accordance with the planning scheme

> the project does not cut across the high level planning strategy for the City.

The detailed town planning assessment that has been completed as part of the EIS demonstrates that the project is consistent with the higher order provisions of the statutory planning framework and ought to be approved.

Recommendation

The EIS has been prepared to provide a detailed and comprehensive assessment of the environmental, social, cultural and economic impacts of the project, both adverse and beneficial. The EIS also identifies mitigation measures that may be applied to effectively manage any potentially adverse impacts arising from the project.

The EIS has demonstrated that the project can activate a State-significant natural resource for which there is a strong economic, community and planning need in a way that achieves an appropriate balance with the environmental and social values of the site and the surrounding area.

The project complies with all of the statutory limits which regulate the potentially adverse impacts of the project in terms of noise, air quality, blasting and water quality. By clearly demonstrating the ability to comply with all of the applicable regulatory limits, the EIS has established that the project will not have any unacceptable impacts on the existing character, or amenity, of the local area

The site contains a number of important environmental values which are protected at the Commonwealth, the State and the local level. The proponent's commitment to ecologically sustainable development and sensitive design, including the preparedness to retain around 70% of the site as environmental buffers, enables the project to achieve valuable environmental outcomes on the site, including a net benefit for koalas.

The potential impact of the project on the safe and efficient operation of the road network has also been assessed as part of the EIS. The project will not have a significant impact on the operation of the road network.

Finally, the project satisfies the requirements of the statutory planning framework and ought to be approved.

The proponent respectfully requests that the Coordinator-General now considers the EIS and prepares an Evaluation Report for the project.

Glossary

Legislation / Policies

ACH Act	*Aboriginal Cultural Heritage Act 2003*	State
EP Act / EPA	*Environmental Protection Act 1994*	State
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*	Federal
EPP	*Environmental Protection Policy*	State
EPP Air	*Environmental Protection (Air) Policy*	State
EPP (Noise) 2008	*Environmental Protection (Noise) Policy 2008*	State
EPP Water	*Environmental Protection (Water) Policy 2009*	State
Fisheries Act	*Fisheries Act 1994*	State
LPA	*Land Protection (Pest and Stock Route Management) Act 2002*	State
Koala SPRP	*Koala State Planning Regulatory Provisions*	State
NCWR	*Nature Conservation (Wildlife) Regulation 2006*	State
NCA	*Nature Conservation Act 1992*	State
NT Act / NTA	*Native Title (Queensland) Act 1993*	State
QHA	*Queensland Heritage Act 1992*	State
SDPWOA	*State Development and Public Works Organisation Act 1971*	State
SPP	*State Planning Policy*	State
SPA	*Sustainable Planning Act 2009*	State
Water Act	*Water Act 2000*	State

Abbreviations

3G/4G	Third / Fourth Generation of Mobile Technology
4WD	Four Wheel Drive
ABS	Australian Bureau of Statistics
ABN	Australian Business Number
ACN	Australian Company Number
ACCUs	Australian Carbon Credit Units
ADSL	Asymmetrical Digital Subscriber Line
AHD	Australian Height Datum
AHPI	Australian Heritage Places Inventory
ALS	ALS Laboratory Services Pty Ltd
ANZECC	Australian and New Zealand Environment and Conservation Council (as per L&R: Stage 1 Preliminary Site Investigation)
ANZECC	Australia New Zealand Environment Conservation Committee (as per L&R: Lake Water Quality Management Plan)
ARI	Average Recurrence Interval
AS/ AS/ NZS	Australian Standard / Australian / New Zealand Standard
As	Arsenic
AWS	Automatic Weather Station
BAMM	Biodiversity Assessment and Mapping Methodology
BCC	Brisbane City Council
BCR	Benefit-Cost Ratio
BMP	Bushfire Management Plan
BMT WBM	An Engineering and Environmental Consultancy
BoM	Bureau of Meteorology
BP	Before Present; as a convention, 1950 is the year from which BP dates are calculated.
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
C	comparative site
CBA	Cost-Benefit Analysis
Cd	Cadmium
cfu	colony-forming unit
CG or COG	Coordinator General
CH^4	Methane
CHL	Commonwealth Heritage List
CHMP	Cultural Heritage Management Plan
CHRP	Cardno HRP
CLR	Contaminated Land Register
CO_2	Carbon dioxide

COA	Certificate of Analysis
COC	Chain of Custody
Cr	Chromium
CONCAWE	Conservation of Clean Air and Water in Europe. The CONCAWE methods were developed under funding from European and North American groups to quantify noise prediction procedures for emission from large industrial facilities such as oil refineries and petrochemical plants. The methods were first published in 1981 in research paper CONCAWE Report No. 4/81 entitled *The Propagation of Noise from Petroleum and Petrochemical Complexes to Neighbouring Communities*. In contrast to the methods of ISO 9613-2:1996, the CONCAWE algorithms allow prediction of noise emission under calm conditions and specified stability class conditions. The CONCAWE algorithms are endorsed by DEHP, Gold Coast City Council and most State environmental authorities.
CRTN '88	*Calculation of Road Traffic*, UK DoE, HMSO, 1988. This is the method endorsed by DTMR, Gold Coast City Council and various local authorities.
Cu	Copper
DATSIMA	Department of Aboriginal and Torres Strait Islander and Multicultural Affairs
DCC	Department of Climate Change
DCCEE	Commonwealth Department of Climate Change and Energy Efficiency
DEEWR	Department of Education, Employment and Workplace Relations
DEHP	Department of Environment and Heritage Protection
DEM	Digital Elevation Model
DEO	Desired Environmental Outcomes
DERM	Department of Environment and Resource Management now Department of Environment and Heritage Protection (DEHP)
DFE	Defined Flood Event
DNRM	Department of Natural Resources and Mines
DO	Dissolved Oxygen
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DSLR	Digital Single Lens Reflex
DSM:	Digital Surface Model, a 3-dimensional model of the land surface (with vegetation and buildings) generated by LiDAR data
DTM / DEM	Digital Terrain Model / Digital Earth Model, a 3-dimsional model of the land surface (without trees and buildings) generated by computer from contour, survey or remote-sensing data
DTMR	Department of Transport & Main Roads
DPR	Development Proposal Report
EC	Electrical Conductivity
EDS	Economic Development Strategy 2020
EEO	Energy Efficiency Opportunities
EHMP	Ecosystem Health Monitoring Program

EHP	Refer to DEHP
EIS / EIA	Environmental Impact Statement (also referred to as Environmental Impact Assessment)
EIL	Environmental Investigation Level
EMP	Environmental Management Plan
EMR	Environmental Management Register
EMS	Environmental Management System
ENSO	El Niño Southern Oscillation
EP	Equivalent Persons
EPA	Environment Protection Authority (as per Katestone: Air Quality)
EPA	Environmental Protection Agency (as per L&R: Erosion and Sediement Control Program)
ERP	Emergency Response Plan
ESCP	Erosion and Sediment Control Program / Plan
EV	Environmental Value
EVs	Environmental Values
FFDI	Forest Fire Danger Index
FOBOTS	Fibre Optic Break Out Trays
FTE	Full-time Equivalent
GCCC	Gold Coast City Council
GCM	Global Climate Model
GCQ	Gold Coast Quarry (all other references)
GCQP	Gold Coast Quarry Project (as per Jabree Limited)
GFC	Global Financial Crisis
GHG	Greenhouse Gas
GI	Ground Integrity
GIS	Computerised Geographic Information System
GPS	Global Positioning System
GRP	Gross Regional Product
GSM	Global System for Mobile Communications
GSV	Ground Surface Visibility
GWP	Global warming potential
HEV	high ecological value
HFCs	Hydrofluorocarbons
Hg	Mercury
HIL	Health-based Investigation Level
HME	Heavy Mobile Equipment
HRPP	Humphreys Reynolds Perkins Planning (see also CHRP)

HSEC	Health, Safety, Environment and Community
HV	High Voltage
HV/ HGV	Heavy Vehicle / Heavy Goods Vehicle
ICH	Indigenous Cultural Heritage
ICOMOS	International Council on Monuments and Sites
IDAS	Integrated Development Assessment System
IECA	International Erosion Control Association
IFD	Intensity Frequency Duration
IPCC	Intergovernmental Panel on Climate Change
IRTM	Interactive Resource Tenure Map
KRA	Key Resource Area
kW / kWh	Kilowatt/ Kilowatt hour
L&R	Lambert & Rehbein (SEQ) Pty Ltd
LCC	Large Customer Connection
LCS	Laboratory Control Spike
LED	Light Emitting Diode
LGA	Local Government Area
LHR	Local Heritage Register
LiDAR	Light Detection And Ranging
LOR	Limit of Reporting (Laboratory Analysis)
Lot 105	Lot 105 on SP144215 and constitutes the land that is subject to the proposed quarry development
Lot 901	Lot 901 on RP907357, which constitutes the reserved that is administered by the Gold Coast City Council as the trustee and is not relied upon for the project.
LULUCF	Land Use, Land Use Change and Forestry
lux	Standard International unit of illuminance
LWQMP	Lake Water Quality Management Plan
MCU	Material Change of Use
MGA	Map Grid of Australia (Australian Map Grid)
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
N_2O	Nitrous oxide
NAMU (GCCC)	Natural Areas Management Unit
NATA	National Association of Testing Authorities
ND	no data
NEPM	National Environment Protection Measure
NGA	National Greenhouse Accounts
NGER	National Greenhouse and Energy Reporting
NHL	National Heritage List
Ni	Nickel

NICH	Non-Indigenous Cultural Heritage
NPI	National Pollutant Inventory
NPV	Net Present Value
NT	northern tributary site
NTU	nephelometric turbidity unit
OCP	Organochlorine Pesticide
OESR	Office of Economic and Statistical Research
OH&S / OHS&E	Occupational Health and Safety/ Occupational Health and Safety and Environment
OPP	Organophosphorous Pesticide
PAH	Polycyclic Aromatic Hydrocarbon
Pb	Lead
PCA	Property Council Australia
PDO	Pacific Decadal Oscillation
PFCs	Perfluorocarbons
PFD	Process Flow Diagram
pH	measure of acidic or basicity
PID	Photo Ionisation Detector / Proporhomal, Integral, Derivative
PM	particulate matter (fine dust)
PMF	Probable Maximum Flood
PPE	Personal Protective Equipment
PPV	Peak Particle Velocity (in mm/ sec)
PSI	Preliminary Site Investigation
P & ID	Piping and Instrumentation Diagram
QA	Quality Assurance
QC	Quality Control
QHC	Queensland Heritage Council
QHR	Queensland Heritage Register
QLD	Queensland
QNT	Queensland National Trust
QSA	Queensland State Archives
QWQG	Queensland Water Quality Guidelines
REDD	Regional Ecosystem Description Database
RBL	Rating Background Level. For the purposes of determining the limits for acceptable levels of noise emission from facilities not yet established, the background noise level is determined as the longterm background noise level (minL_{A90}) also termed the Rating Background Level, RBL. This value is determined using the methods described in Appendix B of DEHP *Planning for Noise Control*.
RL	Reduced Level
RNE	(former) Register of the National Estate
ROM	Run of Mine
RP	Registered Plan

RPD	Relative Percentage Difference
SCA	Sunshine Coast Airport
SD	standard deviation
SEQ	South East Queensland
SEQRP	South East Queensland Regional Plan 2009 – 2031
SEWPaC	(Commonwealth) Department of Sustainability, Environment, Water, Population and Communities
SIGNAL	stream invertebrate grade number - average level
Site	Lot 105 (as per L&R: Erosion and Sediment Control Program, Civil and Environmental Staging Details, Stormwater Management Plan, Overburden Management Plan)
SWMP	Stormwater Management Plan
SMP	Site Management Plan / Safety Management Plan
SOI	Southern Oscillation Index - an indicator of the intensity of the ENSO phenomenon, specifically, the difference in mean sea level air pressure between Tahiti and Darwin
sp.	species
spp.	species'
SPRAT	Species Profile and Threats (Database)
SRN	Sample Receipt Notifications
SST	sea surface temperature
ST	southern tributary site
STS	Sewerage Treatment System
SWL	Standing Water Level / Safe Working Load
TAPM	The Air Pollution Model
TEC	Threatened Ecological Community
TMR	(Department) Transport and Main Roads
ToR / TOR	Terms of Reference
TPH	Total Petroleum Hydrocarbons
TPZ	Tree Protection Zone
TSS	Total Suspended Solids
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
USEPA	United States Environmental Protection Agency
VIA	Visual Impact Assessment
VMA	Vegetation Management Act
VSD	Variable Speed Drive
VSI	Vertical Shaft Impactor
W	wetland or farm dam site
WHL	World Heritage List

WLL	Working Load Limit
WMA	Wetland Management Area
WTC	Waste Transport Certificate
WQO	Water Quality Objective

Measurements

°C	degrees Celsius
µ	microns (m + 10 - ^{6})
µg/L	micrograms per litre
µg/m^3	micrograms per cubic metre
d/year / dpy	Days per year
dBL	decibel (linear) (as used for meaning air blast)
dBA	Decibel (A – weighted scale)
g/s	Grams per Second
GJ	Gigajoule
h/day / hpd	Hours per Day
ha	Hectares
K	Kelvin (unit of measurement of colour temperature)
kg/hr	Kilograms per Hour
kl	Kilolitre
km	Kilometre (m x 10^3)
kt	Kilo-tonnes (t x 10^3)
kVA	Kilovolt Ampere
kW	Kilowatt
k + pa	Thousands of tonnes per annum
L	Litre
$L_{10(18hour)}$	$L_{10(18hour)}$ is defined by DTMR in their *Road Traffic Noise Management: Code of Practice* and by UK DoE in their *Calculation of Road Traffic*, as the arithmetic mean of each of the eighteen hourly $L_{10,1hr}$ levels between 6:00am and 12:00 midnight on an average weekday where $L_{10,1hr}$ is the noise level measured in dBA that is exceeded for 10% of the specific one hour period.
$L_{A01,15min}$	The A-weighted sound pressure level exceeded for 1% of the 15 minute monitoring time interval.
$L_{A10,15min}$	The A-weighted sound pressure level exceeded for 10% of the 15 minute monitoring time interval.
$L_{A90,15min}$	The A-weighted sound pressure level exceeded for 90% of the 15 minute monitoring time interval, also termed the background noise level.
$L_{Aeq\ adj,T}$	Adjusted energy average A-weighted sound pressure level. $L_{Aeq\ adj,T}$ is the adjusted energy average A-weighted sound pressure level over the time period, T. It is the constant noise level whose energy is equivalent to that of the noise level which varies over time plus, if applicable, an adjustment for noise character.
$L_{Aeq,15min}$	The energy average A-weighted sound pressure level over the 15 minute monitoring time interval.
$L_{AMAX\ adj.t}$	Adjusted average maximum A-weighted sound pressure level. $L_{Amax\ adj,T}$ is the adjusted average maximum A-weighted sound pressure level over the time period, T. When measured using a sound level meter, it is determined as the average of the maximum noise levels plus, if applicable, an adjustment for noise character.

L_w	Sound power level is a measure of how powerful a source is acoustically. It is measured in decibels (dB or dBA) and given by the equation, $L_w = 10 \log(w/w_0)$, where w is the sound power of the source measured in Watts and w_0 is set equal to 10^{-12}W (ie 1 picowatt). By contrast, the actual sound pressure level that would be measured at any point will depend on the sound power level, the distance between the source and the receiver and the nature of the space in which the determination of sound pressure level is made. The significance of the difference between these two parameters can be illustrated by drawing the analogy to a light bulb (electric lamp) in a room. The difference between sound power level and sound pressure level can be compared to the difference between the power of a light bulb (which is fixed and is measured in Watts), how bright it appears (which depends on its power as well as the distance from the light bulb) and the amount of reflection in the room (ie the nature of the space).
L_p	A level value measured in decibels (dB or dBA) and given by the equation, $L_p = 10*\log(p^2/p^2_0)$, where p_0 equals $2x10^{-5}$ Pa (ie 20 micropascals).
m	metres
m/s	metres per second
m^2	square metres
m^3	Cubic metres
m^3/s	cubic metres per second
m bgl	metres below Ground Level
Mbps	Mega bits per second
mg	milligram
mg/kg	milligrams per Kilogram
mg/L	milligrams per Litre
mg/m²/day	milligrams per Square Metre per Day
MJ/m²	megajoules per square metre
mm	millimetre
mm/s	millimetres per second
mm/yr	millimetres per Year
Mt	Million tonnes
Mtpa / mtpa	Million tonnes per annum
MW	Megawatt
MWh	Megawatt hour
Peak particle velocity (ppv)	A measure of ground vibration reported in millimetres per second (mm/sec).
PJ	Petajoule
$PM_{2.5}$ and PM_{10}	Particulate matter less than 2.5 or 10 microns, respectively
ppm	Parts per million
t	tonne
tCO_2-e	tonnes of CO_2 equivalent
TJ	Terajoule
tpa	tonnes per annum
tph	Tonnes per hour
TSP	total suspended particles

Definitions

Aeration	The process of increasing the oxygen saturation of the water
Aesthetic	concerned with visual appreciation of beauty, a sensory and subjective experience which brings pleasure to the viewer
Airblast Overpressure	A shock wave form, resulting from the activity of man or from natural processes, causing adverse effects to man and the environment.
Air pollutant	A substance in ambient atmosphere, resulting from the activity of man or from natural processes, causing adverse effects to man and the environment (also called "air contaminant").
Ambient air quality	The quality of the ambient air near ground level, expressed as concentrations or deposition rates of air pollutants - also expressed as existing air quality.
Amenity:	The pleasantness or usefulness of a place, as conveyed by desirable attributes
Annual Exceedance Probability	Means the likelihood of occurrence of a flood of a given size or larger in any one year, usually expressed as a percentage. For example, if a peak flood discharge of 500 cubic metres per second has an AEP of 5 percent, it means that there is a 5 percent risk, that is the probability of 0.05 or a likelihood of 1 in 20, of a peak flood discharge of 500 cubic metres /second or larger occurring in any one year. The AEP of a flood event gives no indication of when a flood of that size will occur next.
Attribute	(with respect to landscape) An identifiable element, quality or characteristic located at or associated with a place or feature
Attributes	see Elements, Criteria and Indicators
Average Recurrence Interval	Means the average period between the recurrence of a storm event of a given rainfall intensity. The ARI represents a statistical probability. For example, a 100 year ARI indicates an average of 100 years between exceedance of a given storm magnitude
Background noise levels	The level of the ambient sound indicated on a sound level meter in the absence of the sound under investigation (eg sound from a particular noise source; or sound generated for test purposes).
Blasting	The operation of breaking rock by means of explosives.
Boral	Boral Resources (QLD) Pty Limited
Bund wall	A man-made earth mound.
Catchment area	The area determined by topographic features within which rainfall will contribute to runoff at a particular point.
Character / Landscape Character:	A distinct pattern or combination of elements that occurs consistently in parts of the landscape, and often conveys a distinctive ‘sense of place’
Character Type / Landscape Character Type:	A broad categorisation of landscape character, generally on a geographic basis using topography, land cover and land use
Concrete products	Products manufactured primarily from Portland Cement concrete these include bricks, blocks, pavers, pipes and box culverts and other precast concrete sections.
Concentration	Concentration is the mass of particulate matter that is suspended per unit volume of air. Suspended particulate matter in ambient air is usually measured in micrograms per cubic metre (µg/m³).
Conveyor	A device fitted with an endless rubber belt used for moving crushed rock within the processing plant.
Cool phase PDO	negative PDO values
Crushing	The mechanical process of reducing rock size usually by pressure or impact.

Disturbance Footprint	The portion of Lot 105 on SP144215 that is being utilized for the proposed quarry (approximately 65 hectares).
Dust	Particles of mostly mineral origin generated by erosion of surfaces and the mining and handling of materials.
Dust deposition rate	Deposition is the mass of particulate matter that settles per unit surface area. Deposited particulate matter is usually measured in grams per square metre per month or milligrams per square metre per day (g/m2/month or mg/m2/day).
Dust or particulate matter	Dust or particulate matter are terms used to define solid or liquid particles that may be suspended in the atmosphere. Particulate matter is a generic term that is commonly used interchangeably with other terms such as smoke, soot, haze and dust. The potential affect of particulate matter on the environment, human health and amenity depends on the size of the particles, the concentration of particulate matter in the atmosphere and the rate of deposition
Ecosystem	The totality of biological processes and interactions within a specified physical environment.
Effluent	Discharged wastewater
Element / Landscape Element:	A component part of the landscape, usually biophysical, such as hills, river, islands, lake, forest etc.
Environmental constraints	Limitations on a project by components of the environment.
Excavator	Item of earth moving equipment either tracked or wheeled fitted with a bucket on an articulated boom and used for digging material from a face in front of, or below the machine.
Exposed Quarry Benches	benches identified in the Visual Impact Assessment Report as being visible from points defined in the report.
Fallout	The sedimentation of dust or fine particles in the atmosphere.
Feature / Landscape Feature	A prominent, eye-catching or noteworthy element or landmark that makes a contribution to landscape character or identity, or helps mark a place or route
Fill	Material imported and emplaced to raise the general surface level of a site.
Flyrock	Rock that is propelled in an uncontrolled way into the air by the force of the explosion. Usually comes from pre-broken material on the surface or open face.
Fresh rock	Rock unaffected by weathering processes.
Frequency	The objective measure of pitch measured in cycles per second, Hertz (Hz).
Grader	An item of earthmoving equipment, rubber tyred and fitted with a centrally mounted blade and rippers used to shape and trim the ground surface.
Ground vibration	Oscillatory motion of the ground caused by the passage of seismic waves originating from a blast.
Groundwater	Water contained in voids such as fractures and cavities in rocks and inter-particle spaces in sediments.
Haul road	Road used in quarry for haulage of rock from the face to the crusher and for general site access.
Integrity / Scenic Integrity	The extent to which the landscape is perceived to be in its original natural condition or consistent with long established patterns of land use and built form. The term 'Condition' is similar
JORC	Joint Ore Reserves Committee

Land Type	A geographic sub-unit of the landscape, distinguishable as an area with essentially homogeneous elements, usually topography, land use and/or character; such as hill slopes, foreshore, town, headland, cane fields, plain, lake etc., and which may occur within a number of different Landscape Settings.
Landcover	Vegetation (natural or rural)
Landscape Assessment / Evaluation	Description and analysis (and usually mapping) of landscape values and attributes, including scenic amenity, visual quality, sensitivity, integrity, cultural heritage and associations; usually by repeatable procedures including relative ranking of landscape values
Landscape Setting / Setting	Landscape units at district scale separated by visual barriers formed primarily by the topography but also by vegetation or natural systems, or defined by viewing distance, land use patterns or cultural factors; and which are perceived by observers in various locations as the setting or backdrop for human activity and association. Landscape Settings are the visual catchments of places or areas used by people, and are generally large enough to support the cultural or natural processes which create its character.
LiDAR	Light Detection and Ranging data used to create a Digital Surface Model incorporating vegetation and building heights
Lithosol	One of a group of azonal soils having no clearly expressed soil morphology and consisting of a freshly and imperfectly weathered mass of rock fragments; largely confined to steep hillsides.
Meta-greywacke	Indurated sedimentary rock consisting of unsorted detritus of the grain size of sandstone but containing fragments of feldspars and ferromagnesium minerals.
Metamorphic rock	Any rock which has been altered by heat or pressure.
Mobile equipment	Wheeled or tracked self propelled equipment such as trucks and front end loaders.
Monitoring	The regular measurement of characteristics of the environment.
El Niño	Warm phase ENSO associated with negative values of the SOI
La Niña	Cool phase ENSO associated with positive values of the SOI
Neutral phase	SOI values greater than negative 8 and less than positive 8
Noise Character Adjustment	For both $L_{Amax\ adj,T}$ and $L_{Aeq\ adj,T}$, the adjustment for noise character, if applicable, is usually 2dBA or 5dBA depending on the nature of the noise and the discernibility of the specific noise characteristic/s within the overall noise level environment in which the noise is being experienced.
Non-terminal Quarry Benches	benches at do not represent final design earthworks levels and will be removed in the course of quarrying activities. Benches may however remain in place for several years between quarry phases.
Operational constraints	Limitations upon a project by equipment or machinery.
Overburden	Low value quarry material, including soil/overburden and weathered rock
Particulate matter	Small solid or liquid particles suspended in or falling through the atmosphere.
Percussion drill hole	Drill hole made by equipment using the repetitive impact of a tungsten tipped bit onto rock; rock cuttings are usually returned uphole by flushing with compressed air.
Petrological	Relating to the study of rock mineral composition at hand specimen or microscopic scale.
Plant	Boral crushing plant
Podzol	A zonal soil having a very thin organic mineral layer above a leached layer which rests upon an illuvial dark brown layer.
Podzolic	A duplex soil having a light textured organically stained topsoil, underlain by a pale 'bleached' light textured soil layer and clay subsoil.

the project	Gold Coast Quarry Project
the proponent	Boral Resources (Qld) Pty Limited
Primary crusher	The first crusher through which the rock passes in the processing plant.
Processing plant	A combination of crushers, screens, conveyors and chutes.
Product	High value quarry material assumed deeper then 12m below the existing surface
Receptor	A place, route, viewer group or interest group which may experience an effect.
Regional Frame / Landscape Frame	The natural topographic “frame” of a region or district visible from many viewpoints, usually determined by landform but also formed by vegetation and water features, and not confined to a single Landscape Setting
Rehabilitation	The preparation of a final landform after quarrying and its stabilisation with grasses, trees and shrubs.
Revegetation	Replacement of vegetation on areas disturbed by quarrying activities.
Rip rap	Rock protection for water retention structures.
Road base	Road pavement material usually made up of densely graded crushed rock in varying sizes.
Road grades	The longitudinal slope of a road surface usually defined by a vertical rise or fall over a horizontal distance. Gradient, grade, slope and inclination are synonymous. Thus a fall of 1 unit vertically in 12 units horizontal distance may be stated as a negative gradient (grade, slope and inclination) of 1 in 12 (or 1:12). This slope may also be expressed as a grade of -8.33o, a fall of 83.3 metres per kilometre or slope angle of 4o46'.
Scalping	The removal by screening of fine material from the raw feed prior to presenting it to the crushers. This material is a combination of fine material from the blast and decomposed material.
Screening	A process which separates crushed rock into various sizes - this usually involves a mechanical vibration of the rock over a series of decks fitted with steel mesh, steel plate or polyurethane or rubber mats with fixed sized apertures.
Sealing aggregate	Crushed rock usually of uniform size bonded by bitumen on the surface of the road to form a wear surface.
Scenery	The composite impression of a number of landscape features and elements surrounding a viewer, perceiving a wider scene than just the immediate foreground, for example as seen from a vantage point or while moving through a landscape. Usually refers to landscapes which are mostly natural or rural.
Scenic	Attractive scenery, particularly combinations of landscape features and elements which appear ‘composed ‘ similar to landscape paintings i.e. the concept of ‘scenic’ is culturally-based.
Scenic Amenity	A measure of the relative contribution of each place in the landscape to the collective appreciation of open space as viewed from places that are important to the public. The South-East Queensland Regional Plan Implementation Guideline No.8 defines Scenic Amenity as a function of both Scenic Preference and Visual Exposure.
Scenic Demand	A relative indication (High/Medium/Low) of the expectations of viewers for attractive unspoilt scenery as the setting for their activities and travel
Scenic Preference	A subjective evaluation whereby one or more scenes are preferred relative to others. The South-East Queensland Regional Plan Implementation Guideline No.8 provides a method for ascertaining community consensus regarding scenic preferences, using a process whereby representative samples of the community population rank photographs of scenery, and the results are collated and averaged. The selected photographs sample various Visual Domains and a range of landscapes and naturalness, with varying proportions of elements. Analysis of the photographs for their varying proportions of Visual Domains and landscape elements allows the results to be applied to air photos to produce Scenic Preference maps.
Scenic Quality / Visual	The values of visible components of landscape which contribute to its scenic characteristics, assessed by reference to defined Scenic Quality criteria. Scenic

Quality	quality is the relative nature or character of landscape features expressed as an overall impression by people after perceiving an area of land. The degree of harmony, contrast and variety within the landscape; the overall impression retained after driving through, walking through or flying over an area of land.
Sense of Place	The perception that a particular place is recognisable and identifiable, distinct from other places, through a combination of landscape and/or urban elements, features and less tangible sensations. Similar to 'genius loci'.
Septic tank	Bacterial environment used to break down waste
Siltstone	A rock type intermediate in character between shale and sandstone.
Suspended solids	Analytical term applicable to water samples referring to material recoverable from the sample by filtration.
Stakeholders:	Persons, groups, government and semi-government agencies, non-government organisations and corporate bodies with a legitimate interest in the process of assessment, its inputs and outcomes.
Study Area	Area including Lot 901 (SP144215), and entry road works area (see map CEL1200101 for extents) on Old Coach Road, Reedy Creek.
Terminal Quarry Benches	benches that represent final design earthworks levels.
Temperature Inversion	An increase in air temperature with height in contrast with the usual decrease of temperature with inversion height.
Topsoil	Soils within 50mm of the existing surface. The surface layer of a poorly-developed or well-developed soil profile containing a relatively high percentage of organic material. To be stockpiled for future reuse.
Turbidity	A measure of water clarity
Viewing Distance	Division of seen areas into categories (Foreground, Midground and Background), which largely determine the degree of visible detail.
Viewpoints / Sensitive Viewpoints	Viewpoint places and/or people likely to be particularly affected by visible changes to landscape values, by virtue of the numbers of viewers and/or their expectations of scenery.
Viewshed:	Edges or limits to views from a single place or combination of viewpoints. Viewshed mapping or modelling usually shows all areas, which are potentially within view of viewpoints, based on topography.
Visual Absorption Capability (VAC)	The capacity of the landscape to absorb change (usually development-related) ,without significant detriment to its landscape values(character, scenic quality and integrity). VAC is a function of both slope and vegetation screening capacity.
Visual Analysis	Landscape analysis based on visual qualities only, excluding consideration of heritage, cultural or social values, or other sensory attributes of the landscape
Visual Catchments:	Areas within viewsheds
Visual Exposure	The visibility of parts of the landscape to lookouts, the major road network, sensitive viewpoints and scenic routes, usually computer-generated from a DTM (with or without screening trees and buildings). The South-East Queensland Regional Plan Implementation Guideline No.8 provides a method for mapping composite Visual Exposure from multiple viewpoints along routes, ranked according to traffic numbers, viewing distance and the length of viewing time.
Visual Impact Assessment / Landscape Impact Assessment:	Likely impacts of development projects or land use change on landscape values, usually assessed through detailed landscape analysis as part of an EIS.
Visualisation	Photo-realistic representation of the likely appearance of proposed structures and features, such as by modelling and/or photomontage images
Warm phase PDO	positive PDO values

Weathered rock	Rock affected to any degree by the process of chemical or physical decomposition.
Zone of Visual Influence (ZVI)	Areas from which a particular feature is or may be visible (i.e. views to a feature). 'Maximum possible ZVI' is based on landform topography, often modelled from DTM data, without taking into consideration the screening effects of vegetation and/or buildings.