# Section 5
# Environmental Features, Safeguards and Impacts

## Preamble

This section describes the specific environmental features of the Site and its surrounds that would or may be affected by the Project. Information on existing conditions, proposed safeguards and controls and potential impacts the Project may have following the implementation of these measures is presented for all relevant issues. The various issues in this section are addressed generally in the order prioritised in Section 3.3.

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# 5.1 AIR QUALITY

## 5.1.1 Introduction

The SEARs for the Project require the EIS to include an assessment of the following potential impacts of the Project on Air Quality.

- A detailed assessment of potential construction and operational impacts, in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*, and with a particular focus on dust emissions including $PM_{2.5}$ and $PM_{10}$, and having due regard to the *Voluntary Land Acquisition and Mitigation Policy*.
- An assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products.
- Reasonable and feasible measures to minimise dust and emissions.
- Monitoring and management measures, in particular, real-time air quality monitoring.

The assessment requirements identified by the Environment Protection Authority (EPA) were also considered during the preparation of the air quality assessment. A summary of the SEARs and requirements of the EPA are listed within **Table A2.2**, **Appendix 2** together with a record of where each requirement is addressed in the EIS.

An air quality impact assessment for the Project was undertaken by Northstar Air Quality Pty Ltd (Northstar). The resulting report is presented as Part 1 of the *Specialist Consultant Studies Compendium* and is hereafter referred to as Northstar (2018). The following subsections provide a summary of the air quality impact assessment and describe the operational safeguards and management measures that would be implemented by the Operator.

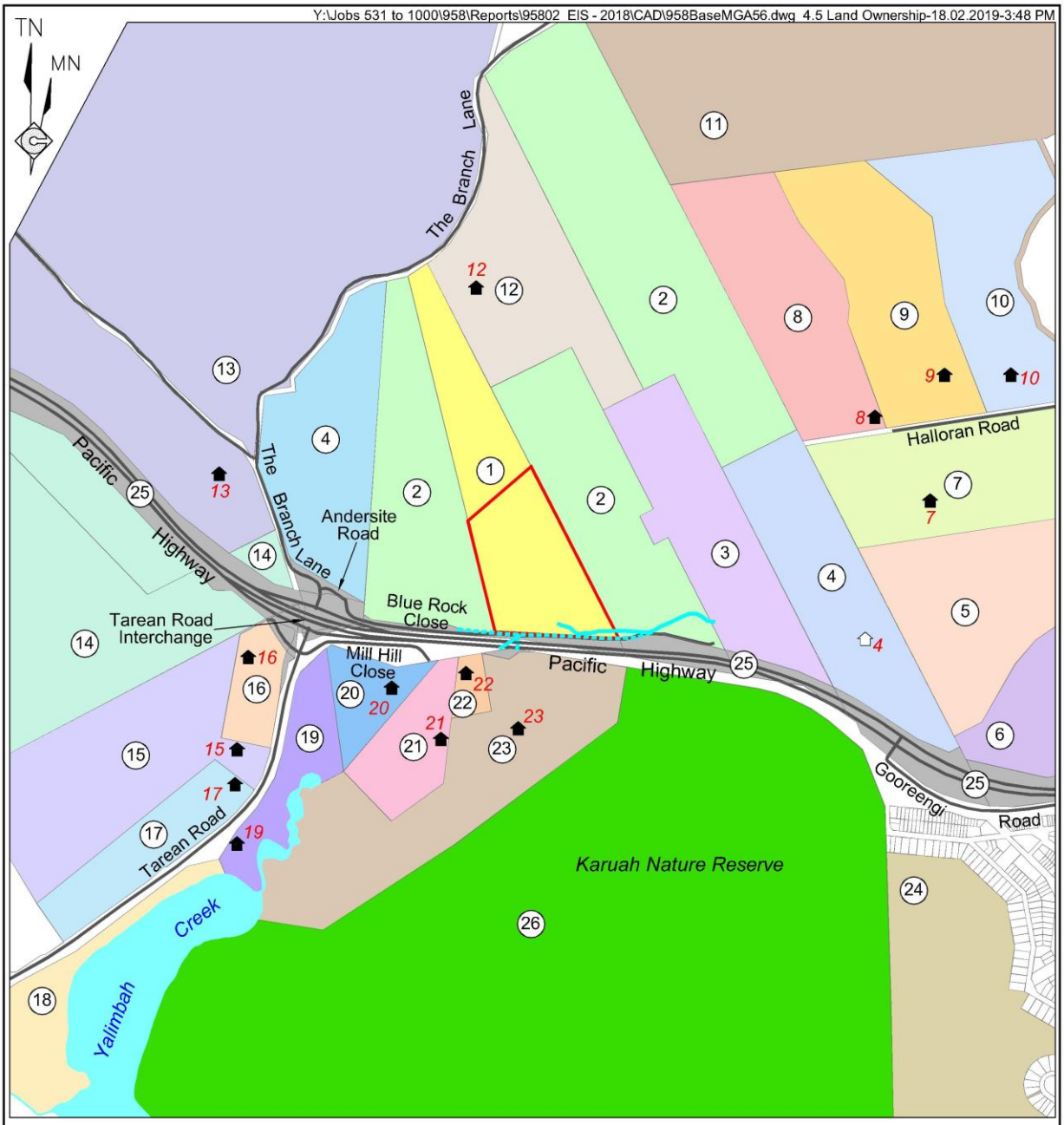
## 5.1.2 Study Area

The Study Area for the air quality assessment covered the privately-owned residential properties within approximately 2km of the Site. **Figure 5.1** displays the locations of the residences considered in the air quality assessment.

## 5.1.3 The Existing Environment

### 5.1.3.1 Meteorological Environment

The meteorology experienced within a given area can govern the generation, dispersion, transport and eventual fate of pollutants in the atmosphere. The meteorological data used for the air quality assessment (Northstar, 2018) utilised data from the Nobbys (Newcastle), Williamtown RAAF and Paterson (Tocal) meteorological stations. This data was analysed using CALMET modelling software to develop Site-specific meteorological conditions. A full description of the modelling exercise, methods and input data used to establish Site-specific meteorological conditions is presented in Annexure 1 of Northstar (2018).




REFERENCE
- Site Boundary
- Sealed Road
- Watercourse/Drainage Line
- Longitudinal Drain and Culvert
- Former Watercourse
- Cadastral Boundary
- (1) Landowner Reference
- Privately-owned Residence
- Resource Company-owned Residence
- *19* Sensitive Receiver Identifier

SCALE 1:25 000 (A4)

250 0 250 500 750 1000 1250 m

Landowner Source: Department of Lands Online Search - February 2019
Cadastral Boundary Source: © NSW Department of Finance and Services
Panorama Avenue Bathurst NSW 2795 www.lpi.nsw.gov.au

Figure 5.1
SENSITIVE RECEIVER LOCATIONS

A description of the meteorological data relied upon in this assessment is provided in Section 4.3.

#### 5.1.3.2 Air Quality Environment

The existing air quality experienced in the area surrounding the Site was determined by examining measurements obtained by NSW Office of Environment and Heritage (OEH) from air quality monitoring stations (AQMS) in the Newcastle area and monitoring data collected as part of ongoing operations at the Karuah and Karuah East Quarries.

Background regional air quality was determined by analysing data acquired from the Wallsend AQMS. This data was modified slightly to accurately reflect local conditions in recognition of the fact that Wallsend is influenced by different sources than the area surrounding the Site. **Table 5.1** identifies the regional air quality adopted for the assessment. A full description of the methodology used to determine regional background air quality is provided in Annexure 4 of Northstar (2018).

**Table 5.1**
**Background (Regional) Air Quality***

| Pollutant | Averaging Period | Value |
|---|---|---|
| $PM_{10}$ | 24-hour | Hourly varying |
| | Annual | 14.9µg/$m^3$ |
| $PM_{2.5}$ | 24-hour | Hourly varying |
| | Annual | 5.1µg/$m^3$ |
| TSP | Annual | 26.3µg/$m^3$ |
| Dust Deposition | Monthly | 2g/$m^2$/month |
| $NO_2$ | 1-hour | 4.3pphm |
| | Annual | 0.8pphm |
| * Excludes modelled impacts from Karuah Quarry and Karuah East Quarry | | |
| Source: Modified after Northstar (2018) – Table 11 | | |

Karuah and Karuah East Quarries were identified as significant sources of pollutants in the area surrounding the Site. Air quality impacts from these local sources were accounted for in the modelling exercises undertaken by Northstar (2018) to determine the cumulative air quality impacts of the Project and Hunter Quarries' operations. The results of this modelling exercise are summarised in Section 5.1.8.

With specific regard to localised contributions to the air quality environment as a consequence of vehicular traffic on the Pacific Highway, the DPE (2008) consider that under adverse conditions (e.g. temperature inversions and light winds), pollutant concentrations (e.g. $NO_2$ and particulate matter) can be expected to be 10% of roadside levels at a distance 100m from the roadside, with further reductions occurring as the distance from the road increases. Subsequently, as the background regional air quality has been determined using data acquired from the Karuah East Quarry (120m from the Pacific Highway) and Wallsend AQMS, Northstar (2018) consider that the data adopted to determine background regional air quality would likely include some level of traffic related pollution and that specific inclusion of the Pacific Highway as an emissions source was not required.

### 5.1.4 Potential Sources of Air Contaminants

Potential sources of air contaminants have been identified for the life of Project and can be broadly categorised into the following stages.

- Site establishment and construction stage.
- Operational stages.

#### Site Establishment and Construction Stage

The site establishment and construction stage is anticipated to last approximately 6 months and would involve vegetation clearing, topsoil and overburden removal, bulk earthworks and development of the Quarry infrastructure and stockpiling areas. The key emissions to air during the site establishment and construction stage would include:

- construction dust generated by vegetation clearing, earthworks, construction, construction traffic and track-out onto the Pacific Highway; and
- plant and vehicle engine exhaust emissions.

#### Operational Stages

The operational stage of the Project is expected to last up to 25 years from the completion of the site establishment and construction stage or until the economic recovery of the resource is completed.

The following activities would be conducted during operations.

- Blasting and drilling;
- Recovered material handling, transfer and storage;
- Recovered material processing using mobile processing plant;
- Quarry product storage; and
- Quarry product loading and despatch to market.

The key emissions to air during the operational stage would include:

- particulate emissions from the extraction, processing and storage of the material;
- wheel-generated particulate emissions from the haulage of material on unpaved and paved road surfaces;
- blasting emissions of particulates and products of combustion; and
- plant and vehicle exhaust emissions.

### 5.1.5 Criteria for Assessment

**Table 5.2** presents the criteria considered to be appropriate for the Project. It is noted that the criteria are based on reducing any potential impacts to human health and amenity.

**Table 5.2**
**Project-Specific Air Quality Assessment Criteria**

| Pollutant | Averaging period | Units | Criterion | Notes |
|---|---|---|---|---|
| Nitrogen dioxide ($NO_2$) | 1 hour | µg/m$^3$ [(a)(e)] | 246 | Numerically equivalent to the AAQ NEPM[(b)] standards and goals. |
| | | pphm[(f)] | 12 | |
| | 1 year | µg/m$^3$ | 62 | |
| | | pphm | 3 | |
| Particulates (as $PM_{10}$) | 24 hours | µg/m$^3$ | 50 | |
| | 1 year | µg/m$^3$ | 25 | |
| Particulates (as $PM_{2.5}$) | 24 hours | µg/m$^3$ | 25 | |
| | 1 year | µg/m$^3$ | 8 | |
| Particulates (as TSP) | 1 year | µg/m$^3$ | 90 | N/A |
| Particulates (as dust deposition) | 1-year[(c)] | g/m$^2$/month$^1$ | 2 | Assessed as insoluble solids as defined by AS 3580.10.1 |
| | 1-year[(d)] | g/m$^2$/month$^1$ | 4 | |

Notes: (a): micrograms per cubic metre of air (b): National Environment Protection (Ambient Air Quality) Measure
(c): Maximum increase in deposited dust level (d): Maximum total deposited dust level
(e) Gas volumes are expressed at 25°C (298 K) and at an absolute pressure of 1 atmosphere (101.325 kPa)
(f): Parts per hundred million ($1x10^{-8}$)s

Source: Northstar (2018) – Table 9

### 5.1.6 Assessment Methodology

A dispersion modelling assessment for the Project was completed by Northstar using the NSW EPA approved CALPUFF atmospheric dispersion modelling system.

The CALPUFF modelling system includes three main components: CALMET, CALPUFF and CALPOST and a large set of pre-processing programs designed to interface the model to routinely available meteorological and geophysical datasets.

CALMET is a meteorological model that develops hourly wind and temperature fields on a three-dimensional gridded domain. Associated two-dimensional fields such as mixing height, surface characteristics, and dispersion properties are also included in the file produced by CALMET.

CALPUFF is a transport and dispersion model that advects "puffs" of material emitted from modelled sources, simulating dispersion and transformation processes along the way. In doing so, it typically uses the fields generated by CALMET. Temporal and spatial variations in the meteorological fields are explicitly incorporated into the resulting distribution of puffs throughout a simulation period. The primary output files from CALPUFF contain either hourly concentrations or deposition fluxes evaluated at selected residences.

CALPOST is used to process the CALPUFF output files, producing tabulations that summarise the results of the simulation (Scire, Strimaitis, & Yamartino, 2000).

In March 2011, NSW OEH published generic guidance and optimal settings associated with the CALPUFF modelling system for inclusion in the Approved Methods (Barclay & Scire, 2011). These guidelines and settings have been considered in the performance of this assessment.

This modelling approach was undertaken as CALPUFF is able to account for the complicated terrain between the Site and the surrounding residences. The use of CALPUFF is also consistent with the modelling approach taken in the Karuah East Quarry AQIA (SLR Consulting Australia Pty Ltd, 2013).

#### 5.1.6.1 Modelling Scenarios

An assessment of the impacts of the operation of activities at the Site was undertaken by Northstar which characterises the likely day-to-day operations of the Site, approximating average and likely maximum operational characteristics which are appropriate to assess against longer term (annual average) and shorter term (24-hour) criteria for particulate matter, and the longer term (annual average) and short term (1-hour) criteria for $NO_2$.

As required by the SEARs, two operational scenarios were selected for dispersion modelling. In addition, dispersion modelling was also undertaken for the site establishment and construction stage. A summary of the three scenarios, incorporating the Project, Karuah, Karuah East and Karuah Red Quarries, is provided in **Table 5.3** with the anticipated maximum extraction / processing rates at each quarry indicated. Operational layouts for each scenario are provided in Section 4 of Northstar (2018) with full emissions inventories for each modelled scenario provided in Annexure 2 of Northstar (2018).

**Table 5.3**
**Summary of Modelling Scenarios**

| Operational Stage at Karuah South Quarry | Karuah Quarry | Karuah East Quarry | Karuah Red Quarry |
|---|---|---|---|
| Site Establishment and Construction | Stage A<br>400 000tpa | Stage 1<br>500 000 tpa | Not operational |
| Stage 1C<br>300 000 tpa<br>Max: 3 000 t/day | Stage A<br>400 000tpa | Stage 1<br>500 000 tpa | Not operational |
| Stage 2B<br>600 000 tpa<br>Max: 3 000 t/day | No extraction<br>Processing of Karuah Red<br>100 000 tpa | Stage 3<br>1.5 Mtpa | Extraction<br>100 000 tpa |
| Source: Modified after Northstar (2018) – Table 15 | | | |

### 5.1.7 Proposed Management and Monitoring Measures

The Operator would employ a number of best practice mitigation measures on site to ensure that dust impacts are minimised. These measures would be summarised in an Air Quality Management Plan (see Northstar, 2018) and include:

- sealing the Quarry access road from the weighbridge to the Quarry Entrance and armouring the trafficked area around the processing plant using crushed, recycled concrete;
- use of a water cart to control emissions from unsealed internal haul roads and other exposed areas;
- use of misting water sprays and canvas covers on the top screens on mobile crushing and screening equipment;
- minimising exposed areas by implementing progressive vegetation clearing and progressive rehabilitation, where practicable;

- the construction of a 4m high fence to limit wind erosion of exposed areas;
- implementation of a wheel wash to limit material tracking from the Site;
- enforcement of speed limits on site and on the Quarry access road;
- training and implementation of standard operating procedures;
- minimising drop height of material during truck loading and unloading where possible;
- sheltering of stockpiles and transfer points, where possible;
- adopting all required safeguards for controlled blasts as set out in the Blast Management Plan for the Quarry;
- management of dust generating activities during unfavourable meteorological conditions, ceasing dust-generating activities, if necessary; and
- implementation of a real-time particulate monitoring program.

The effectiveness of the above measures would be established through a comparison of predicted and monitored air quality. The Operator would endeavour to understand the nexus between on-site dust generation and monitored levels, particularly to avoid any exceedances of the air quality criteria as the quarry operations progress.

It is the implementation of a real-time air quality monitoring program that is of greatest importance to the surrounding landowners as this monitoring would enable the Operator to fully manage the amount of dust emanating from the Site.

## 5.1.8 Assessment of Impacts

### 5.1.8.1 Summary of Results

A summary of the predicted compliance status of the Project based on modelling predictions is provided in **Table 5.4**.

### 5.1.8.2 Scenario 1 – Site Establishment and Construction

#### Particulates

**Figure 5.2** displays the predicted cumulative maximum 24-hour average $PM_{10}$ and $PM_{2.5}$ concentrations and the cumulative annual average deposited dust concentrations for the site establishment and construction stage.

In the case of 24-hour maximum and annual average predictions, all criteria are predicted to be met at surrounding residential locations during the site establishment and construction phase. Contributions from these activities are shown in all cases to result in minor/negligible impacts at all residences.

The full air quality impact assessment for the site establishment and construction stage is presented in Section 6.2 of Northstar (2018). This assessment includes both incremental and cumulative air quality impacts for total suspended particulates (TSP), deposited dust, $PM_{10}$ and $PM_{2.5}$.

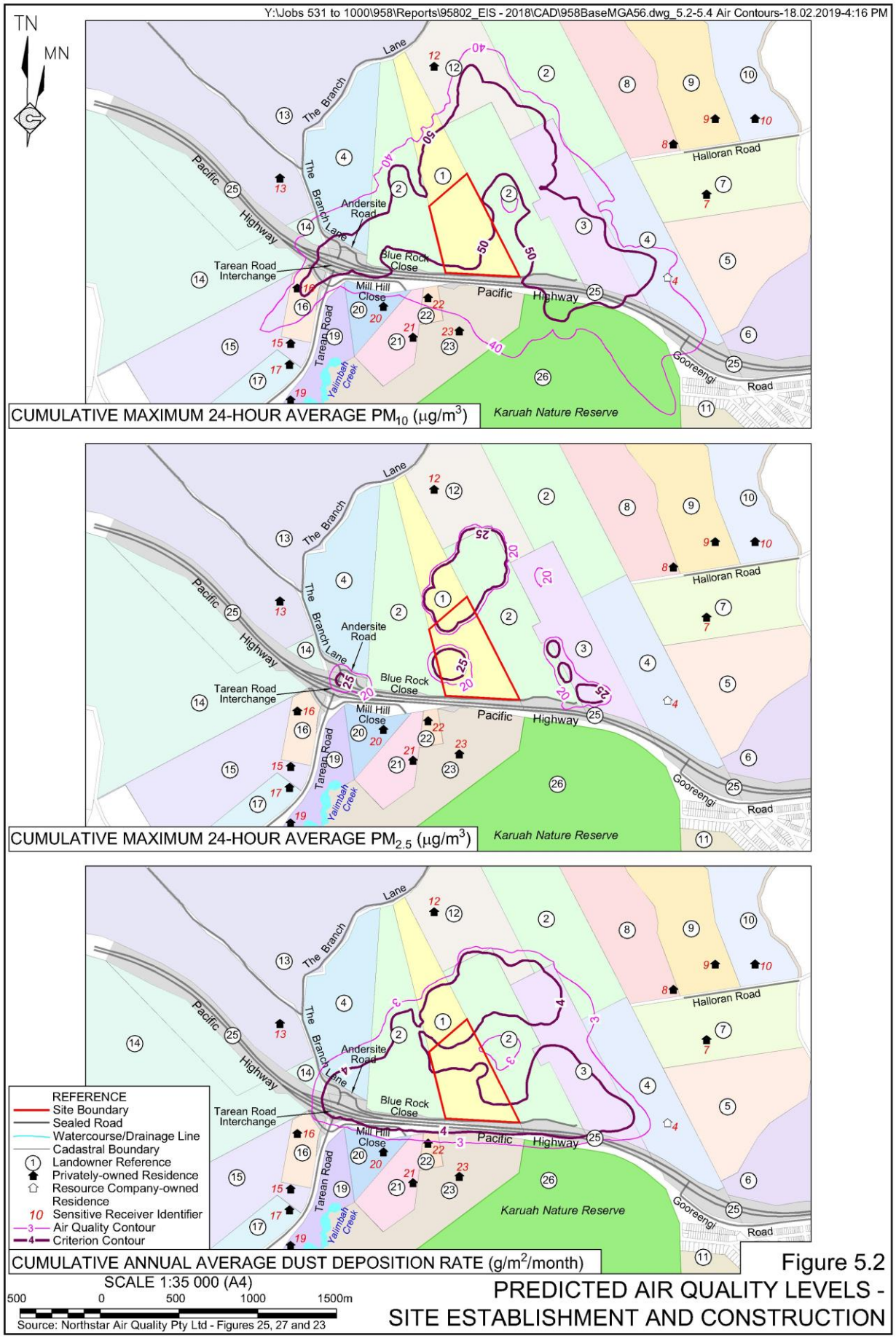



Figure 5.2
PREDICTED AIR QUALITY LEVELS - SITE ESTABLISHMENT AND CONSTRUCTION

**Table 5.4**
**Summary of Predicted Compliance with Air Quality Criteria at Residences**

| Criteria Source | Ambient Air Quality Criteria* | | | Voluntary Acquisition and Mitigation Criteria^ | |
|---|---|---|---|---|---|
| | Annual average | Maximum 24-hour average | Maximum 1-hour average | Annual average | Maximum 24-hour average |
| Residence | Particulate matter $NO_2$ | Particulate matter $PM_{10}$ | $NO_2$ | Particulate matter $NO_2$ | Particulate matter |
| 7 | ☑ | ☑ | ☑ | ☑ | ☑ |
| 8 | ☑ | ☑ | ☑ | ☑ | ☑ |
| 10 | ☑ | ☑ | ☑ | ☑ | ☑ |
| 12 | ☑ | ☑ | ☑ | ☑ | ☑ |
| 13 | ☑ | ☑ | ☑ | ☑ | ☑ |
| 15 | ☑ | ☑ | ☑ | ☑ | ☑ |
| 16 | ☑ | ☒ 50.4µg/m³ in Stage 1C (criterion 50µg/m³) | ☑ | ☑ | ☑ |
| 17 | ☑ | ☑ | ☑ | ☑ | ☑ |
| 19 | ☑ | ☑ | ☑ | ☑ | ☑ |
| 20 | ☑ | ☑ | ☑ | ☑ | ☑ |
| 21 | ☑ | ☑ | ☑ | ☑ | ☑ |
| 22 | ☑ | ☑ | ☑ | ☑ | ☑ |
| 23 | ☑ | ☑ | ☑ | ☑ | ☑ |

* NSW EPA, 2017 AAQ NEPM
^ NSW Government, 2014

Source: Modified after Northstar (2018) – Table 22

### $NO_2$

The impact assessment criterion for 1-hour average $NO_2$ levels is predicted to be met at surrounding residential locations during the site establishment and construction phase. Contributions from activities undertaken during this stage would result in insignificant impacts at all residences.

It is noted that if blasting is required during the site establishment and construction stage, impacts would be consistent with those presented for Stage 1C of operations.

### Crystalline Silica

Although not required by the SEARs, and not an applicable criterion in NSW, the Victorian EPA SEPP PEM (Victorian EPA, 2007) annual average criterion for respirable crystalline silica (as $PM_{2.5}$) of 3µg/m$^3$ was assessed by Northstar (2018) due to concern expressed by some members of the local community. The maximum incremental concentration of respirable crystalline silica (as $PM_{2.5}$) from the Karuah South Quarry during the site establishment and construction stage is predicted to be <0.1µg/m$^3$ at residences with the cumulative impacts from all quarry operations likely to be <0.2µg/m$^3$ and well below the 3µg/m$^3$ criterion adopted for this assessment.

#### 5.1.8.3 Scenario 2 – Stage 1C

**Particulates**

**Figure 5.3** displays the predicted cumulative 24-hour maximum $PM_{10}$ and $PM_{2.5}$ concentrations and the cumulative annual average deposited dust concentrations for Stage 1C.

In the case of maximum 24-hour average predictions, all criteria are predicted to be met at surrounding residential locations during Stage 1C operations, with the exception of a minor exceedance of maximum 24-hour average $PM_{10}$ at Residence 16.

On the day of maximum predicted cumulative impacts at all residences, the 24-hour average $PM_{10}$ criterion is predicted to be achieved at all residences except Residence 16. The total cumulative impacts of $PM_{10}$ during Stage 1C operations would be <97% of the criterion and <102% of the criterion at Residence 16. It should be noted that the minor exceedance at Residence 16 was predicted with the assumption that Karuah Quarry processing plant (the closest dust source to Residence 16) would be operational at the same time as extraction was being undertaken within Stage 1C on the Karuah South Quarry. In fact, by the time extraction is underway in Stage 1C within the Karuah South Quarry, the rate of processing at the Karuah Quarry would be less than that assumed for this scenario. Therefore, it is more than likely that the predicted $PM_{10}$ 24 hour level would not eventuate.

To ensure that these short-term elevations in incremental $PM_{10}$ concentrations do not result in exceedances of the criterion at surrounding residential locations, a real-time air quality monitoring program would be implemented by the Operator. This program, and the air quality management measures informed by those monitoring results, are described in detail in Sections 5.1.7 and 5.1.10.

In the case of annual average predictions, all criteria are predicted to be met at surrounding residential locations during Stage 1C of operations. Contributions from these activities would result in minor / minimal impact at all residences.

The full air quality impact assessment for Stage 1C is presented in Section 6.3 of Northstar (2018). This assessment includes both incremental and cumulative air quality impacts TSP), deposited dust, $PM_{10}$ and $PM_{2.5}$.

**$NO_2$**

The impact assessment criterion for maximum 1-hour average $NO_2$ is predicted to be met at all surrounding residential locations during Stage 1C operations. It is noted that cumulative impacts (other than the addition of background air quality) have not been assessed, as simultaneous blasting at surrounding sites would not occur.

The maximum predicted cumulative 1-hour impact resulting from Stage 1C operations is predicted to be 79.5µg/$m^3$, at Residence 22. This represents <33% of the maximum 1-hour average $NO_2$ criterion.

Exceedances of the short-term $NO_2$ criterion would not be likely to occur at any surrounding residence locations with the implementation of an effective blast management plan.

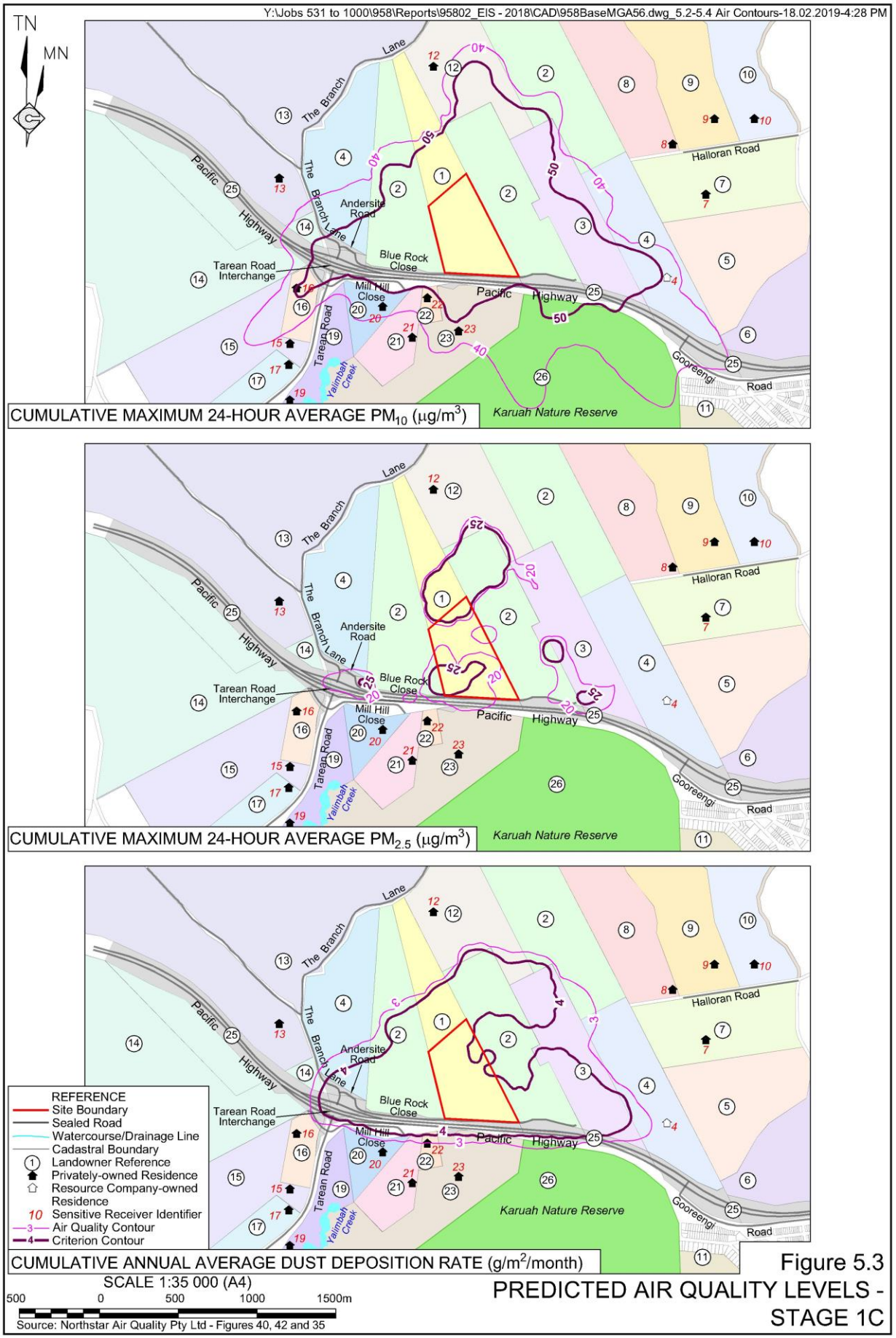



Figure 5.3
PREDICTED AIR QUALITY LEVELS - STAGE 1C

### Crystalline Silica

The maximum incremental concentration from the Karuah South Quarry Stage 1C operations would result in respirable crystalline silica impact of <0.1µg/m$^3$ at residences. With the impacts of all other quarries, and assuming that the existing background is silica free, the maximum cumulative impact is likely to be <0.2µg/m$^3$ and well below the 3µg/m$^3$ criterion adopted for the purposes of this assessment.

#### 5.1.8.4 Scenario 3 – Stage 2B

### Particulates

**Figure 5.4** presents the predicted cumulative 24-hour maximum $PM_{10}$ and $PM_{2.5}$ concentrations and the cumulative annual average deposited dust concentrations for Stage 2B.

All criteria for maximum 24-hour average concentrations are predicted to be met at surrounding residential locations during Stage 2B operations.

On the day of maximum predicted cumulative impact at all modelled residences, the 24-hour average $PM_{10}$ criterion is predicted to be achieved at all residences even with the addition of the predicted impact of all other quarries and background air quality. Total cumulative impacts of $PM_{10}$ during Stage 2B operations are predicted to be <97% of the criterion.

On the day of maximum predicted cumulative impact at all modelled residences, the 24-hour average $PM_{2.5}$ criterion is predicted to be achieved, with the addition of the predicted impact of all other quarries and background air quality resulting in total cumulative impacts of $PM_{2.5}$ during Stage 2B operations being <72% of the criterion.

All annual average criteria are predicted to be met at surrounding residential locations during Stage 2B of operations. Contributions from these activities are shown in all cases to result in minor / minimal impact at all residences.

The full air quality impact assessment for Stage 2B is presented in Section 6.3 of Northstar (2018). This assessment includes both incremental and cumulative air quality impacts for total suspended particulates (TSP), deposited dust, $PM_{10}$ and $PM_{2.5}$.

### $NO_2$

In the case of maximum 1-hour average predictions of $NO_2$, the impact assessment criterion is predicted to be met at surrounding residential locations during Stage 2B operations.

No cumulative impacts (other than the addition of background air quality) have been assessed, as it has been assumed that simultaneous blasting at surrounding sites would not occur.

The maximum predicted cumulative 1-hour impact resulting from Stage 2B operations is predicted to be 82.2µg/m$^3$, at Residence 12. This represents <34% of the maximum 1-hour average $NO_2$ criterion.

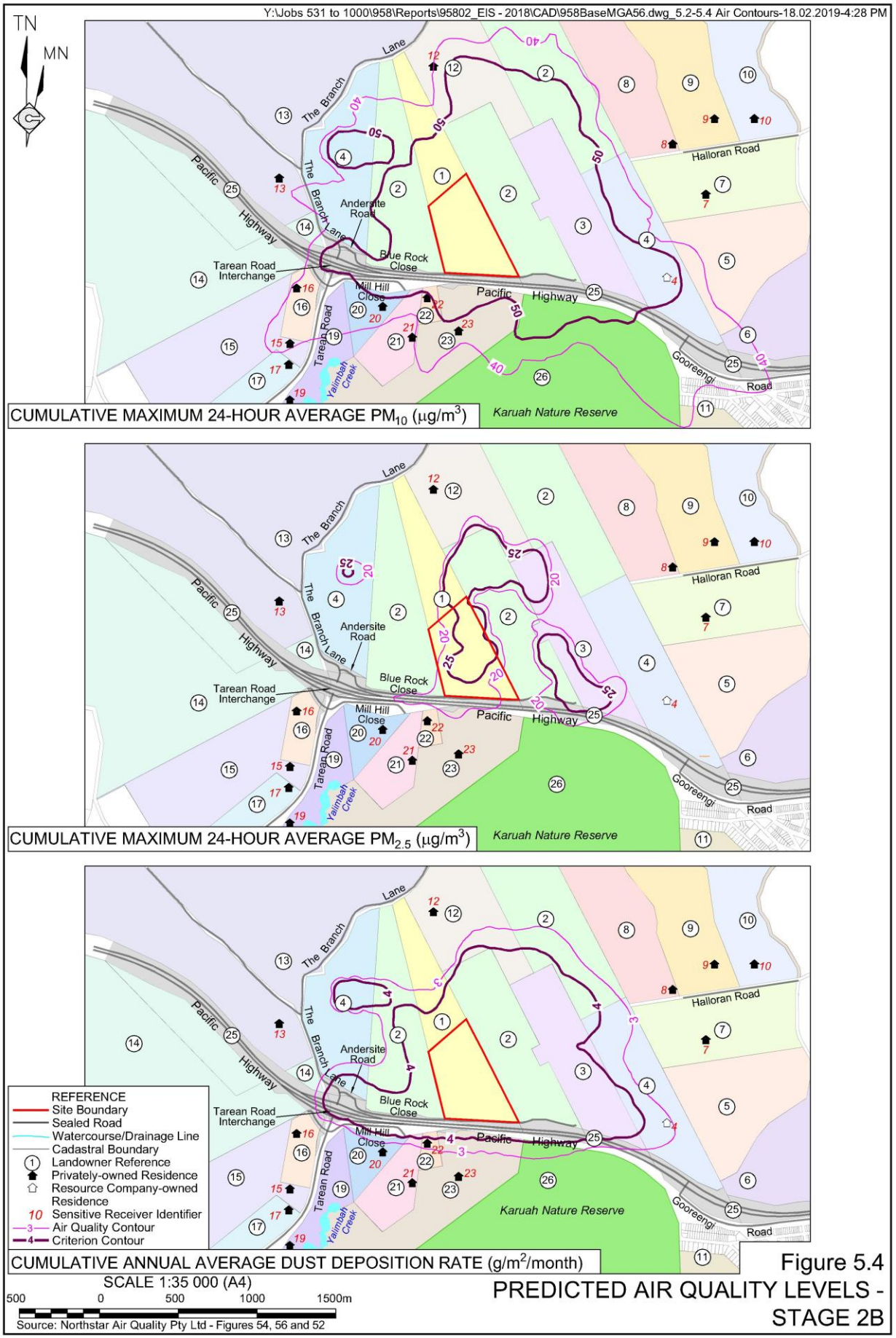



Figure 5.4
PREDICTED AIR QUALITY LEVELS - STAGE 2B

**Crystalline Silica**

The maximum incremental concentration from the Karuah South Quarry Stage 2B operations would result in respirable crystalline silica concentrations at all residences of <0.1µg/m$^3$. With the impacts of all other quarries, and assuming that the existing background is silica free, the maximum cumulative impact is likely to be <0.2µg/m$^3$ and well below the 3µg/m$^3$ criterion adopted for the purposes of this assessment.

## 5.1.9 Greenhouse Gas Assessment

### 5.1.9.1 Calculation of Greenhouse Gas Emissions

**Table 5.5** presents the greenhouse gas (GHG) emissions associated with Stage 2 of the Project.

**Table 5.5**
**Greenhouse Gas Emissions**

| Emission Scope | Emission Source | Emission Factor | Energy Content Factor | Activity Rate | Emissions (t $CO_2$-e/yr) |
|---|---|---|---|---|---|
| Scope 1 | Diesel fuel for mobile plant and equipment | 70.2kg $CO_2$-e/GJ | 38.6 GJ/kL | 1 173.3kL/yr | 3 179.2 |
| | | | **Total Scope 1** | | **3 179.2** |
| Scope 2 | Electricity consumption | 0.82kg $CO_2$-e/kWh | - | Negligible | 0.0 |
| | | | **Total Scope 2** | | **0.0** |
| Scope 3 | Diesel fuel for mobile plant and equipment | 3.6kg $CO_2$-e/GJ | 38.6 GJ/kL | 1,173.3kL/yr | 163.0 |
| | Unleaded fuel for employee transport | 3.6kg $CO_2$-e/GJ | 34.2 GJ/kL | 0.33kL/yr | 0.04 |
| | Diesel fuel for material transport | 3.6kg $CO_2$-e/GJ | 38.6 GJ/kL | 2 727.5kL/yr | 379.0 |
| | | | **Total Scope 3** | | **542.1** |
| Source: Modified after Northstar (2018) – Table 54 | | | | | |

### 5.1.9.2 Comparison with National Totals

A comparison of the calculated GHG emissions associated with the Project and the 2016 GHG emission levels for NSW and the NSW and Australian mining sectors is presented in **Table 5.6**.

**Table 5.6**
**Greenhouse Gas Emissions in Context**

| Emission Scope | Proposal total (t $CO_2$-e/yr) | Emissions (Mt $CO_2$-e/yr) | | | |
|---|---|---|---|---|---|
| | | Australia (2016) (excluding LULUCF*) 549.2Mt | NSW (2016) 131.6Mt | Australian Mining Sector (2016) 82.3Mt | NSW Mining Sector (2016) 20.7Mt |
| Scope 1 | 3 179.2 | 0.0006% | 0.0024% | 0.0039% | 0.0154% |
| * LULUCF = Land Use Land Use Change and Forestry | | | | | |
| Source: Northstar (2018) – Table 55 | | | | | |

These data indicate that the operation of the Project at maximum capacity would contribute up to 0.003% of NSW total GHG emissions and up to 0.0006% of Australian total GHG emissions in 2016.

#### 5.1.9.3 Management of Greenhouse Gas Emissions

The above assessment indicates that GHG emissions resulting from the operation of the Project are anticipated to be small, although emissions would be further reduced by implementing the following measures.

- All vehicles/plant and machinery would be turned off when not in use and regularly serviced to ensure efficient operation, including the optimisation of tyre pressures;
- Truck routes and loading capacity would be designed to reduce the distance and effort required by the vehicles;
- Roads would be maintained in a good condition to avoid meandering of vehicles;
- Gradients would be reduced around Site where feasible; and
- B5 fuel would be used in plant and equipment when feasible.

### 5.1.10 Monitoring

The monitoring of air quality around the various Karuah Quarries will be important to demonstrate to surrounding residents that the combined operations are collectively satisfying the air quality criteria, particularly those for 24 hour $PM_{10}$ given the criteria are health-based and this parameter is predicted to be closer to the nominated criteria than other parameters.

It is intended that the monitoring undertaken for the Project would complement that already undertaken by Hunter Quarries. As outlined in Section 3.2.3,Hunter Quarries representatives recognise that it would be beneficial for both quarries to coordinate monitoring for the combined operations. As part of its contribution to the combined monitoring program for all quarries, the Operator would establish and undertake a real-time monitoring program in conjunction with a Trigger Action Response Plan (TARP) to proactively minimise the generation and subsequent transport of particulate matter from the Karuah South Quarry. Subject to landowner approval and support from the EPA, it is proposed to establish a Tapered Element Oscillating Microbalance (TEOM) dust sampling unit to measure $PM_{10}$ concentrations in real time. This nominated location would be adjacent to Residence 22, i.e. close to the existing $PM_{10}$ high volume air sampler (HVAS) managed by Hunter Quarries Pty Ltd.

The data generated from the TEOM that indicate a trigger level is being approached would be interpreted in conjunction with the prevailing meteorological data and, if appropriate, shared with Hunter Quarries to ensure that the offending source of dust is identified and curtailed.

All other air quality monitoring results would be reviewed regularly and compared to a range of factors including meteorology and operational data for all quarries.

Data from the overall monitoring program would be used to determine the contribution of the operations within the Karuah South Quarry and the adjoining quarries on the air quality surrounding the quarries' environment and the compliance status of operations in relation to the Development Consent conditions for the Project and environment protection licence. Details of the proposed coordinated monitoring program and TARP would be included in the Quarry's Air Quality Management Plan.

All air quality monitoring results would be posted on the Operator's website and included in each Annual Review.

### 5.1.11 Conclusion

The results of the air quality assessment undertaken by Northstar (2018) using three scenarios (Site Establishment and Construction, Stage 1C and Stage 2B) has concluded that the Project is predicted to comply with all impact assessment criteria for each relevant averaging period for TSP, $PM_{2.5}$, $PM_{10}$, dust deposition and $NO_2$ with the exception of a minor exceedance of maximum 24-hour average $PM_{10}$ at Residence 16. In addition, the adopted criteria for crystalline silica was also assessed and the Project was predicted to be compliant. The implementation of a real time air quality monitoring program would ensure that short-term elevations in incremental $PM_{10}$ concentrations do not result in exceedances of the criterion at surrounding residential locations.

The greenhouse gas assessment concluded that average scope 1 and 2 emissions from the Project would represent approximately 0.003% of NSW total GHG emissions and approximately 0.0006% of Australian total GHG emissions which represents a very minor proportion of global greenhouse gas emissions.

## 5.2 NOISE AND VIBRATION

### 5.2.1 Introduction

The SEARs require the EIS to include an assessment of the potential impacts of the Project on noise and blasting, including:

- a detailed assessment of the likely construction and operational and off-site noise transport impacts of the development in accordance with the *Interim Construction Noise Guideline, NSW Noise Policy for Industry* and the *NSW Road Noise Policy* respectively, and having regard to the *NSW Voluntary Land Acquisition and Mitigation Policy*;
- a detailed assessment of the likely blasting impacts of the development (including noise, vibrations, overpressure, visual and odour) on people, animals, buildings, infrastructure and significant natural features, heritage items having regard to the relevant ANZEC (sic) guidelines and paying particular attention to impacts.

The assessment requirements provided by the Environment Protection Authority (EPA), Office of Environment and Heritage (OEH) and the Division of Resources and Geoscience (DRG) were also considered during the preparation of the noise and vibration assessment. A summary of the SEARs and requirements of each of these agencies are listed within **Table A2.2**, **Appendix 2** together with a record of where each requirement is addressed in the EIS.

A noise and vibration impact assessment for the Project was undertaken by Spectrum Acoustics Pty Ltd (Spectrum). The resulting report is presented as Part 2 of the *Specialist Consultant Studies Compendium* and is hereafter referred to as Spectrum (2018). The following sub-sections provide a summary of the noise and vibration impact assessment and describe the operational safeguards and management measures to be implemented by the Operator.

### 5.2.2 Study Area

The Study Area for the noise assessment covered the privately-owned residential properties within approximately 2km of the Site. Each of these properties were considered in the noise assessment with noise monitoring locations established by Hunter Quarries and for this Project, used to establish the project noise trigger levels (PNTLs) for the assessment. **Table 5.7** lists each of the private landowners who have residences within 2km of the Site and **Figure 5.1** displays their locations. Additional residences are located at greater distance to the east and southeast of the Site.

**Table 5.7**
**Residences within 2km of the Site**

| Residence* | Landowner |
|---|---|
| R7 | Bao Lin Pty Ltd |
| R8 | WB Hestelow, TA Hestelow |
| R9 | AW Woodfield, JA Woodfield |
| R10 | J Tonna |
| R12 | GJ Mis, S Mis |
| R13 | Upper Wantalong Station Pty Ltd |
| R15 | DB Clarke |
| R16 | PR Wood |
| R17 | WE Cameron, D Taylor |
| R19 | S Emanuel |
| R20 | GA Norbury |
| R21 | WR Plover |
| R22 | RJ Trotter |
| R23 | GB Myers |
| * See **Figure 5.1** | |

### 5.2.3 The Existing Environment

#### 5.2.3.1 Meteorological Environment

The atmospheric conditions most relevant to noise assessments are temperature inversions, gentle winds (indicative of possible wind shear) and relative humidity. The NSW Noise Policy for Industry (NPI) (EPA, 2017) states that wind effects are to be assessed where the source to receiver winds (at 10m height) of 3m/s or below are anticipated to occur for 30% or more of the time in any season.

The meteorological data analysis conducted for the Air Quality Assessment for the Project (see Part 1 of the *Specialist Consultant Studies Compendium.* (Northstar, 2018) utilised data from the Nobbys (Newcastle), Williamtown RAAF and Paterson (Tocal) meteorological stations and this meteorological data was analysed to establish the relevant meteorological conditions for the noise impact assessment for the Project.

Whilst the analysis identified that winds up to 3m/s occurred less than 20% of the time during all seasons from all primary directions (+/- $45^0$), the following parameters, which also influence noise propagation, were identified during the analysis and adopted for noise modelling.

- Relative humidity: As extremes of relative humidity are rarely experienced during daytime hours, a value of 70% RH was adopted.
- Prevailing conditions: Neutral atmospheric conditions (20°C, no wind).

#### 5.2.3.2 Acoustic Environment

The ambient noise levels in the vicinity of the Project were influenced by noise sources such as traffic, insects, birds and quarrying activity[1]. In order to quantify the existing acoustic environment and establish noise criteria (project noise trigger levels) for this assessment, Spectrum deployed a Rion NL-42 environmental noise logger from 10-16 September 2018 at location R21 (see **Figure 5.1**). Spectrum considered this location to be representative of the most potentially impacted residence, R22 which is the closest residence to the Pacific Highway.

The results of the monitoring conducted by Spectrum (2018) and historical daytime noise monitoring results, as summarised in SLR (2012), are shown in **Table 5.8**.

**Table 5.8**
**Daytime Background Levels, dB(A)**

| Location | $L_{eq}$ |
|---|---|
| R21[1] | 58 |
| R23[2] | 53 |
| R8[2] | 51 |
| Source: [1] Spectrum (2018), [2] SLR (2012) | |

Whilst it is noted that there is existing industrial noise from quarries adjoining the Site, the status of operational noise from the existing quarries was unknown at the time of noise monitoring, however the area of residential receivers that is potentially affected by noise emissions from the Project is best described acoustically as an area dominated by road traffic noise.

### 5.2.4 Criteria for Assessment

#### 5.2.4.1 Noise Criteria

Industrial noise can have a significant effect on residences surrounding the Project. The NPI sets out the procedure to determine the noise assessment criteria which are relevant to a particular industrial development.

[1] These noise sources are consistent with those listed in the Noise and Blasting Impact assessment for the Karuah East Quarry (SLR, 2012).

If it is predicted that any development is likely to cause the noise assessment criteria to be exceeded at existing residences, management measures would be required to reduce the predicted noise level of the Project to a level below the relevant noise assessment criteria.

The following sub-sections describe the criteria, identified under the NPI and applicable to the noise assessment for the Project. Further detail on the criteria is provided in Spectrum (2018).

### Project Noise Trigger Levels

The project noise trigger level (PNTL) provides a benchmark or objective for assessing the potential noise-related impacts associated with the Project. The PNTL is developed using two criteria.

- Intrusiveness Criteria: this criteria limits the degree of change that a new noise source introduces to the existing environment. The NPI considers the intrusiveness of an industrial noise source to be acceptable if the noise generated by the new noise source does not exceed the rating background noise level (RBL) by 5dB(A).
- Amenity Criteria: this criteria aims to limit continuing increases in noises levels from the application of the intrusiveness criterion in isolation (i.e. the combined industrial noise sources should remain below the recommended amenity noise level for a noise amenity area, as nominated by the NPI (Table 2.2).

The PNTL is subsequently derived from the lower (that is, the more stringent) value of the intrusive noise level and the amenity noise level.

### Cumulative Noise Level

The cumulative noise level criteria applies to the total industrial noise from all sources in the vicinity of the Site (i.e. for the existing and proposed quarries).

### Maximum Noise Levels

The maximum noise level events from the Project, during the night-time period, are required to be assessed to determine the potential for sleep disturbance at residences.

This criteria has been applied to the assessment of the loading and despatch of product haulage trucks between the hours of 5:00am and 7:00am.

### Traffic Noise Levels

Noise from vehicle movements associated with an industrial source such as a quarry is assessed in terms of the NPI if the vehicles are not on a public road. If the vehicles are on a public road, the Road Noise Policy (RNP) (DECCW, 2011) applies. Noise from the products has therefore been assessed against the PNTL of the NPI whilst they are within the Site and against the criteria in the RNP when on the public road network.

The criteria applied for the noise assessment of the Project are presented in **Table 5.9**.

**Table 5.9**
**Project Noise Assessment Criteria**

| Criteria | Project Noise Trigger Levels dB(A) | Cumulative Noise Level dB(A) | Maximum Noise Level dB(A) | Road Traffic Noise Level dB(A) | |
|---|---|---|---|---|---|
| | | | | Day (7am-10pm) | Night (10pm-7am) |
| **Noise Averaging Period** | $L_{Aeq(15minute)}$ | $L_{eq(day)}$ | $L_{max}$ | $L_{eq(15\text{-}hour)}$ | $L_{eq(9\text{-}hour)}$ |
| **Residence** | | | | | |
| R22 | 50[1] | 55 | 52 | 60 | 55 |
| R13, R15, R16, R17, R20, R21, R23 | 49 | | | | |
| R7, R8, R19[2] | 39 | | | | |
| R12 | 35 | | | | |
| [1] Amenity noise level conservatively adopted as $L_{Aeq(15min)}$ based on suburban classification. | | | | | |
| [2] Historical background measurement at R7 taken as representative of R8 and R19. | | | | | |
| Source: Spectrum (2018) – Tables 7 and 8. Section 3.4 and Section 3.5 | | | | | |

#### 5.2.4.2 Blasting and Vibration Criteria

Spectrum (2018) considered the blast overpressure and ground vibration criteria for human comfort and building damage.

The EPA adopts the recommended airblast overpressure and ground vibration levels presented in the document "Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration" (ANZECC, 1990). These recommended vibrations levels are based on the prevention of human discomfort and, as they are more stringent than the building damage criteria, have been adopted as the assessment criteria for the blasting and vibration assessment for residences and are as follows.

- The recommended maximum overpressure for airblast is 115dB(L). The level of 115dB(L) may be exceeded on up to 5% of the total number of blasts over 12 months, however, should not exceed 120dB(L) linear peak at any time.
- Peak particle velocity (PPV) from ground vibration should not exceed 5mm/s for more than 5% of the total number of blasts over 12 months, however, the maximum level should not exceed 10mm/s at any time.

The damage criteria relevant to residential buildings are 133dB(L) for airblast overpressure and 10m/s (for ground vibration).

### 5.2.5 Design and Operational Safeguards

#### 5.2.5.1 Construction and Operational Noise

Recognising that the Project would alter the local noise climate, the following design features, operational controls and management measures would be implemented by the Operator.

**Design Features**

1. A 4m high amenity barrier (i.e. a metal fence) would be erected prior to the commencement of processing operations.
2. The Quarry Access Road would be sealed prior to any products being transported from the Site.

**Operational Safeguards, Controls and Management Measures**

1. All mobile equipment would be fitted with standard muffling apparatus.
2. The mobile processing plant would either be positioned behind the 4m high fence (Stage 1) or preferably positioned behind stockpiled material to reduce the noise generated by the plant (Stage 2).
3. Frequency modulated reversing alarms would be used on all mobile equipment.
4. Internal roads would be well maintained to minimise body noise from empty trucks.

Additional operational safeguards to be adopted by the Operator would include:

1. restricting noise-generating activities to the nominated hours of operation;
2. regular maintenance of all equipment; and
3. maintenance of dialogue with surrounding landowners to ensure any concerns over operational noise are addressed.

The above safeguards and controls have been incorporated into the noise modelling developed for the Project by Spectrum (2018) to assess the likely change to local noise levels.

### 5.2.5.2 Traffic Noise

Whilst the movement of heavy vehicles from Hunter Quarries operations is already a feature of local roads, the Operator would implement the following safeguards and controls to minimise the potential for any increase in overall noise levels.

1. Transport operations would adhere to the approved hours of operation.
2. The Operator would refuse entry to poorly maintained vehicles, or those reported to generate excessive noise levels.
3. The Operator would ensure all truck drivers comply with a Drivers Code of Conduct outlining procedures for reducing noise impacts when travelling to and from the Site and whilst on site.

### 5.2.5.3 Blasting

The Operator would adopt a professional and comprehensive approach to blasting to ensure no exceedances occur of any blast-related criteria or limits and best practice blasting is undertaken throughout the entire life of the Quarry.

It is recognised that the proximity of surrounding residences and the Pacific Highway are important constraints that need to be satisfied for all blasts, particularly during Stage 1 of the Quarry's operation. It is proposed that a comprehensive set of design and operational safeguards would be adopted throughout the life of the Quarry, all of which would be documented in a Blast Management Plan, which would be reviewed annually, and updated when required. The key design and operational safeguards to ensure blast-related impacts are acceptable are as follows.

1. The initial blasts in Stage 1A would be undertaken at locations at least 400m from the Pacific Highway and 630m from the nearest residence (Residence 22). The commencement of blasts in this area of Stage 1A would enable accurate blast designs and well-controlled blasting practices to be developed prior to the reduction in distances from the blast location to the Pacific Highway and residences as extraction proceeds in a westerly direction during Stage 1.
2. All blasts would be designed with conservative assumptions until on-site monitoring data assists to establish optimum blast practices within the extraction area. For example, the amount of stemming would be maximized, i.e. between 2.5m and 3m.
3. All blast faces, and their respective blast envelopes would be oriented either to the east or west and not towards the Pacific Highway or nearby residences south of the Pacific Highway.
4. The front face of all proposed blasts would be "bore-tracked" to identify any areas where the thickness of rock is insufficient and may cause a blow-out producing fly rock. The blast design would be adjusted where the thickness of rock is insufficient.
5. All blasts would be videoed to record the behaviour of each blast.
6. Consideration would be given to selecting a day for each blast with suitable meteorological conditions, i.e. avoidance of low cloud and high wind speeds, particularly from the northern sector given the presence of the Pacific Highway and residences to the south.
7. Prior to the first blast, the Operator would approach all residents within 2km of the Site to establish their preferred method of notification for future blasts. On the day prior to each blast, the Operator would notify the residents by their preferred communication method.

All blast design and initiation would be undertaken by a fully licenced and experience shotfirer.

## 5.2.6 Assessment Methodology

### 5.2.6.1 Noise Assessment Methodology

The SEARs for the Project require that a cumulative assessment be undertaken that considers the potential impact of the Project in concert with the various quarries operated or proposed to be operated by Hunter Quarries. Therefore, the noise assessment was undertaken using the

operational scenarios described for the air quality assessment in **Table 5.3**. These scenarios are briefly described below and the modelled noise source locations are shown in **Figures 5.5** to **5.7**. Noise modelling was undertaken using the Environmental Noise Model (ENM v3.06) which also considered the meteorological conditions described in Section 5.2.3.1.

The methodology employed to quantify the additional traffic noise generated by the Project at residences adjacent to the Pacific Highway was sourced from the US Environmental Protection Agency document No. 550/9-74-004 *Information on Levels of Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, March 1974*.

Full details of the methodologies employed for the noise assessment are presented in Section 4 of Spectrum (2018).

### Scenario 1 – Site Establishment and Construction

Extraction of material at approximately 40m AHD and earthworks to form the base of the site infrastructure area at approximately 30m AHD (see **Figure 5.5**).

### Scenario 2 – Extraction Stage 1C

Extraction of material between approximately 40m-70m AHD (natural surface) and the lowest floor elevation of the active extraction area being 8m AHD. The site infrastructure area would be at approximately 30m AHD with mobile processing plant located in the southwestern corner of this area. Product haulage trucks would utilise a ramp along the southern edge of the site infrastructure area for access and egress to the Site from Blue Rock Close (see **Figure 5.6**).

The maximum production rate of the Quarry during this scenario would be 300 000 tonnes per annum.

### Scenario 3 – Extraction Stage 2B

Extraction of material between approximately 40m-120m AHD (natural surface) and the lowest floor elevation of the active extraction area being 12m AHD. The elevation of the site infrastructure area would remain at approximately 30m AHD with the mobile processing plant would be located within the northeastern corner of the area. The product stockpiles shown in **Figure 5.7** have been modelled at 4m high. Product haulage trucks would continue to utilise the ramp along the southern edge of the site infrastructure area for access and egress to the Site from Blue Rock Close (see **Figure 5.7**).

The maximum production rate of the Quarry during this scenario would be 600 000 tonnes per annum.

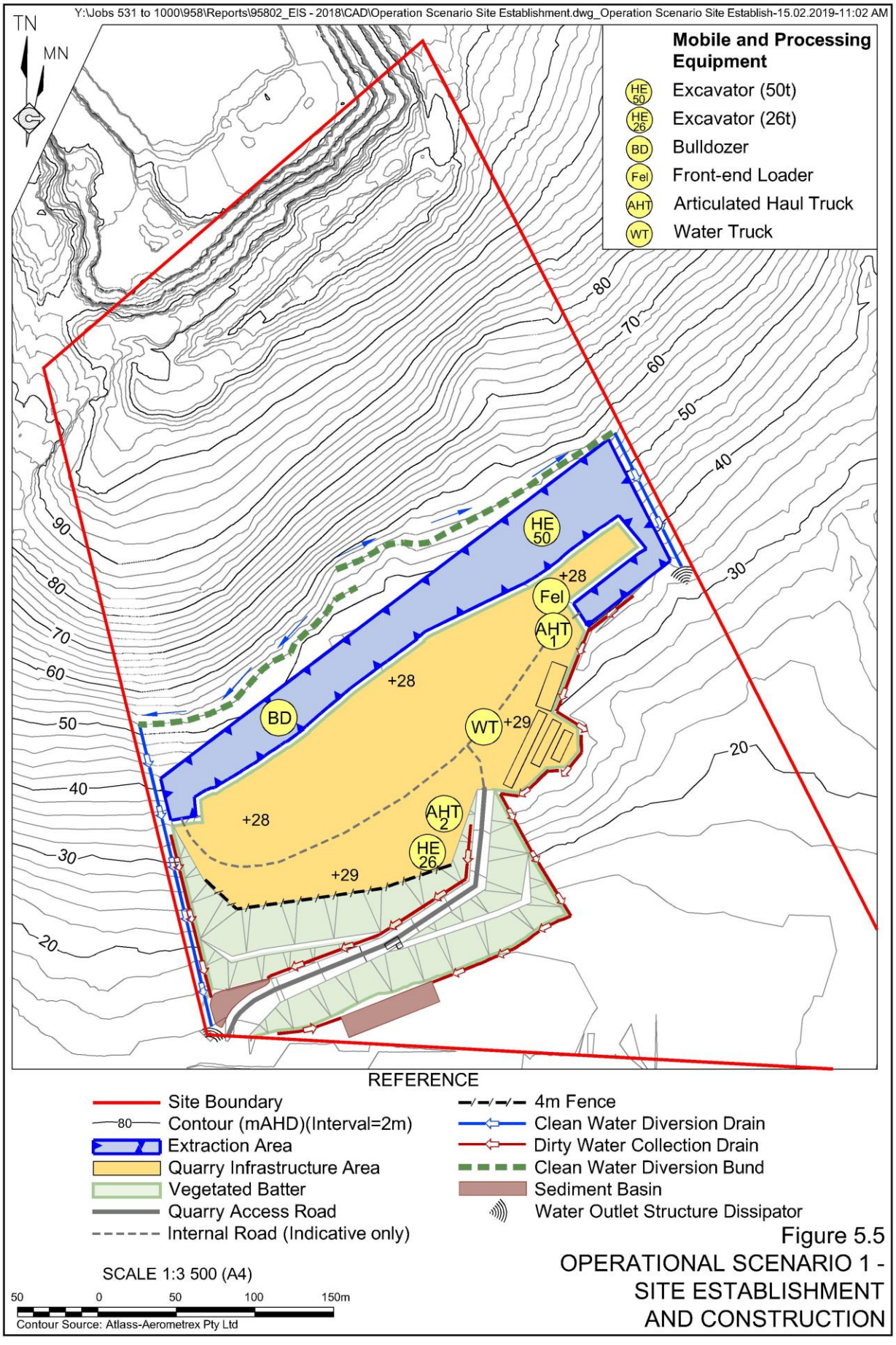



Figure 5.5
OPERATIONAL SCENARIO 1 - SITE ESTABLISHMENT AND CONSTRUCTION

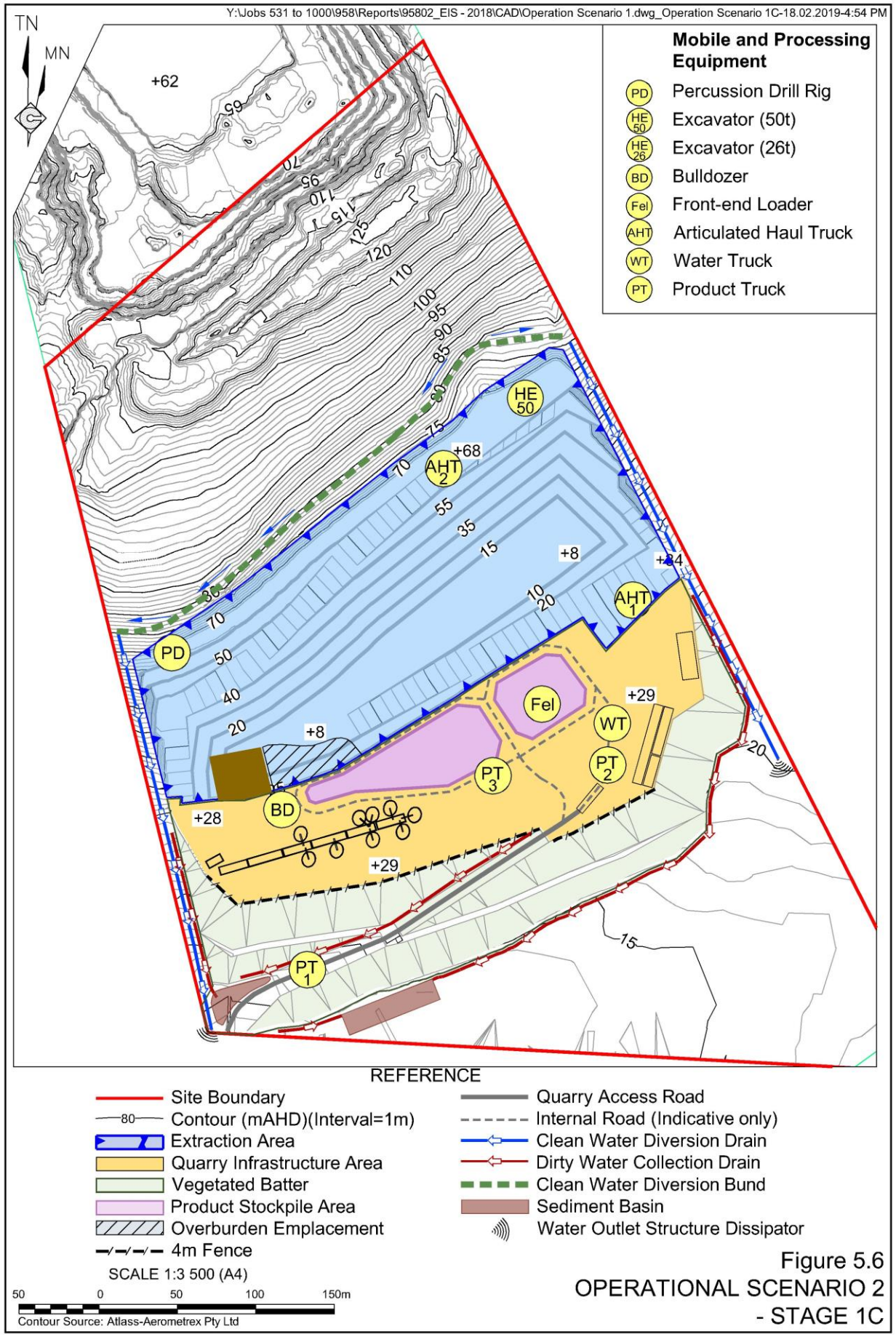



Figure 5.6
OPERATIONAL SCENARIO 2
- STAGE 1C

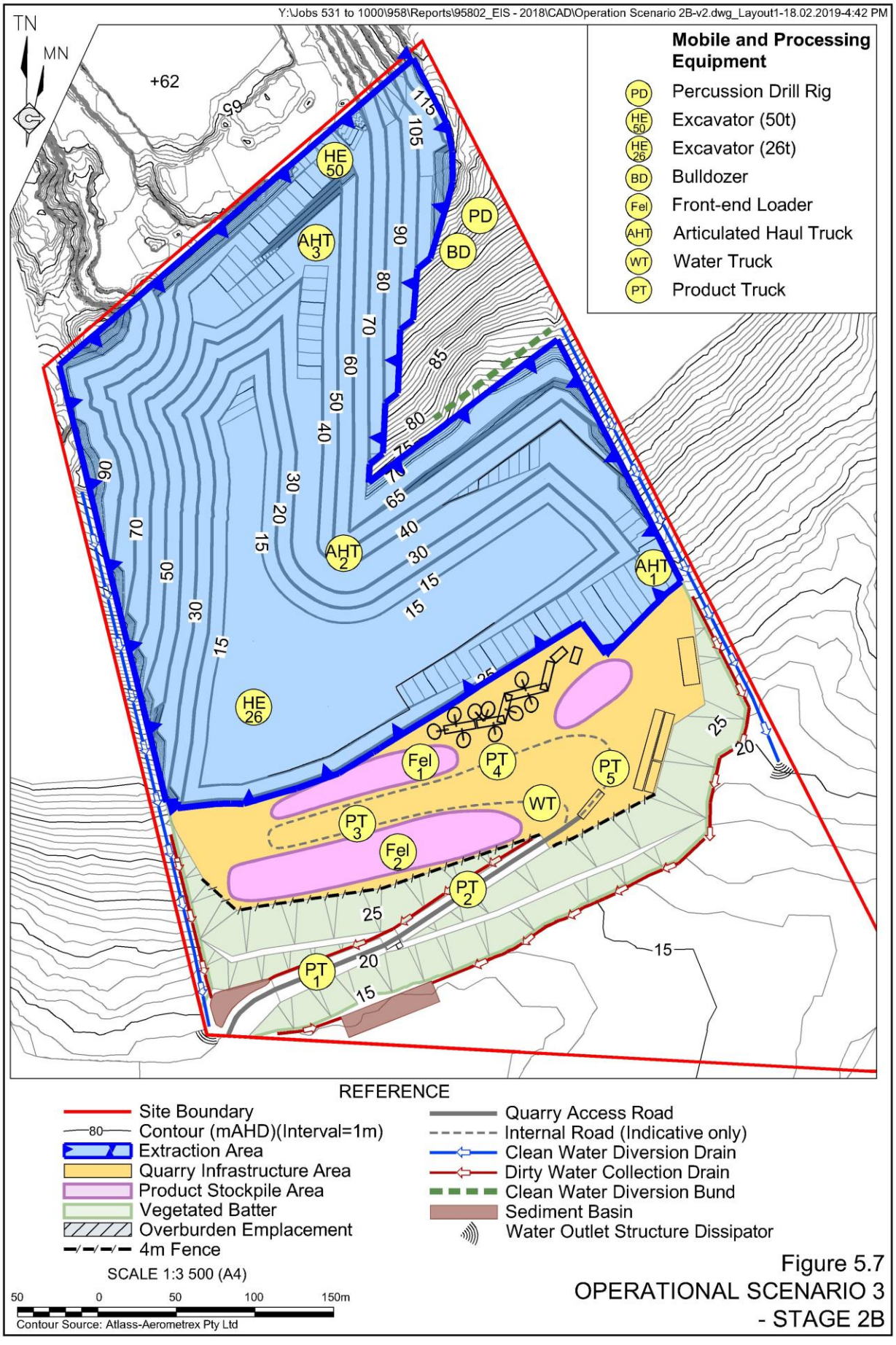



Figure 5.7
OPERATIONAL SCENARIO 3
- STAGE 2B

#### 5.2.6.2 Blasting and Vibration Assessment Methodology

The blasting and vibration assessment utilised standard equations for predicting blast overpressure and ground vibration levels that were sourced from the Bureau of Mines as incorporated in AS 2187.2 – 2006. The calculations were based on charge weights (Maximum Instantaneous Charge weight, [MIC]) of a nominal 60kg and a likely maximum value of 80kg. The actual MIC used for each blast would vary due to a range of factors. Further detail on the equations relied upon for the calculations is presented in Section 4.6 of Spectrum (2018).

### 5.2.7 Assessment of Impacts

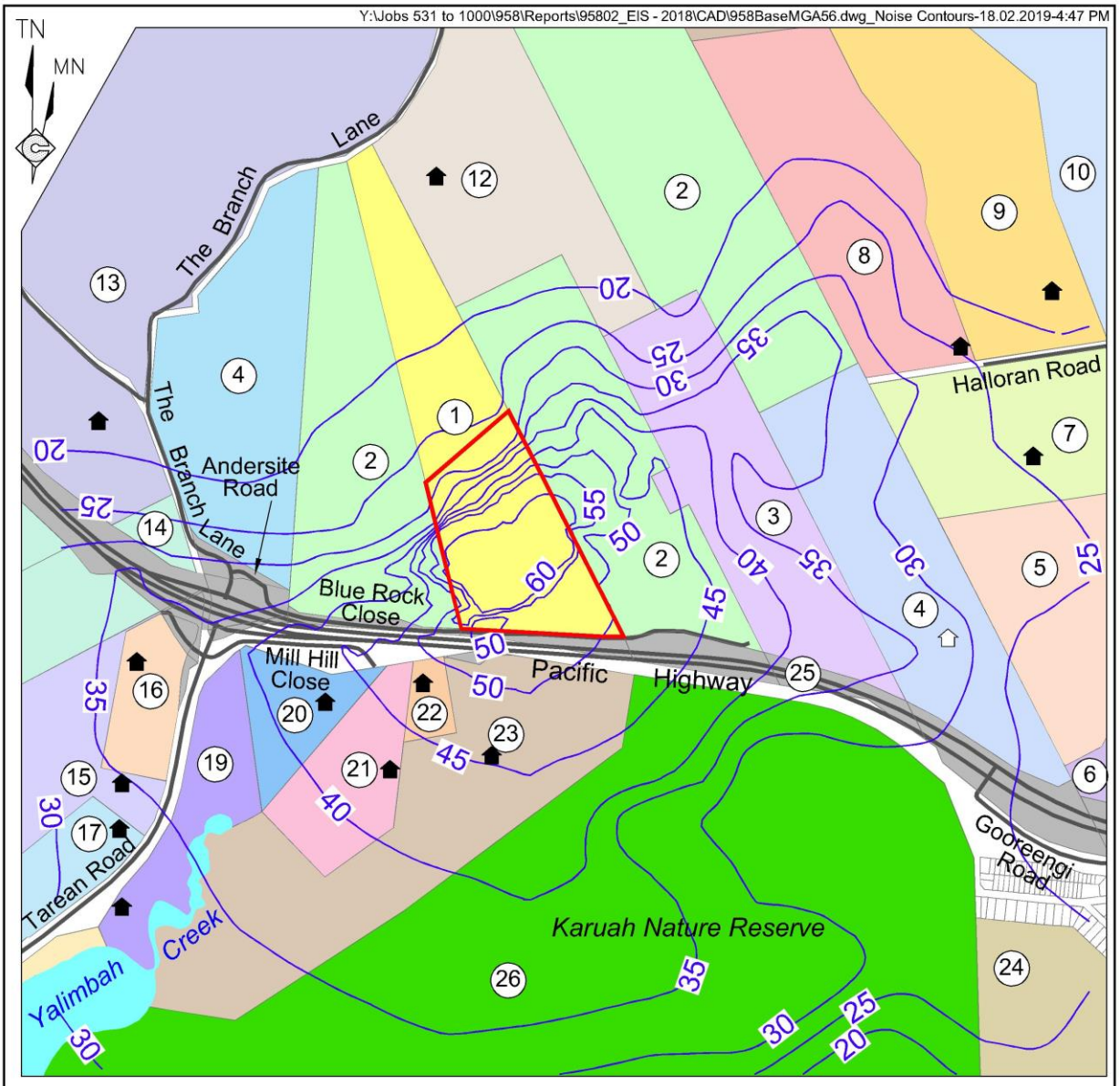
#### 5.2.7.1 Predicted Noise Impacts

**Project Noise Trigger Levels**

The predicted noise levels at the residences identified in **Table 5.7** for the three scenarios are summarised in **Table 5.10** (see **Figures 5.5**, **5.6** and **5.7**)**.** As shown in **Table 5.10** the predicted noise levels at all residences are all below the project noise trigger levels (see **Figures 5.8**, **5.9** and **5.10**).

**Table 5.10**
**Predicted Project $L_{Aeq\ 15min}$ Noise Levels, dB(A)**

| Residence* | Trigger level $L_{Aeq(15minute)}$ | Scenario 1 | Scenario 2 | Scenario 3 |
|---|---|---|---|---|
| | | Neutral Meteorological Conditions | | |
| R7 | 39 | 25 | 31 | 34 |
| R8 | 39 | 25 | 30 | 34 |
| R12 | 35 | <20 | 20 | 22 |
| R13 | 49 | <20 | 23 | 21 |
| R15 | 49 | 35 | 40 | 33 |
| R16 | 49 | 36 | 44 | 26 |
| R17 | 49 | 34 | 37 | 33 |
| R19 | 39 | 33 | 36 | 32 |
| R20 | 49 | 43 | 44 | 38 |
| R21 | 49 | 43 | 44 | 41 |
| R22 | 50 | 47 | 48 | 45 |
| R23 | 49 | 46 | 48 | 45 |
| Source: Modified after Spectrum (2018) – Tables 11, 12 and 13 | | | | |




| Criteria | Project Noise Trigger Levels dB(A) |
|---|---|
| Noise Averaging Period | $L_{Aeq(15minute)}$ |
| Receiver | |
| R22 | 50 |
| R4, R13, R15, R16, R17, R20, R21, R23 | 49 |
| R7, R8, R19 | 39 |
| R12 | 35 |

Source: Spectrum Acoustics (2018)

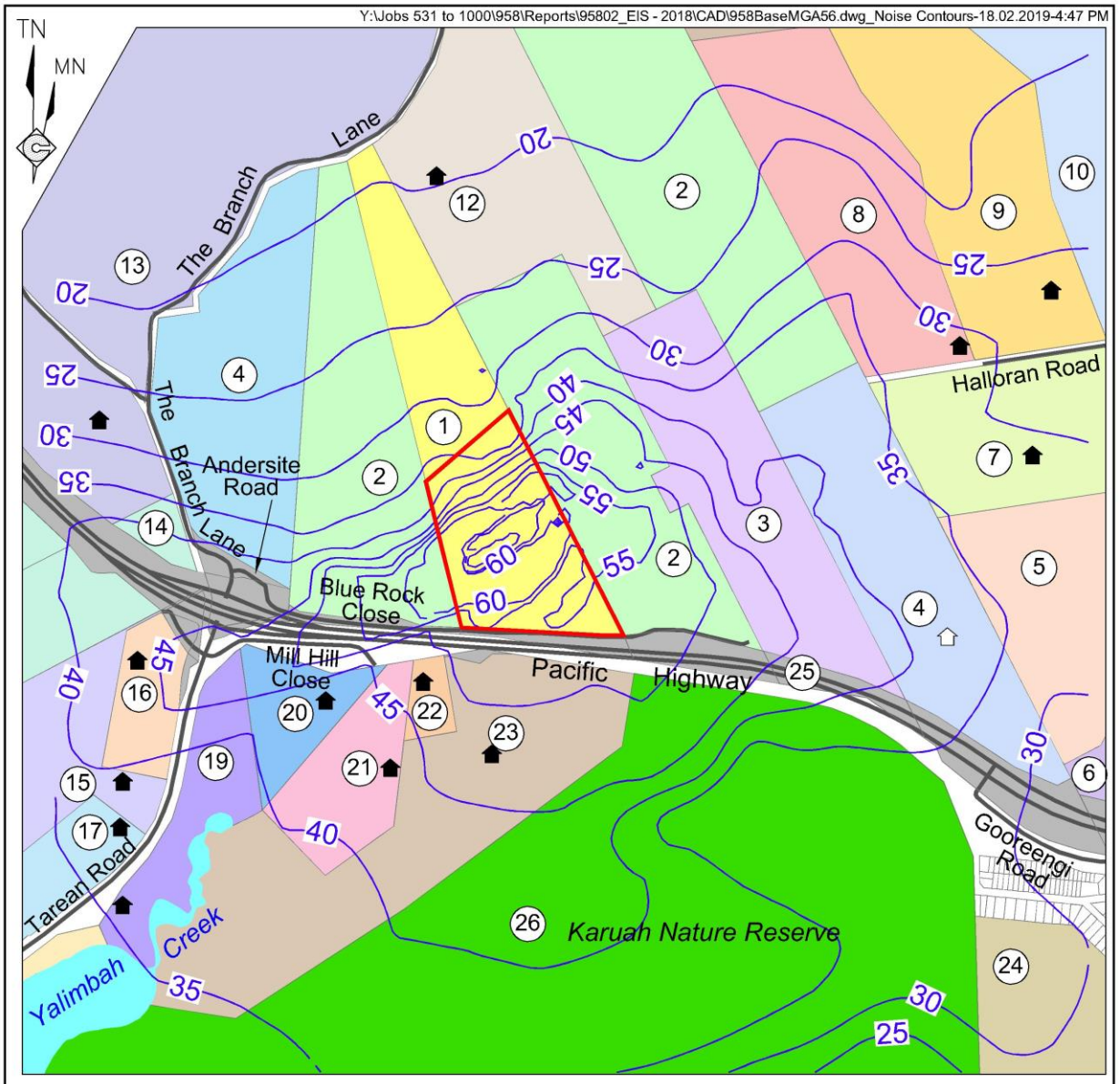
REFERENCE
- Site Boundary
- Sealed Road
- Cadastral Boundary
- (1) Landowner Reference
- Privately-owned Residence
- Resource Company-owned Residence
- Noise Contour dB(A)

SCALE 1:20 000 (A4)

200 0 200 400 600 800 1000 m

Noise Contour Source: Spectrum Acoustics (2019) - Figure 8

Figure 5.8
NOISE CONTOURS - SCENARIO 1
SITE ESTABLISHMENT
AND CONSTRUCTION




| Criteria | Project Noise Trigger Levels dB(A) |
|---|---|
| Noise Averaging Period | $L_{Aeq(15minute)}$ |
| Receiver | |
| R22 | 50 |
| R4, R13, R15, R16, R17, R20, R21, R23 | 49 |
| R7, R8, R19 | 39 |
| R12 | 35 |

Source: Spectrum Acoustics (2018)

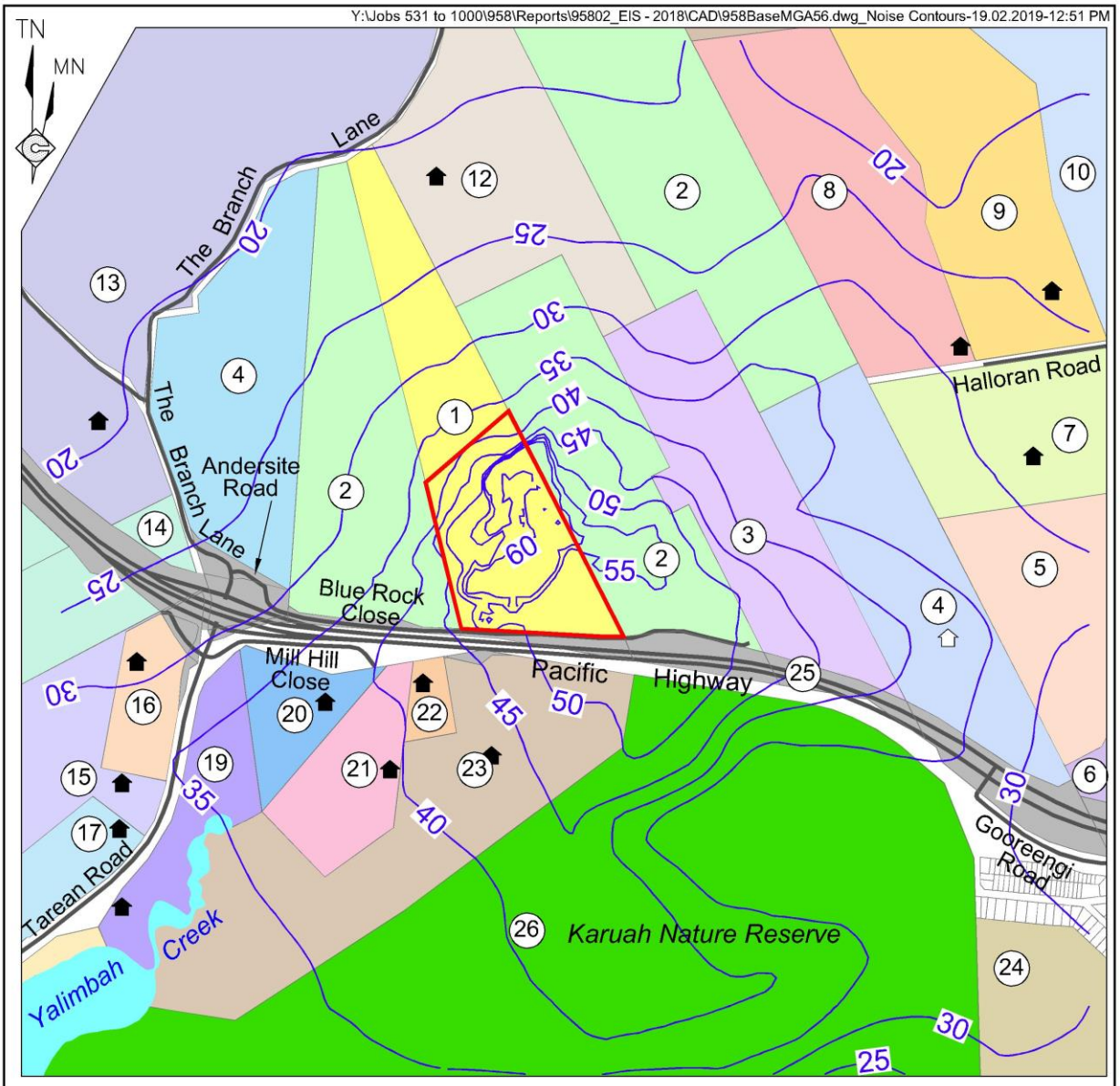
REFERENCE
- Site Boundary
- Sealed Road
- Cadastral Boundary
- (1) Landowner Reference
- Privately-owned Residence
- Resource Company-owned Residence
- Noise Contour dB(A)

SCALE 1:20 000 (A4)

200 0 200 400 600 800 1000 m

Noise Contour Source: Spectrum Acoustics (2019) - Figure 9

Figure 5.9
NOISE CONTOURS - SCENARIO 2
STAGE 1C




| Criteria | Project Noise Trigger Levels dB(A) |
|---|---|
| Noise Averaging Period | $L_{Aeq(15minute)}$ |
| Receiver | |
| R22 | 50 |
| R4, R13, R15, R16, R17, R20, R21, R23 | 49 |
| R7, R8, R19 | 39 |
| R12 | 35 |

Source: Spectrum Acoustics (2018)

REFERENCE
- Site Boundary
- Sealed Road
- Cadastral Boundary
- (1) Landowner Reference
- Privately-owned Residence
- Resource Company-owned Residence
- Noise Contour dB(A)

SCALE 1:20 000 (A4)

200 0 200 400 600 800 1000 m

Landowner Source: Department of Lands Online Search - February 2019

Figure 5.10
NOISE CONTOURS - SCENARIO 3
STAGE 2B

### Cumulative Noise Level

The worst-case predicted project noise levels (see **Table 5.10**) were used to assess the cumulative noise levels from the Project and the existing quarries in the area under calm weather conditions. The results of the assessment of cumulative noise are presented in **Table 5.11**.

**Table 5.11**
**Predicted Cumulative Noise Levels, dB(A),$L_{eq(15min)}$**

| Residence | Cumulative Noise Level Criteria | Predicted Noise levels by Source | | | Predicted Cumulative Level |
|---|---|---|---|---|---|
| | | Karuah Quarry | Karuah East Quarry | Project | |
| R7 | 55 | 34 | 37 | 31 | 40 |
| R13 | 55 | 48 | 19 | 23 | 48 |
| R15 | 55 | 43 | 31 | 40 | 45 |
| R16 | 55 | 44 | 30 | 44 | 47 |
| R20 | 55 | 48 | 34 | 44 | 49 |
| R22 | 55 | 42 | 37 | 48 | 49 |
| R23 | 55 | 34 | 40 | 48 | 49 |
| Source: Modified after Spectrum (2018) – Table 14 | | | | | |

It is noted that, whilst the operational status of the existing quarries was unknown at the time of noise monitoring, it is evident that traffic noise dominated the logger data and there was no significant contribution from existing quarries. Notwithstanding this, predicted cumulative noise levels are below the cumulative noise level criteria shown in **Table 5.9**.

### Maximum Noise Levels

As noted in Section 5.2.4.1, this criteria was only applied to the assessment of the loading and despatch of product haulage trucks between the hours of 5:00am and 7:00am.

The predicted maximum noise levels, based on the assessment criteria shown in **Table 5.9** for loading and despatch of product haulage trucks, are shown in **Table 5.12**. The predicted maximum noise levels at all residences are all below the maximum noise assessment criteria.

**Table 5.12**
**Predicted Maximum Noise Levels, dB(A),$L_{max}$**

| Residence | Maximum Noise Level Criteria | Predicted Maximum Level |
|---|---|---|
| R7 | 52 | <30 |
| R8 | 52 | <30 |
| R12 | 52 | <30 |
| R13 | 52 | <30 |
| R15 | 52 | <30 |
| R16 | 52 | <30 |
| R17 | 52 | <30 |
| R19 | 52 | <30 |
| R20 | 52 | 30 |
| R21 | 52 | 36 |
| R22 | 52 | 38 |
| R23 | 52 | 40 |
| Source: Spectrum (2018) – Table 16 | | |

### Traffic Noise Levels

Point calculation modelling of the road traffic noise level attributable to the transportation of quarry products at the most potentially impacted residence (R16), was based on a nominal vehicle entry speed onto the Pacific Highway of 70km/h. This calculation resulted in a level of 43dB(A),$L_{eq(1hour)}$ which is significantly below the night-time road traffic noise assessment criteria of 55dB(A),$L_{eq(9hour)}$ (see **Table 5.9**) and even below the previously measured background noise level at this residence.

### 5.2.7.2 Predicted Blasting Impacts

The principal potential impacts of blasting relate to the airblast overpressure, ground vibration and fly rock.

Predicted airblast overpressure and ground vibration levels at the closest blast location to the residences in each direction from the Site are shown in **Table 5.13** based upon the maximum instantaneous charge (MIC) quantities of 60kg and 80kg. These results confirm that airblast overpressure and ground vibration levels would be at or below the criteria presented in Section 5.2.4.2, at the assessed residences. In reality, the Operator will adjust the MIC quantities to ensure that the airblast overpressure and ground vibration levels are well below the nominated limits, particularly when approaching the closest point of blasting to the Pacific Highway and residences south of the highway.

**Table 5.13**
**Predicted Blast Impacts**

| Residence | Distance to Site (m)[a] | Criterion | | MIC = 60 kg | | MIC = 80 kg | |
|---|---|---|---|---|---|---|---|
| | | PPV[b] | OP[c] | PPV | OP | PPV | OP |
| R22 (south) | 315 | 5 | 115 | 2.1 | 114 | 2.1 | 115 |
| R16 (west) | 950 | 5 | 115 | 0.5 | 104 | 0.6 | 106 |
| R12 (north) | 720 | 5 | 115 | 0.8 | 107 | 1.0 | 108 |
| R8 (east) | 1260 | 5 | 115 | 0.3 | 100 | 0.4 | 101 |
| a Distance from residence to closest point of extraction area.<br>b Peak vertical ground vibration, mm/s.<br>c Airblast overpressure, dB(L). | | | | | | | |
| Source: Spectrum (2018) – Table 17 | | | | | | | |

All blasts generate fly rock, however, emphasis is placed in the design of each blast to ensure that the fly rock generated is confined to the design envelope around the blast site. There are generally two main areas of a blast which have the potential to generate fly rock.

1. At the blast hole collar, where the stemming length has not been optimised, and the explosive column is too close to the upper surface of the rock to be blasted, resulting in crater effects and rifling or the upward projection of fly rock.
2. At the face of the blast, where there could be less than optimum burden between the blast hole and the rock face causing explosive gases to vent to the atmosphere causing blow-outs and producing fly rock.

The adoption of the design and operational safeguards nominated in Section 5.2.5.3 would confine the blast fly rock to the design envelope which typically should be less than 80m in front of the blast, 20m behind the blast and 40m of each side of the blast.

Given each blast would be orientated in an easterly or westerly direction across the extraction area and the anticipated maximum projection of fly rock to the south for a distance of 40m there would be no impacts on any vehicles travelling along the Pacific Highway. Importantly, the initial blasts within the Site will be undertaken approximately 400m from the Pacific Highway and 630m from the closest residence which will enable the Operator to demonstrate to the RMS and DPE that the blast design relied upon can be used throughout the remainder of Stage 1.

Whilst it is a requirement for coal mines to consider closing public roads when blasts in overburden rock (typically blasting 250 000t to 500 000t per blast) occur within 500m of the public roads, accepted practice within the Quarrying industry enables blasts to be closer to public roads without road closures. Examples are known where blasting has occurred within Quarries within 120m of a State Highway.

### 5.2.8 Voluntary Land Acquisition and Mitigation Policy Assessment

The NSW Voluntary Land Acquisition and Mitigation Policy (VLAMP) for State Significant Mining, Petroleum and Extraction Industry Development lists five different levels of noise impact and recommended actions to ameliorate these impacts.

The noise impact assessment (Spectrum, 2018) identified that none of the assessed residences would experience noise levels greater than 5dB above the project amenity level. Hence, no recommended actions are required under the VLAMP considerations.

## 5.2.9 Monitoring

### 5.2.9.1 Noise

Attended noise monitoring would be conducted on a quarterly basis for the first year of operations at the Quarry to determine compliance with the noise criteria, confirm the results of the predictive modelling and to inform management decisions relating to further noise mitigation works, should the need arise. Attended monitoring is required to enable the noise source(s) being recorded to be identified, particularly given the presence of highway traffic and the adjoining quarry operations. Monitoring locations would include Residences 22 and 7 to monitor operational noise from extraction and processing activities. Details of the proposed monitoring program would be included in the Quarry's Noise Management Plan. It is proposed that the Operator of the Karuah South Quarry would liaise with Hunter Quarries to identify the most effective manner in which to coordinate monitoring for the combined operations.

All noise monitoring results would be posted on the Operator's website and included in each Annual Review.

### 5.2.9.2 Blasting

All blasts would be monitored at the Quarry Entrance and Residences 22 and 23 to record airblast overpressure and ground vibration levels. Videos would be taken of all blasts to confirm the extent of fly rock generation and any observations not consistent with the design of the blast. Details of the proposed monitoring program would be included in the Quarry's Blast Management Plan.

All blast monitoring results would be posted on the Operator's website and included in each Annual Review.

## 5.2.10 Conclusion

The predicted noise levels were less than the noise assessment criteria at all non-project-related residences. Noise impacts over privately owned land were also lower than the acceptable amenity levels.

In addition, ground vibration and overpressure levels from blasting are predicted to be below the blasting and vibration assessment criteria for all residences.

Subsequently, the noise and blasting impact assessment (Spectrum, 2018) identified that the Project would be able to operate in compliance with all applicable noise, blasting and vibration assessment criteria.

# 5.3 VISIBILITY

## 5.3.1 Introduction

*The SEARs require a "detailed assessment of the likely visual impacts of the development (before, during and post-mining) on private landowners in the vicinity of the development and key vantage points in the public domain, paying particular attention to reasonable and feasible mitigation measures to minimise impacts (including lighting) of the development."*

The visual impact assessment for the Project was undertaken by R.W. Corkery and Co. Pty Limited, concentrating on those matters raised in the SEARs. Particular emphasis has been placed upon the visual assessment with respect to views from the Pacific Highway. Whilst views for motorists travelling past the Site would be very brief, Council's concern is acknowledged regarding the potential views from the highway, particularly for northbound motorists as they enter the MidCoast Local Government Area.

## 5.3.2 The Existing Visual Landscape

The existing visual landscape surrounding the Site varies significantly with the following features of the local setting.

- The Site is located within an area of variable terrain comprising low land adjacent to Blue Rock Close and the Pacific Highway rising to a prominent northeast / southwest ridgeline that is largely covered by remnant native vegetation. The variable topography and substantial areas of vegetation, some of which is remarkably tall (20m-30m), result in limited opportunities to view many features of the existing landscape in the vicinity of the Site.
- Infrastructure in the form of high voltage power lines, local roads and the Pacific Highway are also features of the local visual setting. Opportunities to view features of the existing landscape from local roads and the Pacific Highway are variable and dependent upon the extent of vegetation clearing, orientation of the view and time of day. It is noted that the 2m high wooden fence between the northbound lanes of the Pacific Highway and Blue Rock Close (see **Plate 5.1**) prevents motorists, when travelling past the Site, to observe any activities on the Site.
- A number of the eastern extraction faces within the Karuah Quarry extraction area are observable from the Pacific Highway (see **Plate 5.2**) to the west of the quarry, together with some stockpiles of materials within the quarry itself. Some more distant views of the eastern extraction faces of the Karuah Quarry are possible from areas to the west. It is understood the extraction faces are visible from elevated areas adjacent to Limeburners Road, Limeburners Creek approximately 13km west of Karuah Quarry.


**Plate 5.1 A 2m high wooden fence between the northbound lanes of the Pacific Highway and Blue Rock Close – preventing motorists viewing the Site when adjacent to the Site (Ref: E958D_084)**

- Parts of the Karuah East Quarry are observable from vantage points to the east of the quarry near Halloran Road and Hunter View Road, however, the quarry is largely shielded by topography and vegetation from the Pacific Highway (GSS Environmental, 2012). **Plate 5.3** displays a view from the south-bound lanes of the Pacific Highway towards the Site.
- The Site has limited or no visibility from the residences on the southern side of the Pacific Highway. **Plate 5.4** shows the existing view from near Residence 22 towards the Site through scattered remnant tall vegetation. **Plate 5.5** shows the existing view from Residence 23 to the north with virtually none of the vegetation on the Site being visible.

**Detail of unrehabilitated eastern extraction face in Karuah Quarry (Ref: E958E_001)**

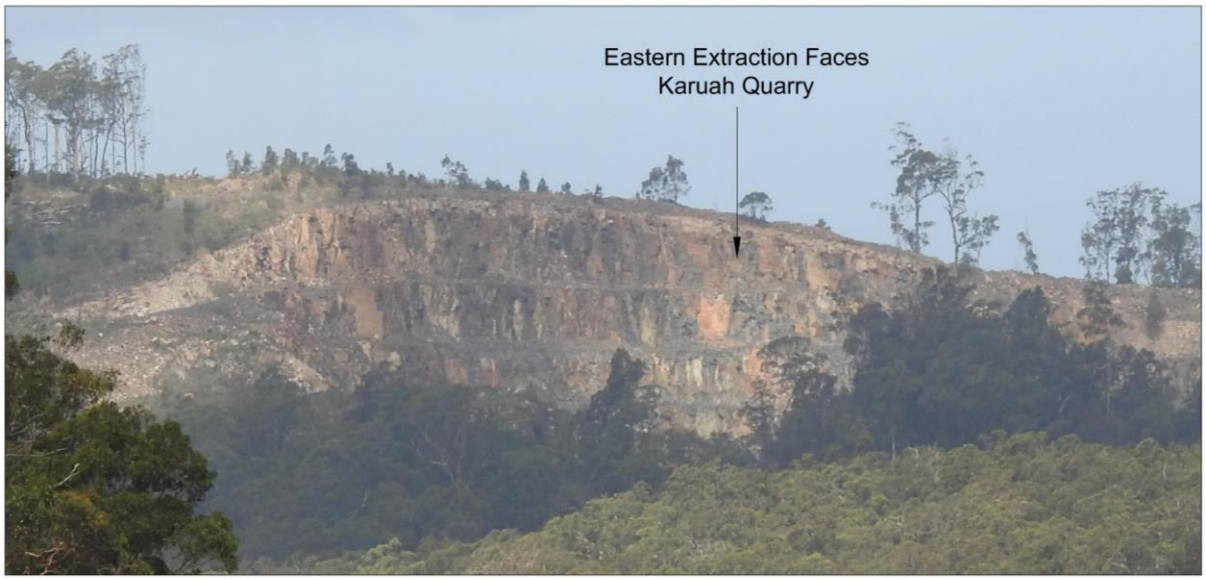




**Plate 5.2 View to the east from the northbound lanes of the Pacific Highway towards Karuah Quarry (Ref: E958F_010)**


**Plate 5.3 View to the west from the southbound lanes of the Pacific Highway towards the Site (Ref: E958F_044)**


**Plate 5.4 View to the northeast from near Residence 22 through existing trees towards the Site (Ref: E958F_103)**

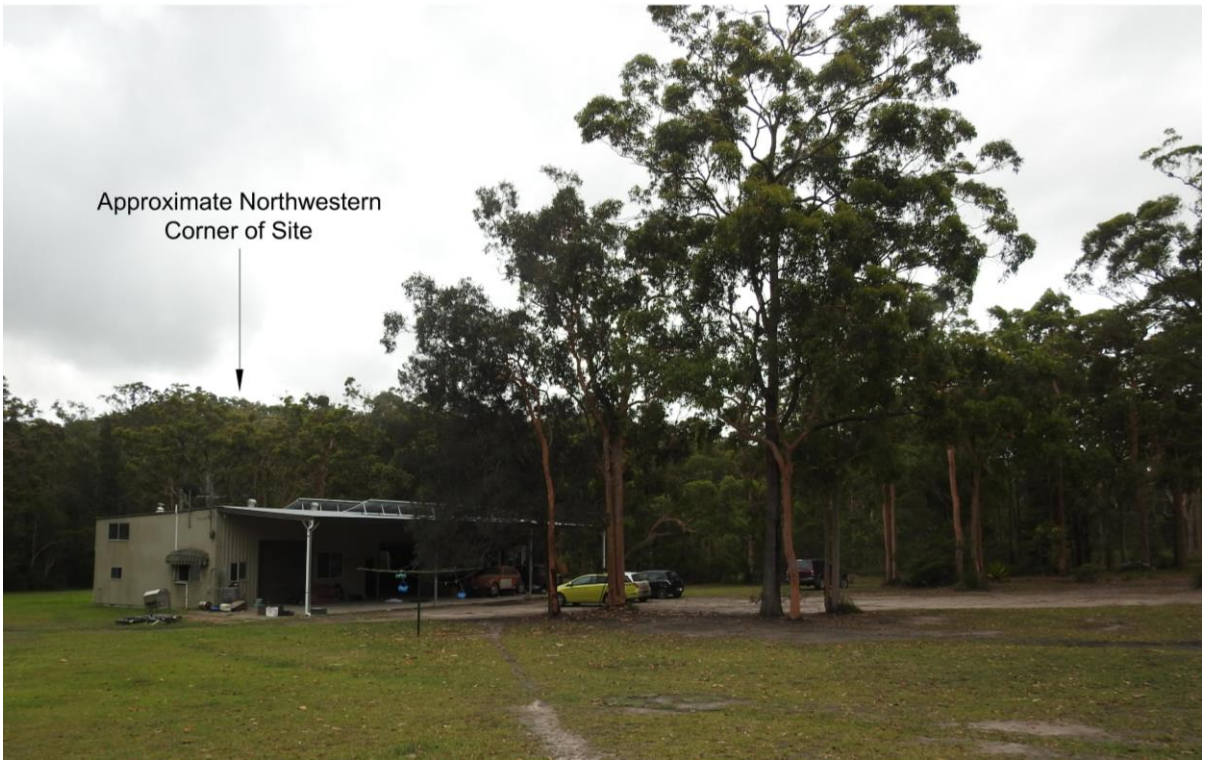



**Plate 5.5 View to the north from Residence 23 with vegetation in the foreground shielding views of the Site (Ref: E958F_111)**

### 5.3.3 Changes to the Visual Amenity of the Site

The Project would result in the progressive creation of a 10.8ha void within the Site with an area of remnant vegetation to the south cleared to accommodate the Quarry infrastructure area. The progressive removal of vegetation would potentially expose some components of the Project although the extent of change, and impact, would be mitigated as much as possible. Other minor changes to the visual amenity of the Site may result from limited security lighting during the night-time period and operational lighting within the Quarry infrastructure area from 5:00am to 7:00am.

### 5.3.4 Design and Operational Mitigation Measures

The Applicant is cognisant of the need to manage the visual impacts of the Quarry from Pacific Highway and Residence 22 and has proposed a range of design and operational mitigation measures to minimise visual impacts of the Quarry's operation.

The principal design mitigation measures to be adopted to minimise visual impacts would comprise the following.

1. The bulk of the existing vegetation between Blue Rock Close and the Quarry infrastructure area would be retained to provide the best possible shielding of the operations on the infrastructure area. Most of the trees in the vicinity of the Quarry Entrance and Southern Sediment Basin would need to be removed with some selected trees retained near the Quarry Entrance.

2. The elevation of the Quarry infrastructure area would be an average of approximately 28m AHD with a slight gradient from south to north. It is anticipated that the retained vegetation on the eastern and southern side of this area would assist to significantly shield the activities undertaken on the Quarry infrastructure area created at this designed elevation.

3. Extraction would advance in six stages throughout the life of the Quarry with vegetation clearing being undertaken in each sub-stage only a short period before the commencement of extraction. This approach would retain screening vegetation for as long as possible which, in turn, would provide time for various operational mitigation measures to be implemented.

4. The sequence of extraction in Stage 2 of operations has been specifically designed to progress from west to east so that the Operator can progressively revegetate the completed benches prior to these benches being exposed as the Stage 2 extraction activities advance eastwards.

5. The Quarry and associated areas of disturbance would be maintained in a clean and tidy condition at all times.

The Operator would adopt the following operational mitigation measures to complement the previously outlined design mitigation measures. The need for these mitigation measures was established through the use of computer-generated cross sections and simulations to identify key areas within the Site that require additional integration measures. **Figures 5.11** and **5.12** display these cross-sections and the areas that would be visible at certain stages of the Quarry's life and require operational mitigation measures. It is noted that whilst the vegetation adjoining the Site and/or to be retained on site is displayed conceptually, the actual heights/elevations of vegetation relied upon for creation of the cross-sections has been obtained by computer analysis from aerial photographs. It is, however, acknowledged that minor local variations in tree or foliage density may result in a minor deviation of the areas visible on site from the Pacific Highway.

1. The effectiveness of the retained vegetation on the southern side of the Quarry infrastructure area to shield views of the activities on site would be reviewed earl in the Project life to establish whether supplementary plants of trees and shrubs would be beneficial in reducing visibility from Blue Rock Close.

2. The outer surface of the Quarry infrastructure area would be progressively vegetated in the manner outlined in Section 2.12.3 to assist in stabilizing the slope and minimizing the visual impact when viewed from Residence 22 and Blue Rock Close.

3. The upper extract face above approximately 58m AHD would become visible from the westbound lanes of the Pacific Highway across the top of the retained vegetation during Stage 1C (see **Figure 5.11**). Following the completion of extraction above the 58m AHD level, the Operator would review the exposed colour of rock and determine whether it would be beneficial to progressively apply a bitumen emulsion to the visible area to darken the subject area and limit its visibility from the highway.

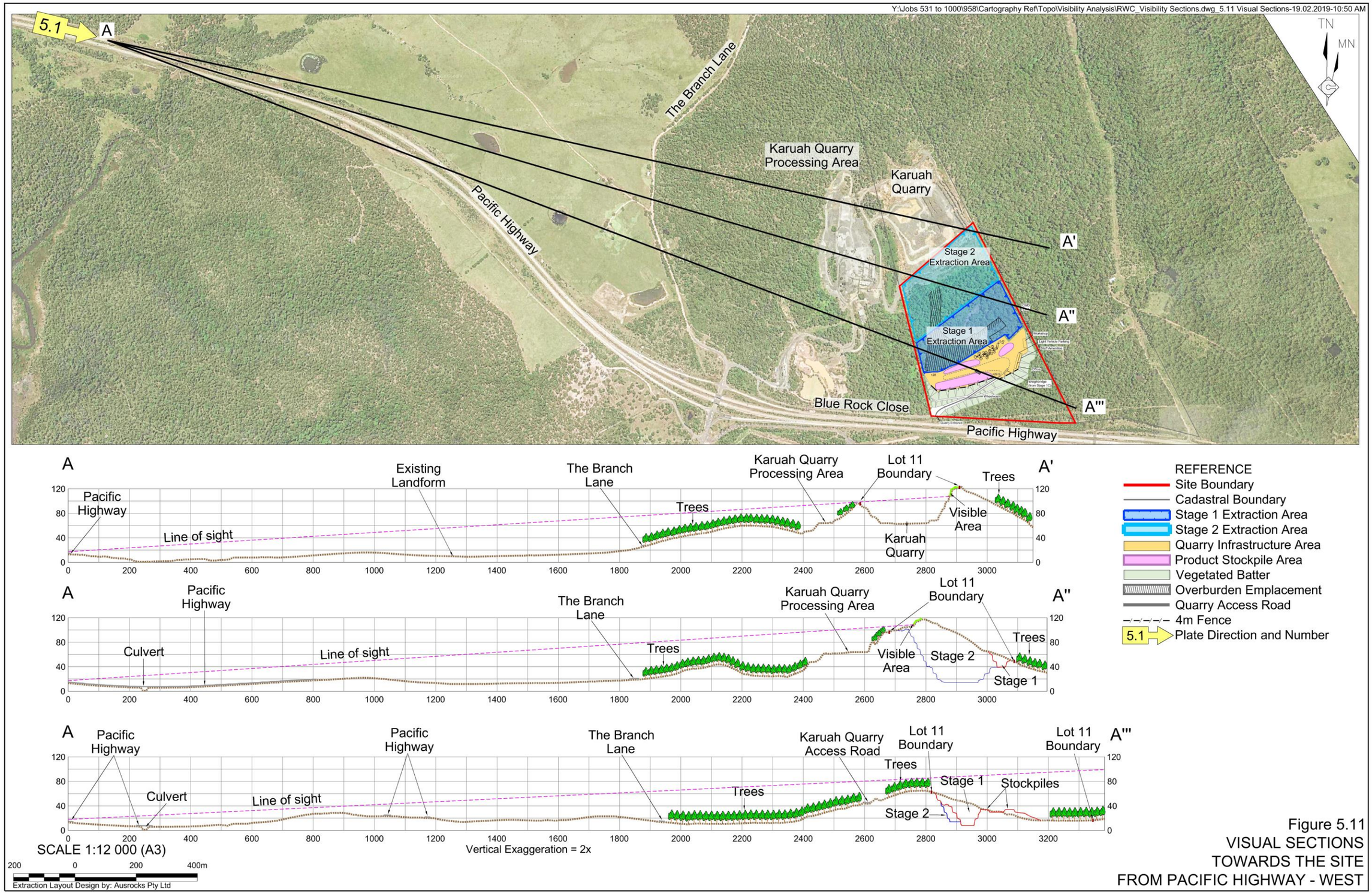



Figure 5.11
VISUAL SECTIONS
TOWARDS THE SITE
FROM PACIFIC HIGHWAY - WEST

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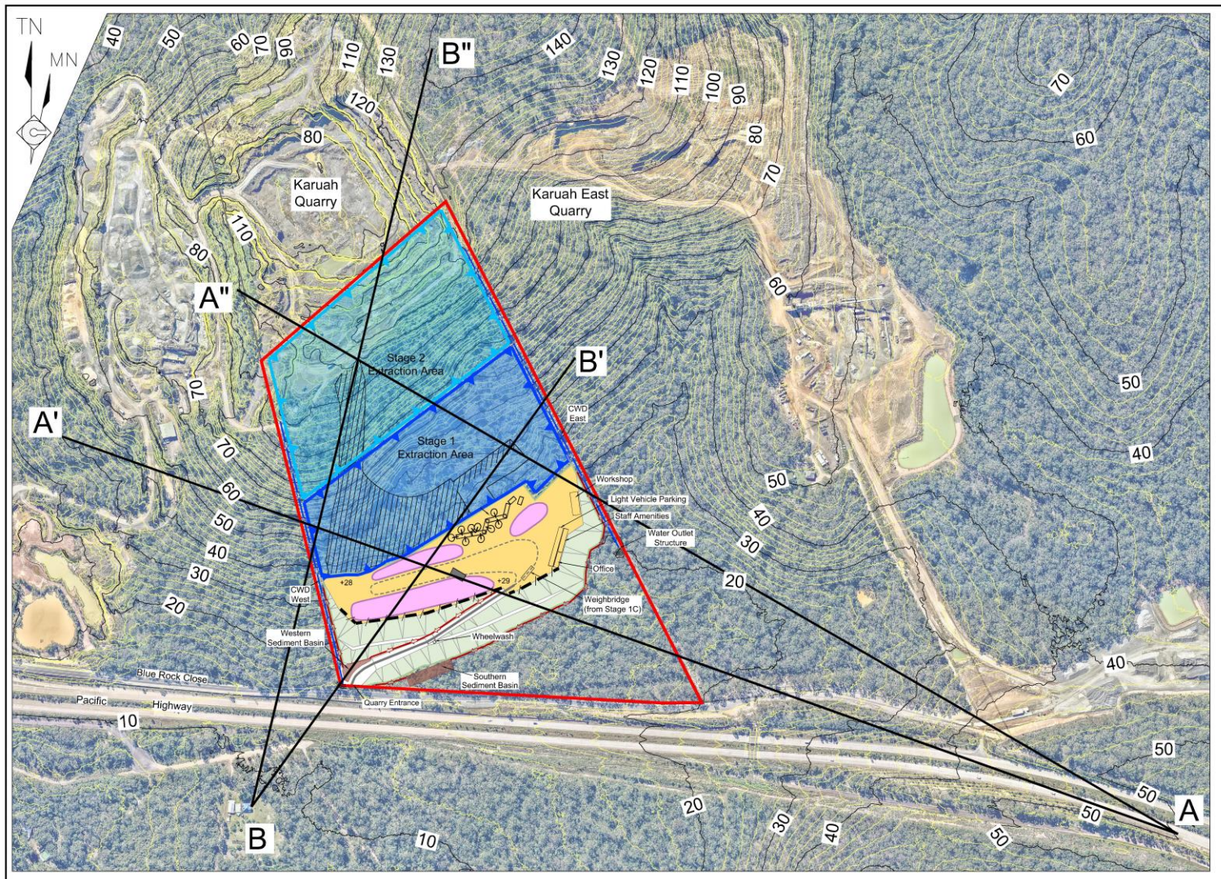


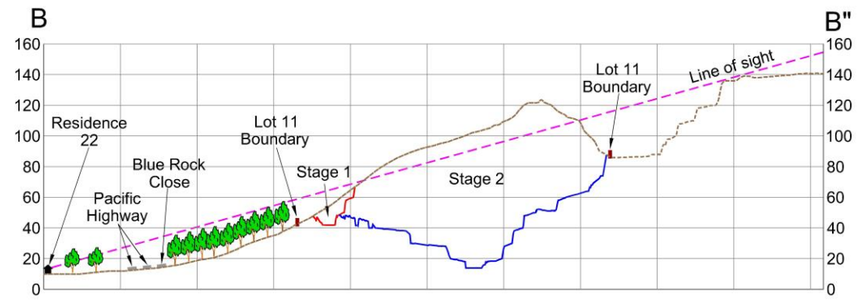


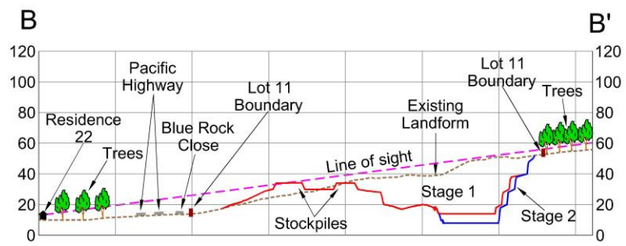


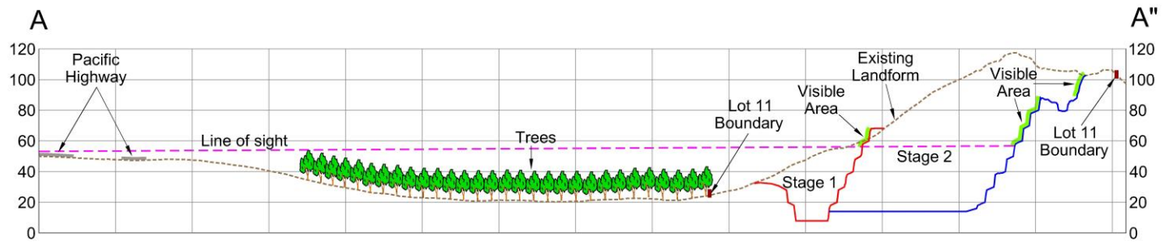


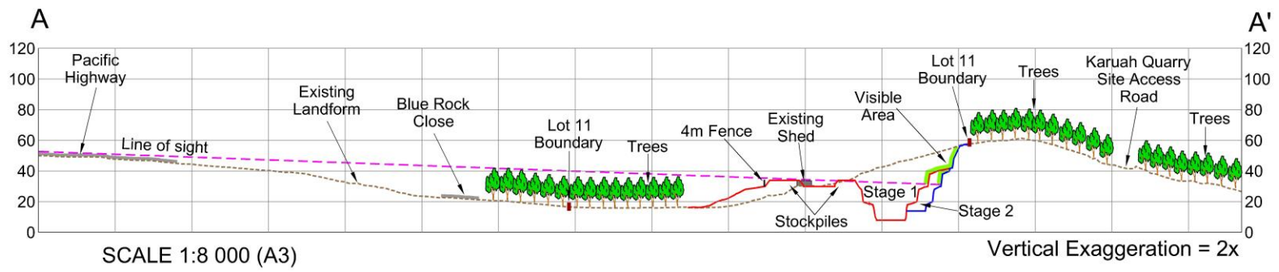


SCALE 1:8 000 (A3)

100 0 100 200 300 400 m

Extraction Layout Design by: Ausrocks Pty Ltd

Vertical Exaggeration = 2x

REFERENCE
- Site Boundary
- Cadastral Boundary
- 80 Contour (mAHD)(Interval=1m)
- Karuah Quarry - Limit of Extraction
- Stage 1 Extraction Area
- Stage 2 Extraction Area
- Quarry Infrastructure Area
- Product Stockpile Area
- Vegetated Batter
- Overburden Emplacement
- Quarry Access Road
- Internal Road (Indicative only)
- Clean Water Diversion Drain
- Dirty Water Collection Drain
- Sediment Basin
- Water Outlet Structure
- 4m Fence

Figure 5.12
VISUAL SECTIONS
TOWARDS THE SITE

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4. **Figure 5.11** also identifies that views of the extraction faces above 58m AHD in Stage 2A would become visible following the extraction of Stage 2B. In order to limit the long-term exposure of unrehabilitated extraction faces from the highway, the Operator would progressively rehabilitate the terminal benches in the manner described in Section 2.12.4.3 (**Figure 2.15**). The practice of progressively rehabilitating quarry benches in this manner is recognised as best practice.

The Operator would progressively rehabilitate all terminal benches as they are completed to assist in providing a long-term acceptable view from the Pacific Highway towards the final landform and obtain the ecological benefits of retaining a range of native species within the final landform.

### 5.3.5 Assessment of Impacts

The assessment of the visual impacts of the Project is presented for each of the potential viewing locations around the Site, i.e. with the recognition that the mitigation measures outlined in Section 5.3.4 would be fully implemented.

#### Pacific Highway East of the Site

Sections A-A' and A-A" on **Figure 5.11** display sections between the location on the southbound lanes of the Pacific Highway at which motorists would view the Site.

Section A-A' displays the line of sight towards the Quarry infrastructure area, with the operations in that area shielded from views. The section continues to the west-northwest and identifies that the one or two extraction faces above 58m AHD would be visible following extraction. The extent of its visibility would depend on the exposed colour of the rock, however, given the rock's colour is a dark grey, it is likely that it would be discernible but without considerable impact. The application of a bitumen emulsion to the exposed faces, if required, would achieve the same low level of impact. It is noted that mobile earthmoving equipment would be visible on the 58m AHD bench and above for a short period during Stage 1C as most of the extraction in Stage 1C would occur in shielded areas beneath 58m AHD.

Section A-A" displays a cross-section through Stage 2A which identifies the upper benches in Stage 2A would be visible from the Pacific Highway. However, with the adoption of the progressive rehabilitation of terminal benches in Stage 2A, the visual impact from the Pacific Highway would be minor as the vegetated benches, whilst visible, would display little contrast with the vegetation in the foreground and far distance (beyond the extraction area). It is also noted that the skyline vegetation behind the Stage 2A extraction area would be retained along the ridge along the western boundary of the Site.

#### Pacific Highway West of the Site

Three cross-sections displayed on **Figure 5.12** show that the extraction faces above approximately 105m AHD would be the only component of the extraction operations within the Site that would be visible form the west, i.e. towards the end of the operational life of the Quarry. The exact area that would be visible would depend upon the final landform left by Hunter Quarries when they cease extraction operations in the Karuah Quarry in 2023.

Extraction activities in Stage 1 and the activities undertaken on the Quarry infrastructure area would not be visible from the Pacific Highway west of the Site.

#### Nearby Residences

Only two residences to the south of the Pacific Highway would view activities undertaken within the Site.

#### *Residence 22*

It is possible that views of the construction activities near the Quarry Entrance could be viewed through the trees between the residence and the Pacific Highway (**Plate 5.4**). However, the activities over the Quarry infrastructure area and extraction areas should largely be shielded by intervening vegetation.

#### *Residence 23*

There is a possibility that a very elevated small section of Stage 2A would be visible from the residence in the area of the northwestern corner of the Site (**Plate 5.5**).

The level of visual impacts from both residences is assessed to be minor.

#### Conclusion

The Karuah South Quarry would be operated in a manner that parts of the active and rehabilitated extraction areas would be visible but for the most part, the activities would be adequately shielded so as to cause little or no visual impact.

The adoption of both the design and operational mitigation measures would limit the colour contrast and duration of visual exposure and therefore the overall visual impacts of the Project. Importantly, the rehabilitated landform would blend into the surrounding vegetated landscape without any substantive long term impacts.

## 5.4 TRAFFIC AND TRANSPORT

### 5.4.1 Introduction

The SEARs issued for the Project identified transport as a key issue, requiring that the EIS include:

- accurate predictions of the road traffic generated by the construction and operation of the development, including a description of the types of vehicles likely to be used for transportation of quarry products;
- a detailed assessment of potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road network (as identified above); and
- a description of the measures that would be implemented to mitigate any impacts, including concept plans of any proposed updates, developed in consultation with the relevant road and rail authorities (if required).

Additional matters for consideration in preparing the EIS were also provided in the correspondence from Roads and Maritime Services (RMS) who requested a traffic and transport study in accordance with the RMS's *Guide to Traffic Generating Developments 2002*. A summary of the SEARs and requirements of the RMS are listed within **Table A2.2**, **Appendix 2** together with a record of where each requirement is addressed in the EIS.

A Traffic and Transport Assessment for the Project has been prepared by The Transport Planning Partnership Pty Ltd which is referred to as TTPP (2018) and is presented as Part 3 of the *Specialist Consultant Studies Compendium*. The following subsections draw upon information presented in that report and describe the existing traffic environment, predicted changes to the traffic environment as a result of the Project, proposed management and mitigation measures and an assessment of traffic-related impacts.

## 5.4.2 Existing Traffic Conditions

### 5.4.2.1 Description of the Existing Road Network

The following roads and road infrastructure would provide access to and from the Site.

- Blue Rock Close.
- Andersite Road.
- The Branch Lane.
- Tarean Road.
- The Pacific Highway / Pacific Highway Interchange.

**Figure 5.13** displays the locations of the key transport infrastructure.

#### Blue Rock Close

Blue Rock Close is a two-way, two-lane local road under the jurisdiction of MidCoast Council that is aligned generally east-west and parallel to the Pacific Highway. Blue Rock Close has recently been sealed and extended to the east to serve the Karuah East Quarry.

Blue Rock Close is generally 8m wide and connects with Andersite Road to the west at a priority-controlled T-junction. The pavement at the intersection has been widened to accommodate simultaneous turning movements of B-Double vehicles. Blue Rock Close has a posted speed limit of 50km/hr.

#### Andersite Road

Andersite Road is a two-way two-lane local road under the jurisdiction of MidCoast Council. Andersite Road connects with The Branch Lane at its western end and provides access to the Karuah Quarry at its eastern end. Andersite Road has a posted speed limit of 50km/hr.

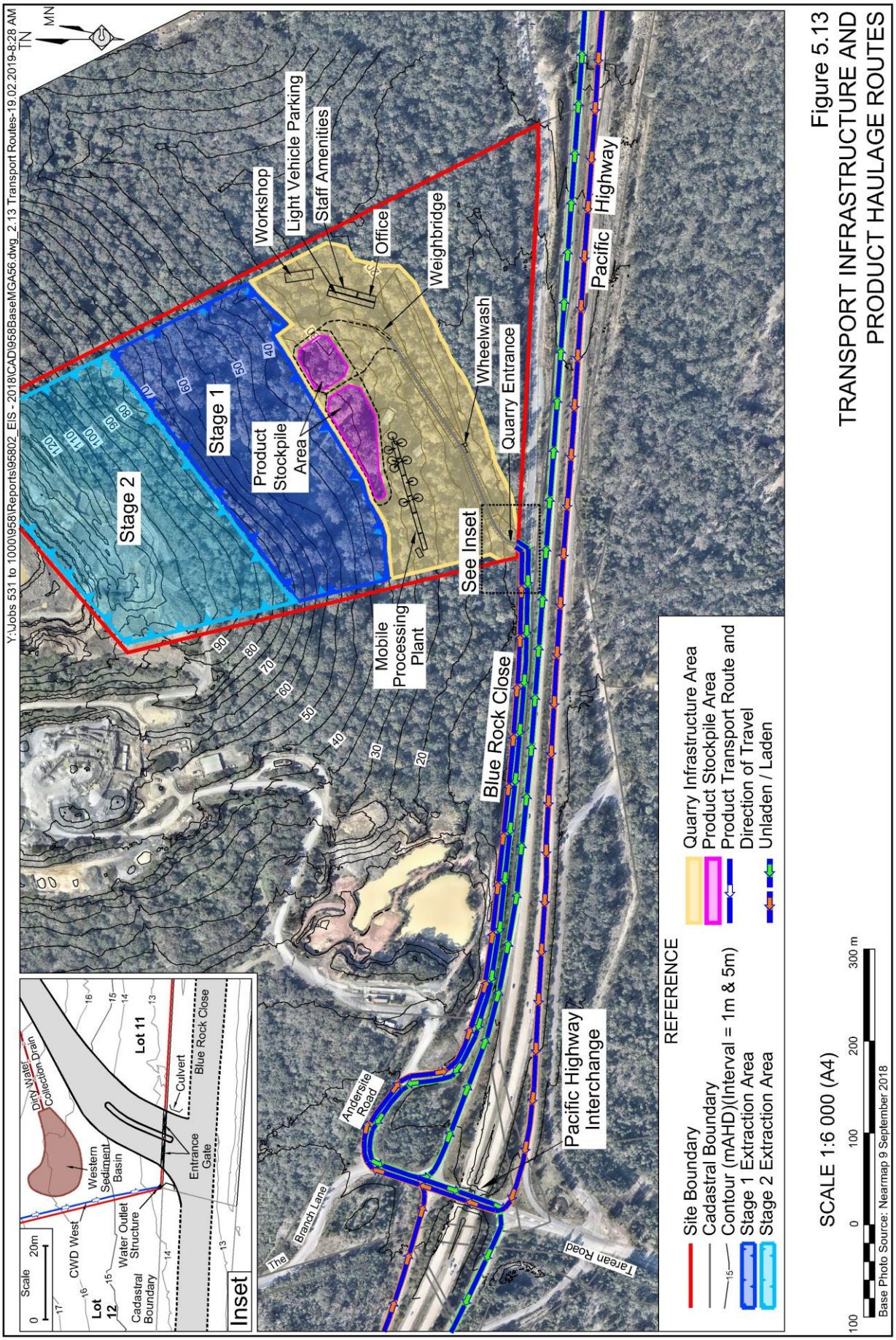



Figure 5.13
TRANSPORT INFRASTRUCTURE AND PRODUCT HAULAGE ROUTES

### The Branch Lane

The Branch Lane is a two-lane, two-way local road under the jurisdiction of MidCoast Council. The Branch Lane provides access to the Pacific Highway interchange to the south and extends to the north to Booral Road. The Branch Lane is sealed and has a posted speed limit of 60km/hr in the vicinity of the Site. The Branch Lane, between Andersite Road and the Pacific Highway, is an approved B-Double Route.

### Tarean Road

Tarean Road is a two-lane two-way local road under the jurisdiction of MidCoast Council which effectively is a continuation of The Branch Lane south of the Pacific Highway. Tarean Road comprises a section of the "Old Pacific Highway" which bisects the Karuah town centre and provides access to interchanges with the Pacific Highway at its eastern and western extents. Tarean Road has a general posted speed limit of 80km/hr which reduces to 60km/h in the vicinity of the Karuah town centre.

### Pacific Highway / Pacific Highway Interchange

The Pacific Highway is a State Highway (SH10) that connects with the New England Highway near Hexham, Newcastle and the Pacific Motorway near Brunswick Heads. In the vicinity of the Site, the Pacific Highway is known as the "Karuah Bypass", with two travel lanes in each direction and a posted speed limit of 110km/hr. The Pacific Highway is an approved B-Double route with a theoretical capacity of 3,700 vehicles per hour in each direction. A grade separated interchange is present providing access to both Tarean Road (to the south) and The Branch Lane (to the north), which provides access to the Site from both directions from the Pacific Highway.

### 5.4.2.2 Existing Traffic Volumes

Traffic counts were commissioned by TTPP (2018) as part of the traffic assessment to establish traffic volumes and vehicle types using the existing road network. Intersection turning movement counts were undertaken on 6 February 2018 at the following locations.

- Andersite Road intersection with Blue Rock Close.
- The Branch Lane intersection with Andersite Road.
- Tarean Road intersection with the Pacific Highway eastbound off-ramp and the eastbound on-ramp.
- Tarean Road intersection with the Pacific Highway westbound on-ramp and the westbound off-ramp.

**Figure 5.14** presents the existing traffic volumes based on data obtained during the traffic survey for morning peak hour and afternoon peak hour periods. Intersections were assessed by TTPP (2018) to provide a satisfactory level of surface with ample capacity to accommodate future growth.

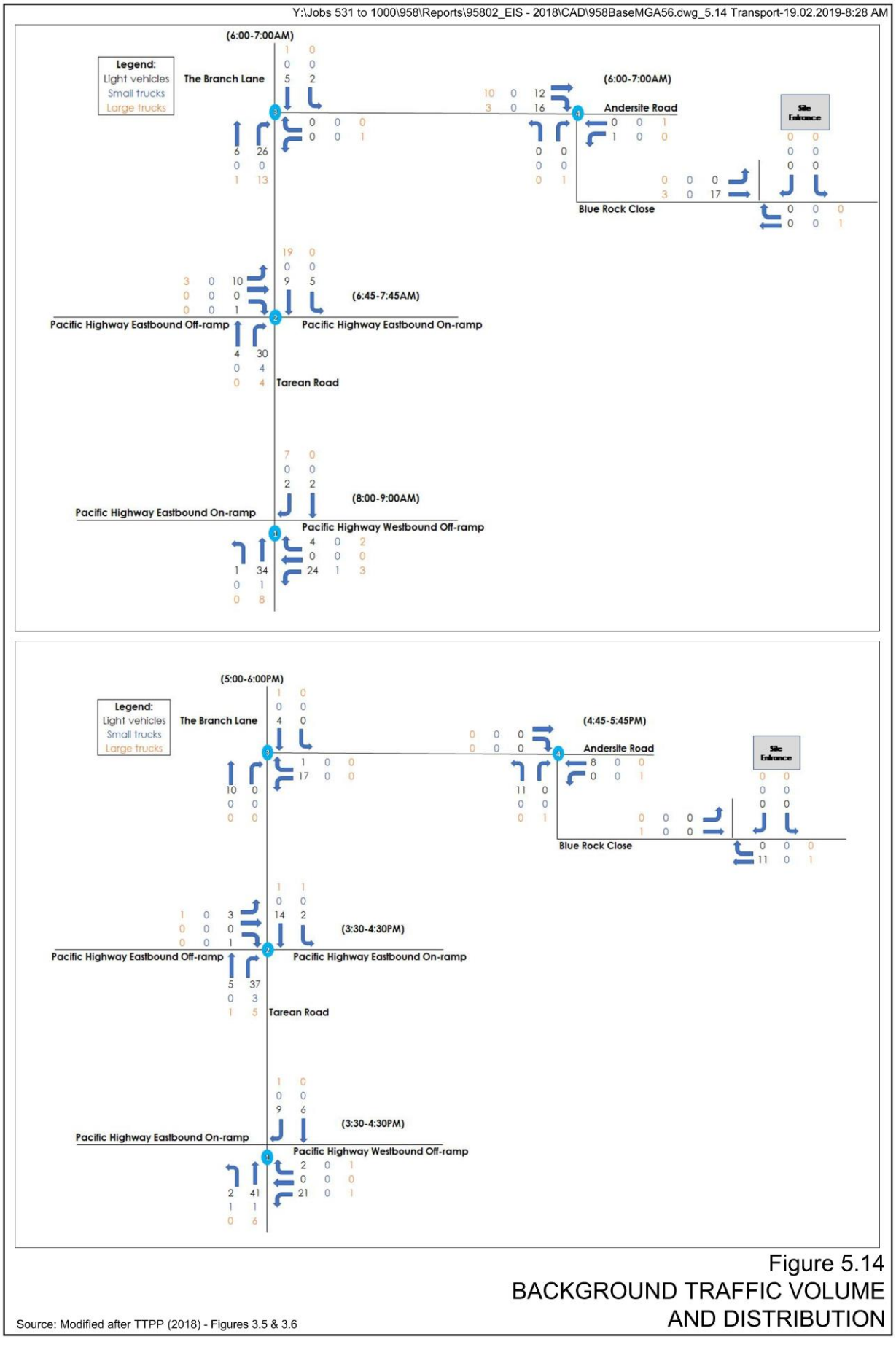



Figure 5.14
BACKGROUND TRAFFIC VOLUME AND DISTRIBUTION

Source: Modified after TTPP (2018) - Figures 3.5 & 3.6

RMS traffic data indicate approximately 12 069 vehicles per day travel westbound / southbound and 11 027 vehicles per day travel eastbound / northbound along the Pacific Highway in the vicinity of the Site. Heavy vehicles account for approximately 7% of westbound / southbound traffic and 17% of eastbound / northbound traffic on the Pacific Highway in the vicinity of the Site.

#### 5.4.2.3 Road Safety

A total of two crashes have been reported in the vicinity of the Site from January 2012 to December 2016 resulting in three injuries.

- A rear end crash on the Pacific Highway.
- A run-off-road crash on The Branch Lane approximately 800m north of Andersite Road.

Based on crash information, these crashes do not demonstrate common contributing factors and did not involve any vehicles travelling to or from the Karuah Quarry or Karuah East Quarry.

During the preparation of the traffic assessment (TTPP, 2018), the following road safety issues were identified.

- Insufficient sight line to the north from Andersite Road along The Branch Lane.
- Deficiency in road delineation along The Branch Lane.

These issues would be addressed through the MidCoast Council's road maintenance program. Mitigation measures may include trimming of vegetation to improve sight lines and repainting of line marking to improve road delineation.

### 5.4.3 Predicted Changes to the Traffic Environment

#### 5.4.3.1 Intersection of Quarry Access Road and Blue Rock Close

The Quarry access road and Quarry entrance would be constructed to provide long-term access to the Site from Blue Rock Close at the location near the existing vehicular access for Lot 11 DP1024564 (see **Figure 2.13**). The Quarry access road would be constructed using appropriate road pavement materials and retained with a gravelled unsealed surface until the end of the site establishment and construction stage. The Quarry entrance would be sealed prior to any products being transported from the Site. Adequate line(s) of sight are available along Blue Rock Close at this location.

#### 5.4.3.2 Predicted Traffic Volumes and Transport Routes

The SEARs for the proposed Karuah South Quarry require a cumulative assessment of the Project with the various quarries operated or proposed to be operated by Hunter Quarries. The operational scenarios considered in the various assessments are presented in Section 1.5.4.

For the purposes of the cumulative traffic assessment (TTPP, 2018), the following three operational scenarios have been considered.

- Construction Phase (Year 0).
- Stage 1C (Year 5).
- Stage 2B (Year 15).

**Table 5.14** presents the maximum daily vehicle movements predicted to be generated by the Project and other quarry operations in the vicinity of the Site during the above stages.

**Table 5.14**
**Maximum Daily Vehicle Movements**

| | Site Establishment and Construction (Year 0) | | Stage 1C (Year 5) | | Stage 2B (Year 15) | |
|---|---|---|---|---|---|---|
| **Location** | **LVM** | **HVM** | **LVM** | **HVM** | **LVM** | **HVM** |
| Project | 26 | 36 | 60 | 148 | 60 | 246 |
| Karuah Quarry | 30 | 144 | 40 | 144 | - | - |
| Karuah East Quarry | 56 | 432 | 60 | 432 | 60 | 432 |
| Karuah Red Quarry | - | - | - | - | 10 | 32 |
| **Total** | **112** | **612** | **160** | **724** | **130** | **710** |
| Source: Modified after TTPP (2018) – Tables 4.3, 4.4 and 4.5 | | | | | | |

### Site Establishment and Construction Stage

The Project would generate a range of traffic during the 6 month site establishment and construction stage. Heavy vehicle traffic travelling to and from the Site during this period would include low loaders, semi-trailers and other trucks used to deliver equipment, construction materials and other supplies to the Site. A range of light vehicles would also be used by the Operator's employees, contractors, couriers and visitors etc. The Project would generate approximately 5% of quarry-related heavy vehicle movements in the vicinity of the Site during the site establishment and construction stage. It is predicted that cumulative quarry-related traffic would comprise a maximum of approximately 90% of traffic at the Tarean Road intersection north of the Pacific Highway during the morning peak hour period during the site establishment and construction stage (Year 0).

### Operational Stages

Following the commencement of quarry operations, heavy vehicle movements generated by the Project would increase due to the despatch of crushed hard rock and other extractive materials from the Site. It is anticipated that the Project would account for a maximum of approximately 20% of quarry-related heavy vehicle movements in the vicinity of the Site during Stage 1C.

As production levels are ramped up in Stage 2B, it is anticipated that the Project would generate a maximum of approximately 35% of total quarry-related heavy vehicle movements in the vicinity of the Site. Cumulative quarry-related traffic would comprise a maximum of approximately 90% of total traffic on Tarean Road north of the Pacific Highway Interchange during the morning peak hour period during Stage 2B (Year 15).

As the majority of the products produced within the Quarry would be destined for the Newcastle, Sydney and Port Stephens LGA markets, approximately 95% of product trucks would enter the Pacific Highway via the westbound on-ramp. During periods of maximum production, Project-generated traffic would represent approximately 2% of westbound / southbound traffic and 28% of westbound / southbound heavy vehicle traffic on the Pacific Highway in the vicinity of the Site. Those product trucks destined towards markets throughout the MidCoast LGA would enter the Pacific Highway via the eastbound on-ramp. Eastbound / northbound vehicle movements are not expected to comprise more than 1% of traffic or 1% of heavy vehicle movements on the Pacific Highway. Minor quantities of products would occasionally be supplied to other local destinations, which would require product trucks to use local roads.

It is proposed that the maximum rate of laden trucks departing the Site would not exceed 26 trucks per hour throughout any hour of the day.

### 5.4.4 Design and Operational Safeguards

#### 5.4.4.1 Design Features

Section 2.7.1 presents the proposed design standards to be achieved for the proposed Quarry entrance.

#### 5.4.4.2 Operational Safeguards and Management Measures

The Operator would implement the following operational safeguards to ensure that other motorists on the Pacific Highway and surrounding roads would be minimally impacted by the traffic generated by the Project.

- The Operator would prepare a detailed Traffic Management Plan, following the receipt of development consent, to safely manage traffic impacts during all stages of the Project.
- The Operator would require all truck drivers travelling to and from the Quarry to sign a Driver's Code of Conduct that clearly outlines the Operator's expectations of each driver whilst travelling to and from the Quarry and whilst on Site e.g. all loads would be required to be covered.
- Overtaking of any product trucks would be prohibited on the transport route between the Pacific Highway and the Site. It is noted that the double barrier centreline in The Branch Lane, Andersite Road and Blue Rock Close would effectively restrict overtaking manoeuvres.
- In the event that overtaking is required (e.g. due to a vehicle breakdown), drivers would be required to undertake the manoeuvre only when safe to do so and when in a position with adequate line of sight.
- Communication between Project-related heavy vehicle truck drivers and heavy vehicle drivers from adjoining quarry operations would be encouraged in the event of a traffic incident.
- Rapid response to traffic incidents would be prioritised to minimise traffic impacts.

### 5.4.5 Assessment of Impacts

As outlined in **Table 5.14**, maximum product truck movements during a high volume campaign would be 246 per day, i.e. 123 loads. At maximum production, employee and visitor light vehicles are estimated to amount to approximately 60 light vehicle movements per day, i.e. 30 return trips. This would represent approximately 1% of total traffic and 9% of heavy vehicle traffic on the Pacific Highway in the vicinity of the Site. TTPP (2018) has considered these additional traffic movements against interpreted background traffic levels, including traffic generated by approved and proposed Hunter Quarries operations, and determined that the moderate increase in traffic levels associated with the Project would not generate adverse impacts on road network.

Traffic modelling, undertaken by TTPP (2018) at key intersections within the vicinity of the Site, indicates that intersections would continue to operate satisfactorily regardless of the additional traffic generated by the Project. During peak production, the highest delay (16 seconds) would occur at the Pacific Highway Interchange by the drivers of vehicles turning right out of the Pacific Highway westbound off-ramp during the AM peak hour (seven vehicles per hour) as well as the PM peak hour (five vehicles per hour). This impact has been assessed as minimal by TTPP (2018).

The proposed transport routes along The Branch Lane and Pacific Highway are approved B-Double routes. Andersite Road and The Branch Lane have also been upgraded and are suitable for B-Double vehicles. TTPP (2018) has assessed that the proposed transport routes are suitable for 19m trucks and trailers which would be used for the transportation of crushed rock and other products from the Karuah South Quarry.

TTPP (2018) has further confirmed that adequate line of sight is available at the proposed Quarry entrance which would be constructed to provide access to the Site.

## 5.5 TERRESTRIAL ECOLOGY

### 5.5.1 Introduction

The SEARs for the Project identified biodiversity as a key issue requiring that the EIS include:

- accurate predictions of any vegetation clearing on site;
- a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, and having regard to the NSW Biodiversity Offsets Scheme and the Biodiversity Assessment Method; and
- a strategy to offset any residual impacts of the development in accordance with the NSW Biodiversity Offsets Scheme.

In addition, the Office of Environment and Heritage (OEH) requested an assessment of impacts on flora, fauna, threatened species, populations, communities and their habitats in accordance with the Biodiversity Assessment Method (BAM). A summary of the SEARs and requirements of the OEH are listed within **Table A2.2**, **Appendix 2** together with a record of where each requirement is addressed in the EIS.

A Biodiversity Development Assessment Report (BDAR) for the Project has been prepared by Ecoplanning Pty Ltd which is referred to as Ecoplanning (2019) and is presented as Part 4 of the *Specialist Consultant Studies Compendium*. The following subsections draw upon information presented in that report and describe the existing environment, potential changes to the natural environment as a result of the Project, proposed management and mitigation measures and an assessment of ecological impacts.

### 5.5.2 Assessment Methodology

Ecoplanning Pty Ltd was commissioned by the Applicant to undertake an ecological assessment of the Site in accordance with the BAM to document potential impacts to biodiversity and to assess the residual impacts of the Project.

#### Desktop Assessment

Ecoplanning (2019) undertook a desktop and literature review of the following information sources to assist with the development of a predictive model to identify candidate threatened flora and fauna within the proposed area of disturbance.

- Regional vegetation mapping by Silversten et al. (2011).
- Previous assessment undertaken by Conacher Environmental Group (2012) incorporating the entire proposed area of disturbance.
- Previous assessments within the local setting undertaken by RPS (2013) and ELA (2013).
- Previous mapping of Plant Community Types (PCTs) across the proposed area of disturbance undertaken by Biosis (2017).
- The Threatened Species Profile Database maintained by OEH.

#### Flora Surveys

A total of 15 threatened flora species were identified as candidate species for flora surveys. Targeted surveys for threatened flora were undertaken in accordance with OEH's *NSW Guide to Surveying Threatened Plants* (OEH, 2016) and involved initial searches to determine potential habitat of the candidate species within the proposed area of disturbance and parallel traverses within areas of potential habitat.

In accordance with OEH (2016), surveys for candidate threatened orchid species (*Pterostylis chaetophora*, *Corybas dowlingii* (Red Helmet Orchid) and *Diuris praecox* (Rough Doubletail)) were undertaken during the flowering period of the species as confirmed by visiting a reference population of each species. Surveys for *Cryptostylis hunteriana* (Leafless Tongue Orchid), were completed when the species was known to be flowering at a reference site, although the reference population itself was not inspected. Additional surveys during the nominated survey period for *Rhizanthella slateri* (Underground Orchid) were undertaken without visiting a reference site due to the highly cryptic nature of the species.

Survey dates and techniques for the flora surveys are presented in detail in Section 4.3.1 of Ecoplanning (2019).

### Fauna Surveys

A total of 38 threatened fauna species were identified as candidate species for fauna surveys. Targeted fauna surveys were completed across several survey periods to coincide with the survey periods for candidate species identified within the BAM. Survey techniques are presented in Section 4.3.2 of Ecoplanning (2019). In summary, fauna surveys comprised the following methodologies to survey for candidate threatened fauna species.

- Nocturnal watercourse searches for amphibians.
- Nocturnal call playback.
- Spotlighting.
- Diurnal bird surveys (incidental and 20 min / 2 ha surveys).
- Hollow-bearing trees and nest searches.
- Remote camera trapping.
- Hair tubes (small [50 mm] and large [110x70 mm]).
- Ultrasonic sounds detection (Anabats).
- Arboreal Elliott traps (A, B and E traps).
- Pitfall traps (30 cm diameter).
- Listening surveys during large owl breeding season.
- Searches for indirect evidence of fauna species (white wash, pellets, scats, tracks, scratches).

## 5.5.3 Existing Ecological Setting

### 5.5.3.1 Plant Community Types

Native vegetation was identified and mapped across 11.6 ha of the approximately 16.4 ha of the proposed area of disturbance. Areas which did not support native vegetation included areas identified as being 'cleared' or areas supporting 'exotic vegetation'. Four PCTs were identified across the proposed area of disturbance, with the distribution of these communities related to their topographical position, slope and aspect within the Site.

**Figure 5.15** displays the spatial distribution of the four PCTs mapped by Ecoplanning (2019). **Table 5.15** identifies the vegetation zone, area and threatened ecological community status of the four PCTs identified within the proposed area of disturbance.

#### 5.5.3.1.1 Requirement for EPBC Act Referral

Of the PCTs identified within the proposed area of disturbance, one PCT (PCT 1527), comprises an Endangered Ecological Community under the Biodiversity Conservation (BC) Act, namely *'Lowland Rainforest in the NSW North-Coast and Sydney Basin Bioregions'*. This vegetation also meets the definition of the *'Lowland Rainforest of Subtropical Australia'*, Critically Endangered Ecological Community (CEEC) as listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

**Table 5.15**
**Plant Community Types within the Proposed Area of Disturbance**

| PCT | Vegetation Class | Vegetation zones | Area (ha) | Threatened Ecological Community (TEC) |
|---|---|---|---|---|
| 1590 - Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest | Hunter-Macleay Dry Sclerophyll Forests | Dense Lantana | 0.58 | None |
| | | Low Lantana | 0.56 | |
| 1567 - Tallowwood - Brush Box - Sydney Blue Gum moist shrubby tall open forest on foothills of the lower North Coast | North Coast Wet Sclerophyll Forest | Lantana | 7.45 | None |
| 1527 - Bangalow Palm - Coachwood - Sassafras gully warm temperate rainforest of the Central Coast | Northern Warm Temperate Rainforests | Intact | 0.47 | Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions (BC Act)<br>'Lowland Rainforest of Subtropical Australia' (EPBC Act) |
| 1550 - Small-fruited Grey Gum - Turpentine - Tallowwood moist open forest on foothills of the lower North Coast | Northern Hinterland Wet Sclerophyll Forests | Intact | 2.53 | None |
| **Total** | | | **11.59** | |
| Source: Modified after Ecoplanning (2019) – Table 2 | | | | |

The Project would result in the loss of the small area (0.47ha) of PCT1527 within the Site. However, given the small area of the ecological community which would be impacted by the Project and the requirements to offset these impacts in accordance with the BAM, it is unlikely that the ecological community would be significantly impacted. As such, Ecoplanning (2019) do not recommend a referral under the EPBC Act.

#### 5.5.3.2 Groundwater Dependent Ecosystems

No Groundwater Dependent Ecosystems or Groundwater Sensitive Ecosystems have been identified on the Site (Ecoplanning, 2019) or within close proximity. However, the Site is approximately 1.1km northeast of the Yalimbah Creek system that hosts Coastal Wetlands listed under the State Environmental Planning Policy (Coastal Management) 2018.

The groundwater assessment for the Project has concluded that the potential for negative impacts on the Yalimbah Creek system is highly unlikely (Section 5.7.5.5).

#### 5.5.3.3 Threatened Flora

Ecoplanning (2019) identified a total of 242 native and exotic flora species within the Site. A full list of identified flora species is presented in Annexure 2 of Ecoplanning (2019).

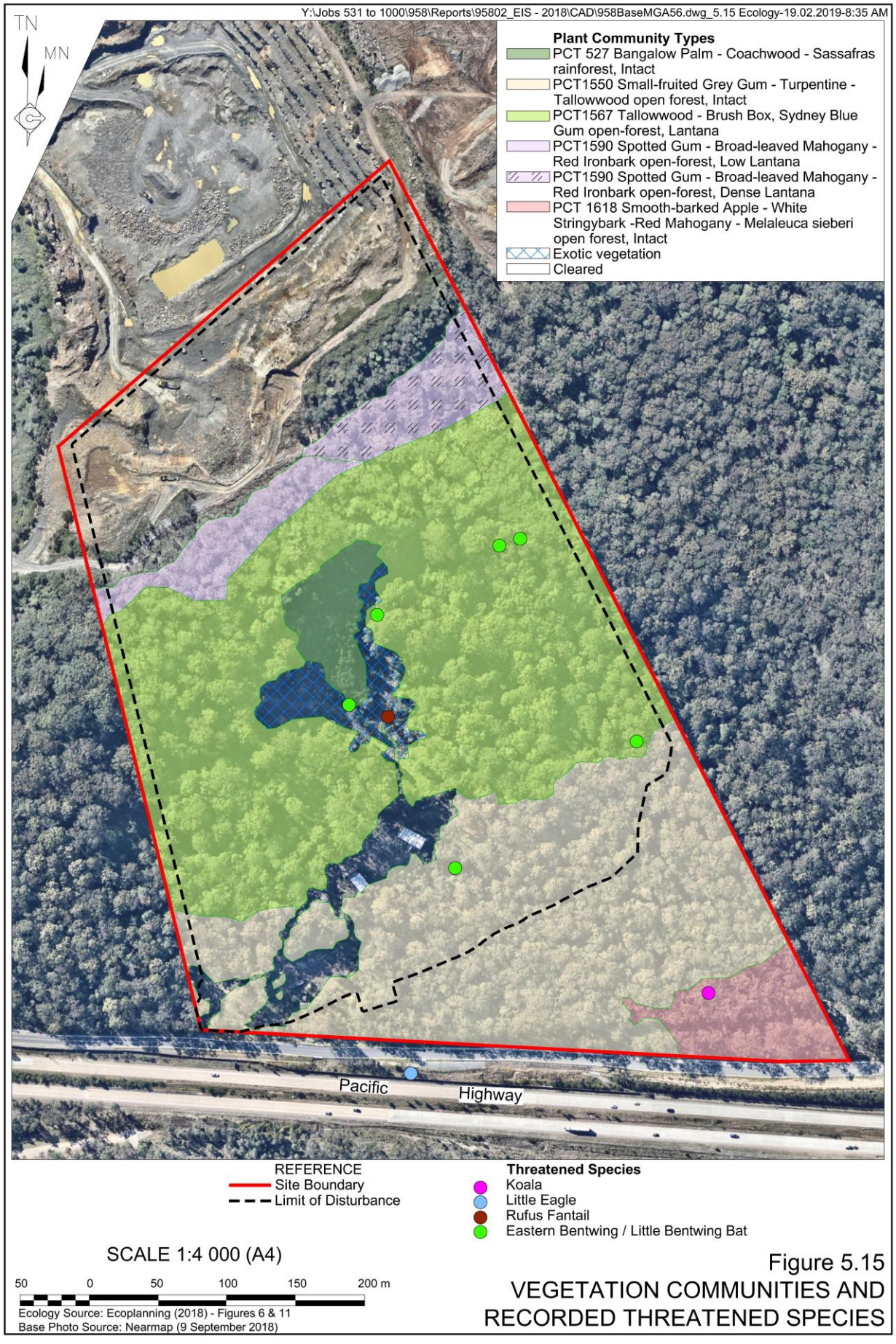



Figure 5.15
VEGETATION COMMUNITIES AND RECORDED THREATENED SPECIES

No threatened flora species were recorded within the proposed area of disturbance. One threatened fauna species, *Tetratheca juncea* (Black-eyed Susan), was recorded in the northern section of Lot 11 DP 1024564 beyond the Site boundary. As neither the individuals observed, or their species polygons calculated in accordance with section 6.4.1.29 of the BAM, are located within the proposed area of disturbance, no further assessment is required for this species.

#### 5.5.3.4 Threatened Fauna

A total of 50 non-threatened fauna species and five threatened fauna species were recorded by Ecoplanning (2019) within or immediately adjacent to the Site. The below subsections identify threatened fauna species observed by Ecoplanning during field surveys conducted throughout 2018 as well as threatened fauna species that have previously been recorded within the Site.

##### 5.5.3.4.1 Bat Species

Two Microchiropteran bat species (Little Bentwing Bat and Eastern Bentwing Bat) listed as Vulnerable under the BC Act were detected from calls within the Site. Additionally, calls which could not be separated between the Eastern False Pipistrelle (listed as Vulnerable under the BC Act), Greater Broad-nosed Bat (listed as Vulnerable under the BC Act) and Eastern Broad-nosed Bat (not listed under the BC Act) were recorded. The foraging habitat for these species is treated as an ecosystem credit under the BAM and impacts to these species are assessed in conjunction with the impacts to PCTs. No further assessment of these species is required.

The Grey-headed Flying-fox has previously been observed on Site. A referral under the EPBC Act is not recommended for the Grey-headed Flying-fox due to the small scale of clearing of vegetation in which no camps have been found.

##### 5.5.3.4.2 Bird Species

One diurnal bird species (Rufous Fantail) listed as Migratory under the EPBC Act was recorded within the Site. The Project would result in the loss of a small area (11.59ha) of habitat for this migratory species within the Site. Ecoplanning (2019), has assessed that this small area of habitat loss would not support an ecologically significant proportion of the species and the impacts of the Project would not be significant.

One raptor species (Little Eagle) was observed flying over the Site during the diurnal bird surveys in February 2018, although it is noted that this species was not observed roosting or nesting within the Site. Additionally, the White-bellied Sea-Eagle has previously been recorded within the Site (HWR Ecological 2004). The observation of these species flying over, or within the Site does not indicate that breeding habitat for the species is present.

##### 5.5.3.4.3 Koala

A single Koala was recorded within the site during surveys conducted in February 2018 and it is noted that this species has previously been observed within the Site (CEG, 2012). The Koala is listed as Vulnerable under both the BC Act and EPBC Act.

Ecoplanning (2019) has assessed that the Project would be unlikely to significantly impact the Koala and a referral to the Commonwealth Department of Environment and Energy (DoEE) is not required as the Site only supports a low density of Koalas and connectivity would be maintained between areas of retained vegetation within the Site and surrounding areas of native vegetation. Annexure 1 of Ecoplanning (2019) provides a detailed justification of why a referral to DoEE under the EPBC Act is not required for this Project.

No other threatened species were observed within the proposed area of disturbance during the ecological surveys undertaken by Ecoplanning (2019).

## 5.5.4 Management and Mitigation Measures

### 5.5.4.1 Design and Operational Measures

The Project has been designed to minimise impacts on native species by firstly avoiding and then mitigating potential biodiversity impacts.

The layout of the Project has been designed with the intent to minimise disturbance and the clearing of remnant native vegetation and where possible to minimise impacts on native flora and fauna.

Management and preservation of biodiversity values within the Site would be guided by a Landscape and Rehabilitation Management Plan that would be provided to DPE for approval 3 months prior to the commencement of the site establishment and construction stage and would include protocols for the following activities.

- Soil stripping and stockpiling.
- Vegetation clearing protocols.
- Clearing, handling and placement of hollow-bearing trees.
- Weed management.
- Bush fire management.
- Threatened species management.
- Management of the biodiversity offset area(s), once secured.
- Progressive and final rehabilitation of the Site.

The removal of approximately 11.59ha of native vegetation would be a residual impact of the Project. The measures to address this offset obligation would be determined as the Project approval progresses. Initial investigations have commenced to identify credits available for purchase, land available to purchase and enter into a Biodiversity Stewardship Agreement (BSA) and the costs of credits through payment into the Biodiversity Conservation Fund (BCF). Based on the initial investigations and the practicality / cost of establishing a biodiversity offset on Lot 11, it is likely that the Applicant would retire the required credits through payment into the BCF.

### 5.5.5 Assessment of Impacts

Impacts to native vegetation are anticipated through the direct clearing of approximately 11.59ha of native vegetation. The direct clearing and subsequent development of the proposed area of disturbance would represent a permanent impact, or loss, of this native vegetation and habitat. It is noted that whilst the principal components of the Project have been defined based upon the occurrence of the underlying hard rock resource and local topographic constraints, both the extraction area and Infrastructure Area have been designed to optimise the recovery of the hard rock resource whilst minimising impacts to native vegetation and riparian buffer areas. These considerations have resulted in a reduction to the proposed area of disturbance of approximately 7.8ha.

Indirect impacts associated with the Project may include impacts such as noise and erosion associated with the construction and operational stages of the Project. Given the location of the proposed area of disturbance, adjacent to existing quarrying activities (Karuah South Quarry and Karuah East Quarry) and the Pacific Highway, it is considered unlikely that the Project would have inadvertent impacts which would reduce the viability of any adjacent native vegetation or habitat due to edge effects, noise, dust, light spill or disturbance to breeding habitats. The Project is also considered unlikely to cause any increase in trampling of flora, rubbish dumping or introduce any pests, weeds or pathogens to adjacent areas of native vegetation and habitat.

No prescribed biodiversity impacts are anticipated from the Project. Impacts to water quality and hydrological processes within the minor tributary of Yalimbah Creek could potentially constitute a prescribed impact, however, impacts to this tributary are to be avoided through the design of the Project and inclusion of clean water diversions around the proposed area of disturbance.

The ecological impacts of the Project have been mitigated to the greatest extent practicable. Residual ecological impacts would be offset in accordance with the BAM to achieve a ‘no net loss standard’.

## 5.6 SURFACE WATER

### 5.6.1 Introduction

The SEARs require the EIS to include an assessment of the potential impacts of the Project on water which include the following requirements relevant to the assessment of surface water resources.

- An annual site water balance to demonstrate sufficient water supplies would be available to meet operational requirements.
- Identification of any licensing requirements or other approvals required.
- An assessment of the likely impacts of the development on the quality and quantity of surface water resources.
- A description of the proposed water management system, water monitoring program and other measures to mitigate surface water impacts.

In addition, DoI – Water, EPA and OEH also identified water related matters for consideration within the EIS. A summary of the SEARs and requirements of each of these agencies are listed within **Table A2.2**, **Appendix 2** together with a record of where each requirement is addressed in the EIS.

A surface water assessment for the Project was undertaken by R.W. Corkery & Co. Pty Limited (RWC). The resulting report is presented as Part 5 of the *Specialist Consultant Studies Compendium* and is hereafter referred to as RWC (2019a). The following sub-sections provide a summary of the surface water assessment and describes the design and operational safeguards and management measures to be implemented by the Operator.

## 5.6.2 The Existing Environment

### 5.6.2.1 Climate

An overview of the meteorological conditions relevant to the Site is presented in Section 4.3.

### 5.6.2.2 Topography

An overview of the regional, local and Site topography is presented in Section 4.1.

### 5.6.2.3 Catchments and Drainage

The Site is located within the Karuah River Catchment (**Figure 5.16**) which drains an area of approximately 1 457km$^2$ (Paterson, 2010).

The surface water resources of the Karuah River Catchment are managed under the "*Water Sharing Plan for the Lower North Coast Unregulated and Alluvial Water Sources 2009*".

Locally, drainage consists of three topographically controlled, ephemeral drainage features (see **Figure 5.17**). These drainage features are characterised by relatively small contributing catchments and a short flow path which generally displays a low capacity channel (if evident at all) that likely reflects the short duration of flow events. The headwaters of one of these drainage features is intercepted by a farm dam, approximately 240m west of the Site (see **Figure 5.17**) whilst another has headwaters in the vicinity of the Karuah East Quarry (see **Figure 5.17**). The farm dam situated on the Site does not intercept flow in a drainage feature, rather this dam receives recharge from overland flow generated on the hill in the central section of the Site. The drainage feature with the longest flow-path originates approximately 0.7km north-northeast of the southern boundary of the Site immediately south of the extraction area for the Karuah East Quarry.

These drainage features within the Site would have historically converged to form the second order watercourse, Yalimbah Creek. Prior to the construction of the Pacific Highway, the flow path of Yalimbah Creek would have traversed the southern section of the Site in a northeast to southwest direction prior to turning south into the estuarine wetlands of this system, downstream of the Site. However, the construction of the Pacific Highway and its subsequent upgrade to a dual carriage motorway, as well as drainage infrastructure along Blue Rock Close have substantially overprinted, substituted or removed much of the former flow path (see **Figure 5.17**).

No other drainage features occur within the Site. A small dam is located southern section of the Site.

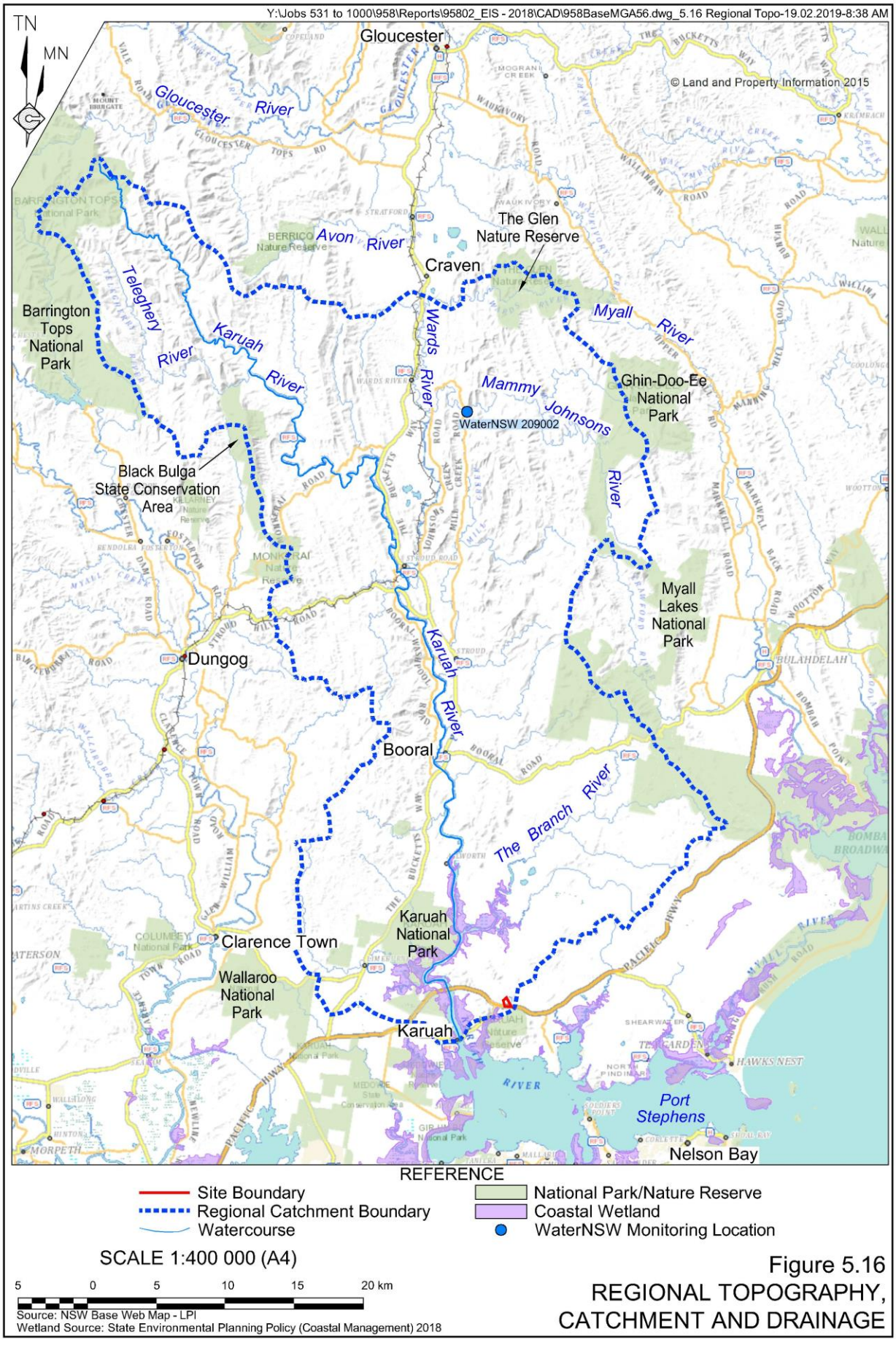



Figure 5.16
REGIONAL TOPOGRAPHY, CATCHMENT AND DRAINAGE

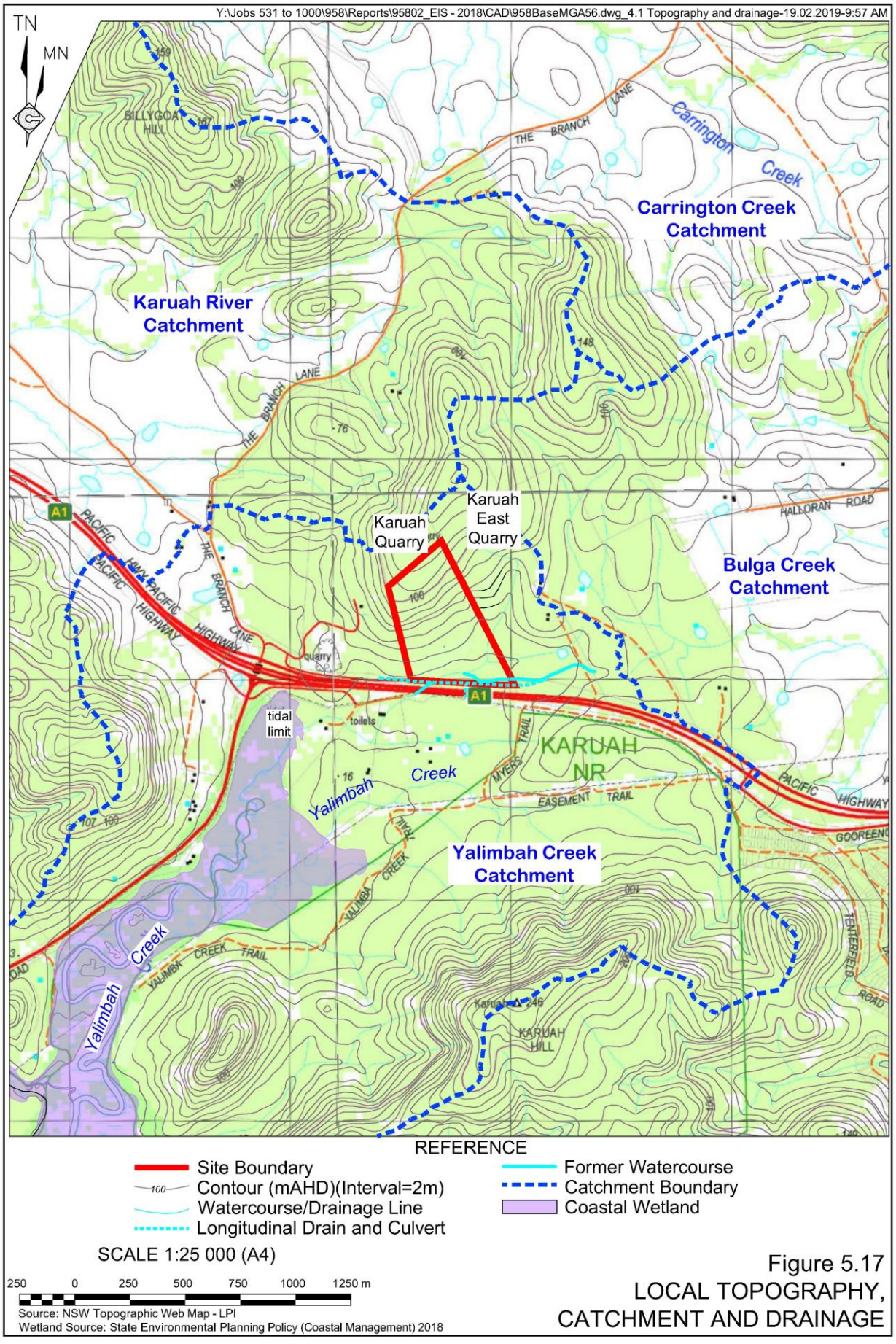



Figure 5.17
LOCAL TOPOGRAPHY, CATCHMENT AND DRAINAGE

#### 5.6.2.4 Flooding

The regional Karuah River Flood Study (Patterson, 2010) identified that in those areas of the Karuah River which are downstream of the confluence with The Branch (i.e. including the Site), flood levels are more affected by the prevailing water level in Port Stephens than flow in the Karuah River such that the difference between the 50% Annual Exceedance Probability flood level (1.48m AHD) and the Probable Maximum Flood level (1.98m AHD) is only 0.5m.

The modelling conducted by Paterson (2010) identified that the Site was not subjected to inundation in the range of design floods modelled. In addition, a review of the Great Lakes LEP identifies that the Site is not situated on land identified in that LEP as being a "Flood Planning Area".

#### 5.6.2.5 Geomorphology

The upper reaches of the Karuah River system generally displays a confined or partially confined valley setting with valley floors generally being less than 1km wide (MCC, 2016) that transitions to a more laterally unconfined valley setting.

An inspection of the Site in 2018 located a small section of natural watercourse, assumed to be Yalimbah Creek, on the southern section of the Site. This reach of watercourse displayed limited geomorphic development (i.e. single, discontinuous, low capacity, shallow channel) (see Section 3.3.2.3 RWC, 2019a) and appeared to be hydraulically disconnected from the drainage infrastructure adjacent to Blue Rock Close.

Subsequently, whilst historically, Yalimbah Creek would have likely collected and conveyed discharge from its upstream, contributing catchment across the topographically lower, southern section of the Site, there is limited contemporary evidence of a flow path or watercourse that is the result of natural processes in this location.

#### 5.6.2.6 Catchment Land Uses

On a regional scale, the land uses in the upper reaches of the Karuah River catchment are predominantly nature conservation, forestry and agriculture whilst the lower reaches, with extensive areas of valley fill have experienced greater agricultural development (grazing) although some areas of native vegetation remain (e.g. Nerong State Forest).

The prevailing land use surrounding the Site is associated with quarrying activity and nature conservation. Other land uses in the locality include:

- residential – Karuah township is located approximately 4km to the southwest of the Site;
- transport – Major road infrastructure exists directly south of the Site, with the Pacific Highway; and
- agricultural – Cleared pastoral landholdings are located approximately 1.2km east and 1.2km northwest of the Site.

### 5.6.2.7 Water Quality

Vegetation types, geology and land use all contribute to the water quality of the receiving system. Multiple land uses in the Karuah River catchment, such as forestry, grazing, poultry production, mining and rural-residential areas has resulted in a system that has continued to show signs of impaired health (MCC, 2018), with elevated levels of chlorophyll-a (median 7.93µg/L [MCC, 2018]), which suggests the presence of algae likely present as the result of nutrient loads entering the system from catchment runoff. A Waterway and Catchment Report Card for the Karuah River (MCC, 2016) also identified the health of the system generally declined with distance downstream. However, it was also noted in the Waterway and Catchment Report (MCC, 2018) that water clarity was excellent, suggesting that turbidity was low. However, with the exception of the dataset supporting the Waterway and Catchment Report (MCC, 2018), limited water quality data collected from either the Karuah River or other freshwater watercourses in the vicinity of the Site was available for review.

Data from the WaterNSW water monitoring station 209002 (Mammy Johnsons River at Pikes Crossing, elevation 75.46m AHD, see **Figure 5.16**), approximately 42km north of the Site for the period 28 May 2010 to 6 July 2010 indicated that the 75$^{th}$ percentile electrical conductivity is 36.4µS/cm. This value is below the range of the water quality objective (125µS/cm to 2200µS/cm) for lowland rivers (<150m AHD) in the Karuah River and Great Lakes catchments (DECCW, 2006).

Due to the ephemeral nature of the watercourses in the vicinity of the Site (see Section 5.6.2.3) the collection of ambient water quality data is limited to flow events. a water quality monitoring event was undertaken on 5 September 2018 to collect surface water samples at the following two locations.

- SP1: downstream boundary of Site in relict Yalimbah Creek watercourse (see Section 5.6.2.3), assumed to be representative of Site water quality; and
- SP2: a vegetated longitudinal drain on southern side of Blue Rock Close, assumed to be representative of receiving water quality, upstream of the Pacific Highway.

In addition, in order to establish the indicative quality of runoff captured in the proposed site water management infrastructure, water held in an existing dam (SP3), located on the Site was sampled on 4 December 2018.

The surface water samples were submitted to Australian Laboratory Services' Newcastle Laboratory (ALS), a NATA accredited facility for the required analyses. The results of the analyses are presented in Table 4 of RWC (2019a) which also compares the result with the relevant water quality trigger value.

With the exception of aluminium, (0.12mg/L [SP1] and 0.21mg/L [SP2]), the results of the water quality analyses indicated that the runoff generated in the upstream sections of the Yalimbah Creek catchment is below or within the desired range for the water quality trigger values shown, suggesting a relatively undisturbed catchment.

No sampling was undertaken downstream of the Pacific Highway however it is likely that this would represent a potential source of suspended solids, hydrocarbons and heavy metals in runoff (Yannopoulos et al, 2012).

## 5.6.3 Management and Mitigation Measures

### 5.6.3.1 Site Water Management

The proposed site water management system for the Quarry has been developed in order to ensure that water is managed in a manner that maximises opportunities for reuse and recycling and minimises the possibility of uncontrolled discharge. The site water management system has been developed in a manner that enables the:

- efficient recovery and use of natural resources;
- effective management of available storage volumes that prevents uncontrolled discharge to receiving environments; and
- effective water quality management strategies that prevent discharge of sediment-laden water to receiving environments.

The site water management infrastructure required for the management of sediment-laden runoff generated on catchments disturbed by quarrying activities, is of a volume that meets the maximum harvestable right under the *Water Management Act 2000*. Subsequently, it is proposed that all runoff collected in Site water storages would be used to meet the Site water demand.

#### 5.6.3.1.1 Site Catchments

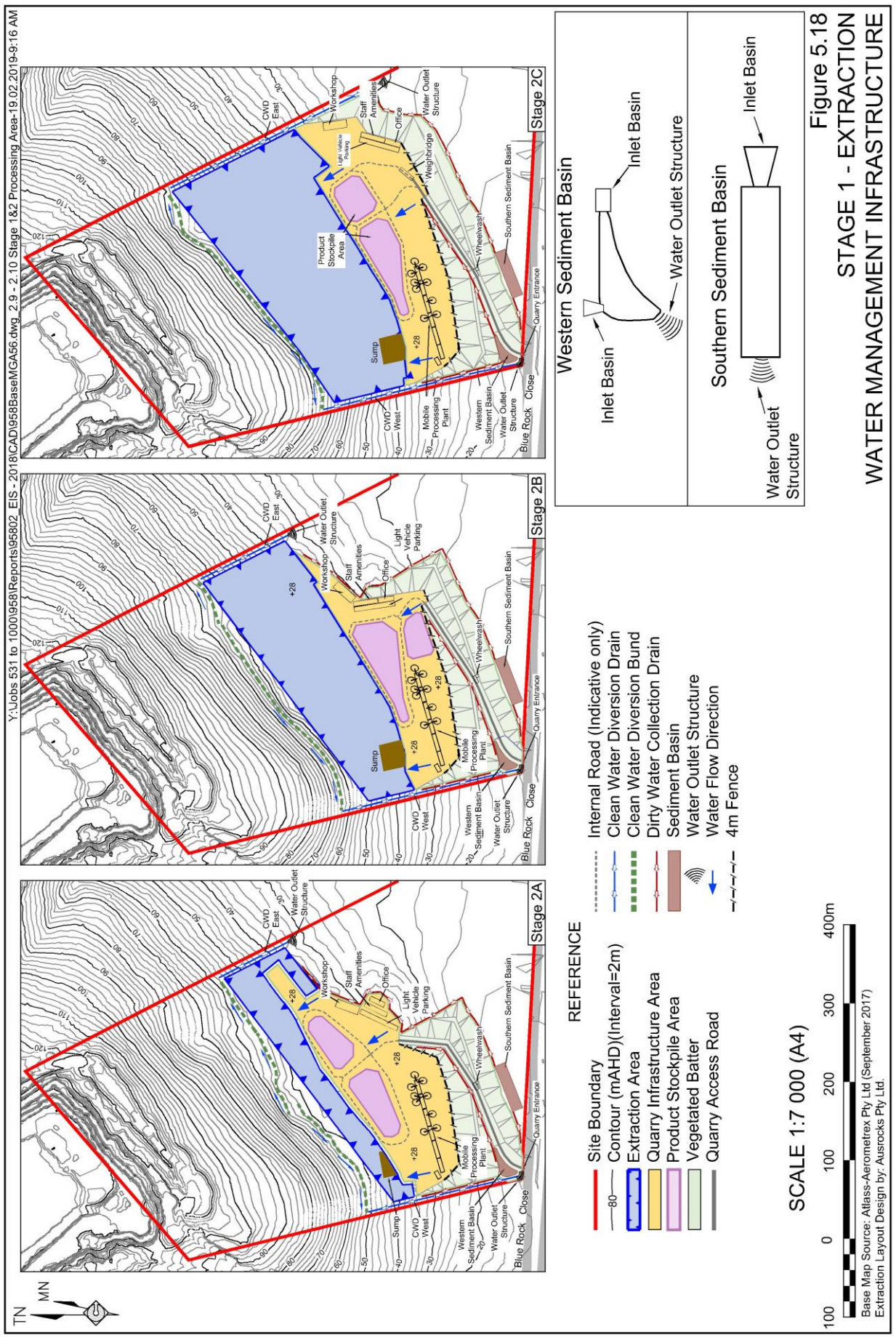
During operations, the surface water drainage within and adjacent to the Site would be divided into sub-catchments by topography, drainage infrastructure or bunds (see **Figure 5.18** and **Figure 5.19**). The management of runoff from each sub-catchment would be based on the class of water (runoff) generated within each sub-catchment. There would be two classes of water that would be managed on the Site as follows.

- "Clean" refers to runoff from those catchments unaffected by quarrying activities (regardless or water quality).
- "Sediment-laden" refers to runoff from disturbed or active sections of the Site with the potential to contain suspended sediment.

#### 5.6.3.1.2 Clean Runoff Management

Runoff from undisturbed catchments upslope of the extraction area (see **Figure 5.18** and **Figure 5.19**) would be directed using diversion bunds that would be progressively developed as extraction operations progress. These diversion bunds would direct runoff to one of two clean water diversion drainage structures that would be installed on the Site. These diversion bunds and drainage structures would ensure that clean water would be diverted around the Site without mixing with other classes of water. Details of the two clean water diversion drainage structures that would be installed on the Site are as follows.

- CWD-West – this structure would collect water diverted from the western section of the undisturbed catchment, upslope from the extraction area and discharge to the drainage infrastructure situated on the northern edge of Blue Rock Close.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Stage 2A
Stage 2B
Stage 2C
Sump
CWD East
CWD West
Water Outlet Structure
Workshop
Staff Amenities
Office
Light Vehicle Parking
Southern Sediment Basin
Wheelwash
Quarry Entrance
Mobile Processing Plant
Western Sediment Basin
Blue Rock Close
Product Stockpile Area
Weighbridge
TN
MN
REFERENCE
Site Boundary
Contour (mAHD)(Interval=2m)
Extraction Area
Quarry Infrastructure Area
Product Stockpile Area
Vegetated Batter
Quarry Access Road
Internal Road (Indicative only)
Clean Water Diversion Drain
Clean Water Diversion Bund
Dirty Water Collection Drain
Sediment Basin
Water Outlet Structure
Water Flow Direction
4m Fence
SCALE 1:7 000 (A4)
100 0 100 200 300 400m
Base Map Source: Atlass-Aerometrex Pty Ltd (September 2017)
Extraction Layout Design by: Ausrocks Pty Ltd.
Western Sediment Basin
Inlet Basin
Water Outlet Structure
Southern Sediment Basin
Inlet Basin
Water Outlet Structure
Figure 5.18
STAGE 1 - EXTRACTION
WATER MANAGEMENT INFRASTRUCTURE

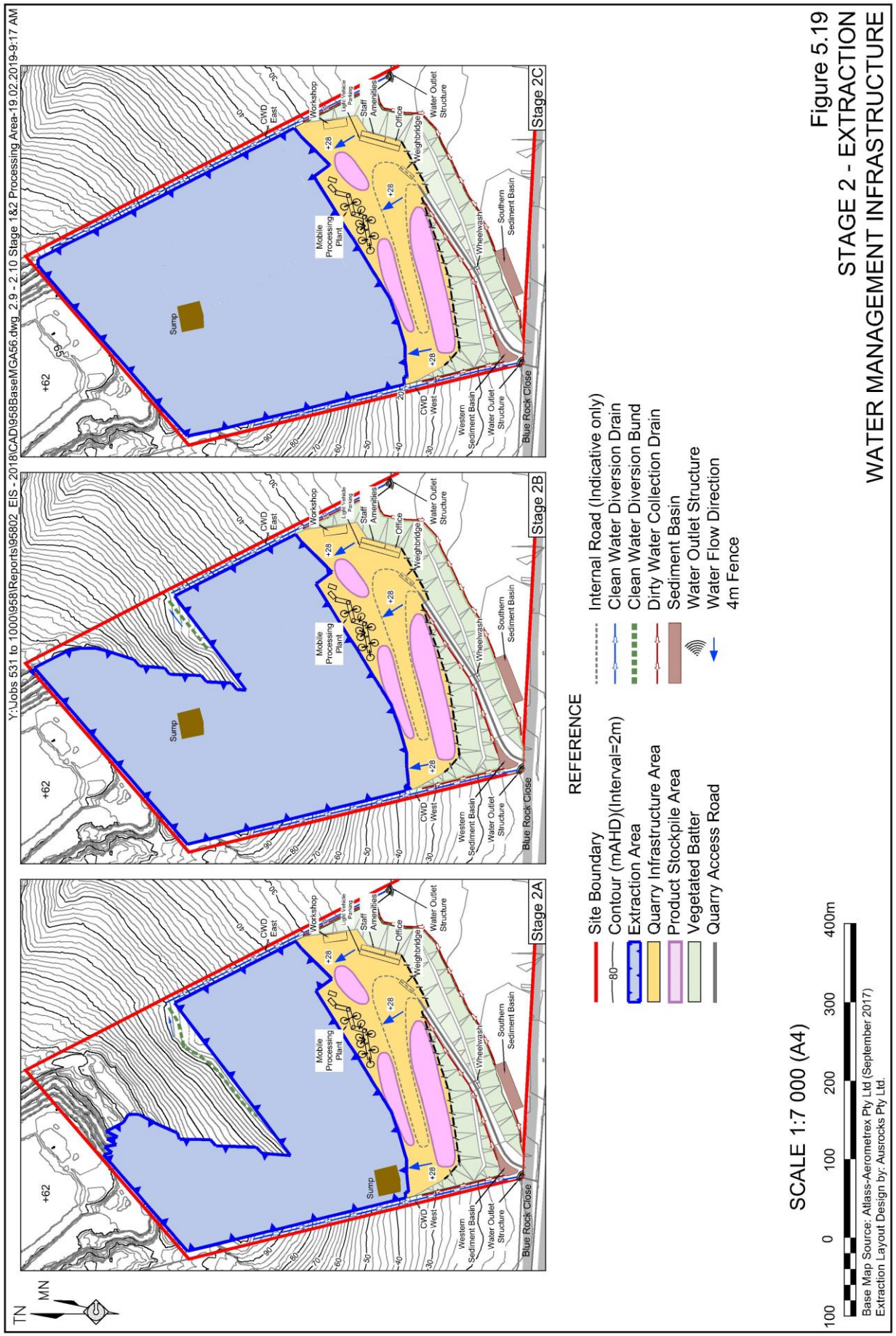



Figure 5.19
STAGE 2 - EXTRACTION
WATER MANAGEMENT INFRASTRUCTURE

- CWD-East – this structure would collect water diverted from the eastern section of the undisturbed catchment, upslope from the extraction area and discharged into the external catchment.
- No disturbance is proposed in the south eastern corner of the Site with no site water management infrastructure proposed in this area of the Site.

#### 5.6.3.1.3 Sediment-laden Runoff Management

Runoff generated within Site catchments disturbed by quarrying activities would be directed into one of two sediment basins or the extraction area sump via gravity drainage and/or open channel.

#### 5.6.3.1.4 Discharge Management

Whilst the volumes of sediment-laden water held in the sediment basins are key sources of water for operations at the Quarry, it is recognised that there is potential for discharge from the sediment basins to the receiving environment to occur. Should discharge from the sediment basins be required, the turbidity of the water would be measured prior to discharge and if found to be above 50NTU (nephelometric turbidity units), flocculant (e.g. bio-polymer) would be added to reduce the volume of sediment in the water such that turbidity is reduced below 50NTU prior to discharging.

Details of the three water storages within the Site which would be used for the capture, storage and management of runoff are presented as follows.

**Sediment Basins**

Runoff generated within two of the disturbed catchments would be directed to one of two sediment basins. Each of these storages would effectively act as a Type F (equivalent to SD 6-4 of the Blue Book) sediment basin. It is noted that, whilst these sediment basins need to be sized according to their respective catchments however, the design of the proposed sediment basins for the Project provides for double the sediment storage zone via the inclusion of inlet basins as the intent of the two sediment basins will be to prevent the uncontrolled discharge of sediment-laden runoff from the Site and to supply water for operational activities such as dust suppression, crushing and the wheel wash.

Further information on the two sediment basins is provided as follows.

***Western Sediment Basin***

This sediment basin would be constructed on the southwestern edge of the Infrastructure Area, north of the Quarry Access Road.

The design of this sediment basin provides for 0.77ML of storage fed by two open channels, one entering from the north of the sediment basin and the other from the east. Each open channel would discharge into an inlet basin to allow for initial settling of suspended sediment. Each inlet basin would gravity discharge into the main sediment basin via a spillway.

The water captured in the main sediment basin would be utilised for dust suppression on site.

***Eastern Sediment Basin***

This sediment basin would be installed on the southwestern edge of the Infrastructure Area, south of the Quarry Access Road.

The design of this sediment basin provides for 1.71ML of storage and would be fed by one open channel, i.e. a perimeter drain that would traverse the southern edge of the Infrastructure Area, which would discharge into an inlet basin located to the east of the main sediment basin and the other from the west. The inlet basin would gravity discharge into the main sediment basin via a spillway.

The water captured in the main sediment basin would be utilised for dust suppression on site operations and the wheel wash. All water utilised for the wheel wash would be reticulated to the inlet basin.

**Extraction Area Sump**

It is proposed that the extraction area sump is constructed in the southwestern corner of the extraction area in a manner that collects all sediment-laden runoff from the areas disturbed whilst the extraction area is developed during the site establishment and construction stage. An initial sump would be excavated on the first day of operations within the extraction area and progressively enlarged as the area of disturbance increases. In this way, all sediment-laden runoff would be contained within the sump.

By the end of the site establishment and construction stage, the surface of the Infrastructure Area would be constructed to a level of approximately 28m AHD with a slight fall to the north directing all runoff from this area towards the extraction area sump.

Throughout the life of the Quarry, a sump would be retained in the southwestern corner of the extraction area albeit that it would be progressively relocated as the extraction area deepens.

All water collected within the sump would be utilised for dust suppression on site.

#### 5.6.3.1.5 Sewage and Effluent Management

Sewage and effluent disposal would be managed on location through a biocycle septic system, similar to the existing system currently utilised but with an increased capacity.

## 5.6.4 Water Balance

### 5.6.4.1 Introduction

During the 6 month site establishment and construction stage of the Project, the existing farm dam on the Site would be utilised to supply the water requirements for construction activities (e.g. dust suppression). Should this supply prove insufficient during the short time required for construction, a licensed water carrier would be contracted on a campaign basis to supply water for the construction activity at that time.

During operations, the transfer of water around the Site would be facilitated by pumping that would involve the following. A schematic of the water balance is shown on **Figure 5.20**.

1. Transfer of water for dust suppression direct to the water truck from either of the sediment basins (western or southern) or the extraction area sump.
2. Supply of water to the processing plant from the extraction area sump or either of the sediment basins (western or southern).
3. Transfer (and return) of water from the Southern Sediment Basin to the wheel wash via pump and pipe.

The gains (inputs) and losses (outputs) for the Quarry water balance are summarised as follows.

- **Inputs:** These include rainfall and associated runoff from the contributing Site catchments that would be captured in one of the sediment basins or the extraction area sump.
- **Losses:** These include water used in dust suppression, dust reduction in the processing operation and the wheel wash.

#### 5.6.4.2 Inputs

Rainfall data for the Site for the period 1 January 1889 to 13 September 2018 was sourced from the SILO database (DES) on 14 September 2018.

The data was then processed using Cunnane's plotting position formula (Cunnane, 1978) and Log Pearson Type 3 (LPIII) interpolation (Ball et al, 2016) to establish rainfall events with a 1 in Y Annual Exceedance Probability (AEP) for analysis in the water balance.

Whilst groundwater was encountered in some of the exploration holes, this was assumed to hosted by fractures of limited extent and connectivity (see Cook, 2018) and subsequently groundwater was not considered in the water balance.

#### 5.6.4.3 Losses

Water usage at the Quarry has been estimated as follows.

- Construction phase demand: 7.8ML for the 6-month period.
- Operational phase demand
  - 1.8ML per annum for the wheel wash
  - 9.1ML per annum for crushing and screening operations at maximum production (600 000tpa).
  - 6ML per annum for haul trucks watering and dust suppression in Stage 1A increasing to 17ML per annum in Stage 2C.

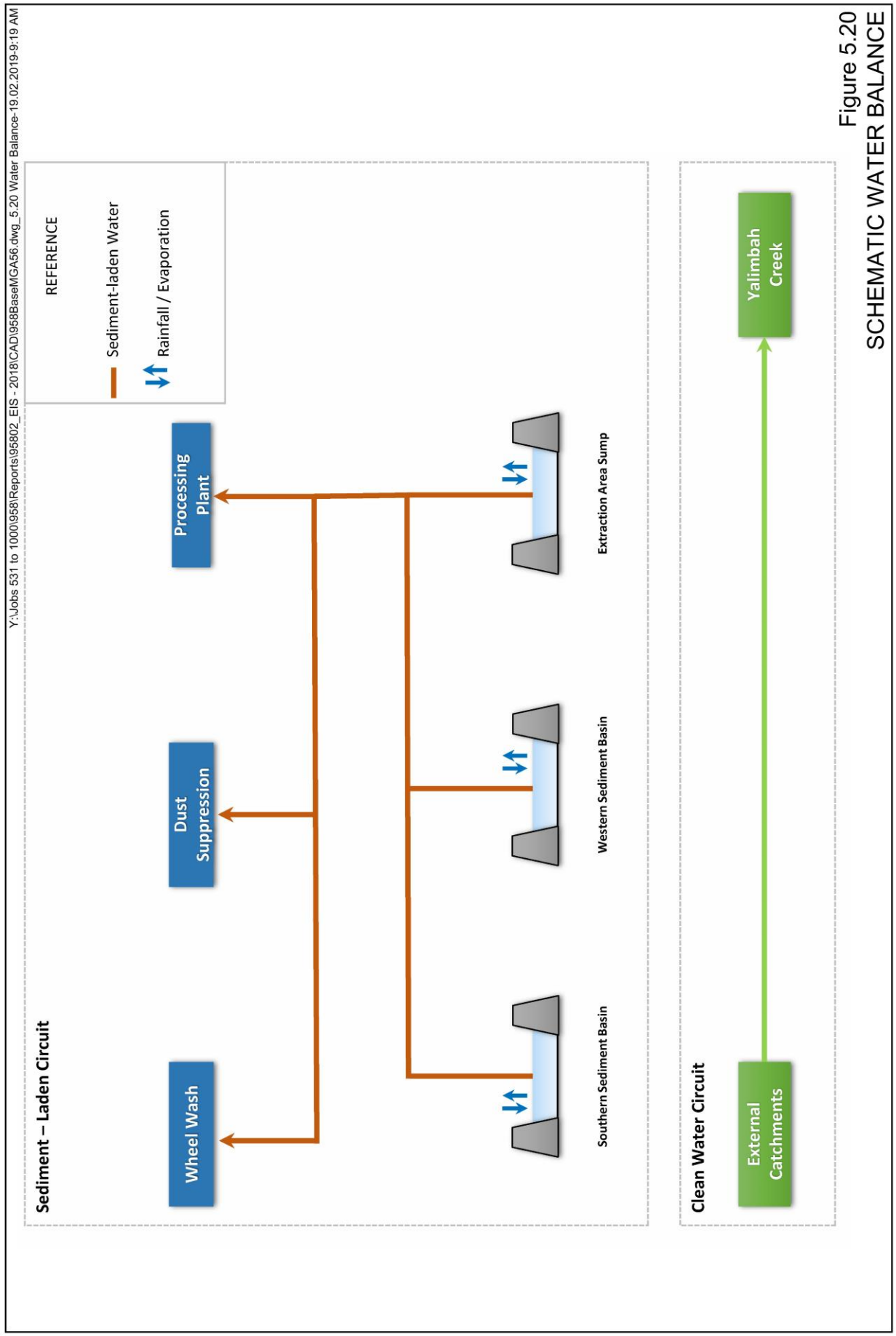



Figure 5.20
SCHEMATIC WATER BALANCE

Haul road watering and dust suppression on the processing plant are proposed during periods of dry weather or sustained winds, however, the annual volumetric water requirement for these activities would be dependent upon the stage of the Quarry life as this will influence the area of application and thus the volumes of water required. Subsequently, the indicative volumes required for haul road dust suppression would range between approximately 6ML (Stage 1A) to 17ML (Stage 2C) per annum.

#### 5.6.4.4 Results

**Table 5.16** presents the anticipated runoff volumes, site water demand and subsequent water balance for each stage of the Quarry across a range of AEPs. As shown in **Table 5.16**, with the exception of the 99% AEP annual rainfall, should it coincide with Stage 2A (1ML deficit), that in all rainfall years runoff volumes would be sufficient to meet the anticipated water demand of Quarry operations.

Subsequently, it is anticipated that, for a normal rainfall year, the water storages on the Site would hold sufficient water to sustain the required production for that year taking into account rainfall and site water demand.

**Table 5.16**
**Annual Water Balance**

| | | Extraction Stage | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1A | | | 1B | | | 1C | | |
| AEP | Rainfall | Runoff (ML/yr) | Site water demand (ML/yr) | Deficit/ Surplus (ML/yr) | Runoff (ML/yr) | Site water demand (ML/yr) | Deficit/ Surplus (ML/yr) | Runoff (ML/yr) | Site water demand (ML/yr) | Deficit/ Surplus (ML/yr) |
| 99 | 634 | 15 | 17 | -2 | 17 | 10 | 8 | 21 | 16 | 5 |
| 95 | 784 | 19 | 17 | 2 | 21 | 10 | 12 | 26 | 16 | 10 |
| 90 | 872 | 21 | 17 | 4 | 24 | 10 | 14 | 29 | 16 | 13 |
| 80 | 985 | 23 | 17 | 7 | 27 | 10 | 17 | 32 | 16 | 16 |
| 50 | 1 220 | 29 | 17 | 12 | 33 | 10 | 24 | 40 | 16 | 24 |
| 20 | 1 475 | 35 | 17 | 18 | 40 | 10 | 31 | 48 | 16 | 32 |
| 10 | 1 613 | 38 | 17 | 21 | 44 | 10 | 34 | 53 | 16 | 37 |
| 5 | 1 730 | 41 | 17 | 24 | 47 | 10 | 38 | 57 | 16 | 41 |
| 2 | 1 861 | 44 | 17 | 27 | 51 | 10 | 41 | 61 | 16 | 45 |
| 1 | 1 949 | 46 | 17 | 29 | 53 | 10 | 44 | 64 | 16 | 48 |
| 0.5 | 2 029 | 48 | 17 | 31 | 55 | 10 | 46 | 66 | 16 | 50 |
| 0.2 | 2 125 | 51 | 17 | 34 | 58 | 10 | 48 | 69 | 16 | 53 |
| | | Extraction Stage | | | | | | | | |
| | | 2A | | | 2B | | | 2C | | |
| AEP | Rainfall | Runoff (ML/yr) | Site water demand (ML/yr) | Deficit/Surplus (ML/yr) | Runoff (ML/yr) | Site water demand (ML/yr) | Deficit/ Surplus (ML/yr) | Runoff (ML/yr) | Site water demand (ML/yr) | Deficit/ Surplus (ML/yr) |
| 99 | 634 | 24 | 31 | -7 | 28 | 30 | -2 | 31 | 27 | 4 |
| 95 | 784 | 30 | 31 | -1 | 34 | 30 | 4 | 38 | 27 | 11 |
| 90 | 872 | 33 | 31 | 2 | 38 | 30 | 8 | 43 | 27 | 16 |
| 80 | 985 | 37 | 31 | 7 | 43 | 30 | 13 | 48 | 27 | 21 |
| 50 | 1 220 | 46 | 31 | 16 | 53 | 30 | 23 | 60 | 27 | 33 |
| 20 | 1 475 | 56 | 31 | 25 | 64 | 30 | 34 | 72 | 27 | 45 |
| 10 | 1 613 | 61 | 31 | 31 | 70 | 30 | 40 | 79 | 27 | 52 |
| 5 | 1 730 | 66 | 31 | 35 | 75 | 30 | 45 | 85 | 27 | 57 |
| 2 | 1 861 | 71 | 31 | 40 | 81 | 30 | 51 | 91 | 27 | 64 |
| 1 | 1 949 | 74 | 31 | 43 | 85 | 30 | 55 | 95 | 27 | 68 |
| 0.5 | 2 029 | 77 | 31 | 46 | 88 | 30 | 58 | 99 | 27 | 72 |
| 0.2 | 2 125 | 81 | 31 | 50 | 92 | 30 | 63 | 104 | 27 | 77 |

## 5.6.5 Assessment of Impacts

Based on the implementation of the proposed water management for the Site as well as the installation of the proposed water management infrastructure, the potential impacts of the Project, with regard to surface water would be as follows.

### 5.6.5.1 Water Availability

Should the water requirements for Project-related construction activities exceed the capacity of the existing farm dam on the Site to meet those demands, a licensed water carrier would be engaged to supply water on an "as needed basis".

During operations, the proposed water management strategy for the Site would capture sediment-laden runoff from those catchments that would be disturbed by quarrying-related activities. This runoff would be captured in water storages that have been designed to remain below the 4.3ML maximum harvestable right for the Site.

Therefore, all water, either that required for construction of the Project of water that is re-used and recycled to meet the operational water demand of the Project, would occur under basic landholder rights, ensuring efficient use of water resources and no loss of water availability to downstream users of water beyond those permissible under the *Water Management Act 2000*.

In addition, the water management strategy for the Site would divert clean runoff from undisturbed catchments away from disturbed areas of the Site, thus helping to maintain flow to the receiving environment.

### 5.6.5.2 Flow and Watercourse Function

The bulk of clean runoff, upon leaving the Site would be directed into existing drainage infrastructure adjacent to Blue Rock Close and subsequently under the Pacific Highway. Therefore, discharge from the Site would not impact on stream function or riparian environments in the receiving system directly downstream of the Site as these have already been removed or overprinted by the construction of Blue Rock Close, the Pacific Highway and ancillary drainage infrastructure.

Furthermore, the flow condition of Yalimbah Creek, approximately 700m downstream of the Site, becomes tidally influenced.

### 5.6.5.3 Water Quality

Each sediment basin has been designed to capture and store a runoff volume that exceeds the design criteria established in the Blue Book.

As the proposed water management strategy for the Site includes the capture, storage and re-use of sediment-laden runoff, the likelihood of sediment-laden discharge from the Site is considered to be low.

#### 5.6.5.4 Flooding

The Site and associated infrastructure, such as the Infrastructure Area are not situated within a flood planning area or a zone where inundation from floodwater could be expected to occur (Paterson, 2010).

Subsequently, neither the development itself or neighbouring properties would be adversely impacted by the Project from floodwater.

### 5.6.6 Monitoring

#### 5.6.6.1 Introduction

Monitoring undertaken to demonstrate compliance with best practice for surface water management would include the monitoring of water quality, flow monitoring during periods of discharge and the monitoring of water management infrastructure on site.

All surface water-related monitoring results would be posted on the Operator's website and included in each Annual Review.

#### 5.6.6.2 Discharge Water Quality

As the intention is to capture all sediment-laden runoff for re-use and recycling in order to meet site water demand, water quality monitoring would only apply to water discharged from the sediment basins, should a rainfall event above the design criteria for the basin lead to runoff volumes that exceed the capacity of the sediment basins. Water quality monitoring would be conducted daily during the period when water is being discharged from the sediment basins on the Site (see Section 4.1.6.1.1 RWC (2019a)).

#### 5.6.6.3 Flow Monitoring

During discharge, an assessment of the flow conditions downstream of the discharge would be undertaken. The methods for determining flow when sampling for discharge water quality are presented in Section 4.1.6.1.2 of RWC (2019a) and have been modified from the velocity-area method of Part 3 of Australian Standard (AS) 3778-2009: Measurement of water flow in open channels (AS, 2009).

#### 5.6.6.4 Water Management Infrastructure Monitoring

Weekly inspections would be undertaken of all water management infrastructure on the Site. Inspections would also be undertaken following a rainfall event of >25mm/24hr.

In any areas where active erosion is observed, additional erosion and sediment controls would be installed, as required.

### 5.6.7 Conclusion

Whilst the Project would result in a minor reduction in discharge to downstream environments as the result of the capture and storage of sediment-laden runoff from those catchments disturbed by quarry-related activities, this volume of runoff would not exceed the maximum permissible under the basic landholder rights set out in the *Water Management Act 2000*.

In addition, as the water demand of the Project would be met by rainfall and runoff captured on the Site, no additional demand would be placed on the water resources of the area. This strategy of capture, re-use and recycling provides for the efficient use of water resources whilst simultaneously reducing the likelihood of discharge from the Site.

## 5.7 GROUNDWATER

### 5.7.1 Introduction

The SEARs require the EIS to include an assessment of the potential impacts of the Project on water which include the following requirements relevant to the assessment of groundwater resources.

- The identification of any licensing requirements or other approvals required.
- An assessment of the likely impacts of the development on the quality and quantity of groundwater resources.
- A description of the proposed water management system, water monitoring program and other measures to mitigate groundwater impacts.

In addition, DoI – Water, EPA and OEH also identified water related matters for consideration within the EIS. A summary of the SEARs and requirements of each of these agencies are listed within **Table A2.2**, **Appendix 2** together with a record of where each requirement is addressed in the EIS.

A groundwater assessment for the Project was undertaken by Larry Cook Consulting Pty Ltd. The resulting report is presented as Part 6 of the *Specialist Consultant Studies Compendium* and is hereafter referred to as Cook (2018). The following sub-sections provide a summary of the groundwater impact assessment and describes the operational safeguards and management measures to be implemented by the Operator.

### 5.7.2 The Existing Environment

#### 5.7.2.1 Hydrogeological Setting

The Site is located within the Water Sharing Plan (WSP) for the North Coast Fractured and Porous Rock Groundwater Sources.

In order to establish the local hydrogeological setting of the Site, Cook (2018) conducted a review of published geological maps combined with recent field observations, knowledge of the geology of the district and experience in similar hydrogeological settings. Cook (2018) identified that principally, one type of water-bearing zone (aquifer) exists beneath the Site. This

aquifer is associated with the relative thick rhyodacite resource belonging to the Nerong Volcanics and the immediately underlying the sequence of interbedded Carboniferous sedimentary rocks of the Karuah Formation although Cook (2018) recognised that extraction operations for the proposed quarry would not intersect the underlying sedimentary sequence.

The rhyodacite aquifer does not exhibit primary porosity, however, Cook (2018) considers that groundwater occurrence in this aquifer would be associated with secondary defects such as discontinuous fractures and shear zones. These secondary defects dissect the rhyodacite and provide a discontinuous fluid pathway for percolating rainfall.

#### 5.7.2.2 Groundwater Flow

The rhyodacite aquifer was interpreted by Cook (2018) to be under semi-confined to confined hydrogeological conditions with the local direction of groundwater flow being from the north to the south of the Site, generally mimicking the topography.

#### 5.7.2.3 Groundwater Levels

Automated fully calibrated water level sensors and loggers with a telemetry function were installed in four piezometers (BH3, BH4, BH7 and BH8, see **Figure 5.21**) in April 2018 in order to collect 'real time' baseline water level data. A composite set of hydrographs showing standing water level for the four piezometers is presented in **Figure 5.22**.

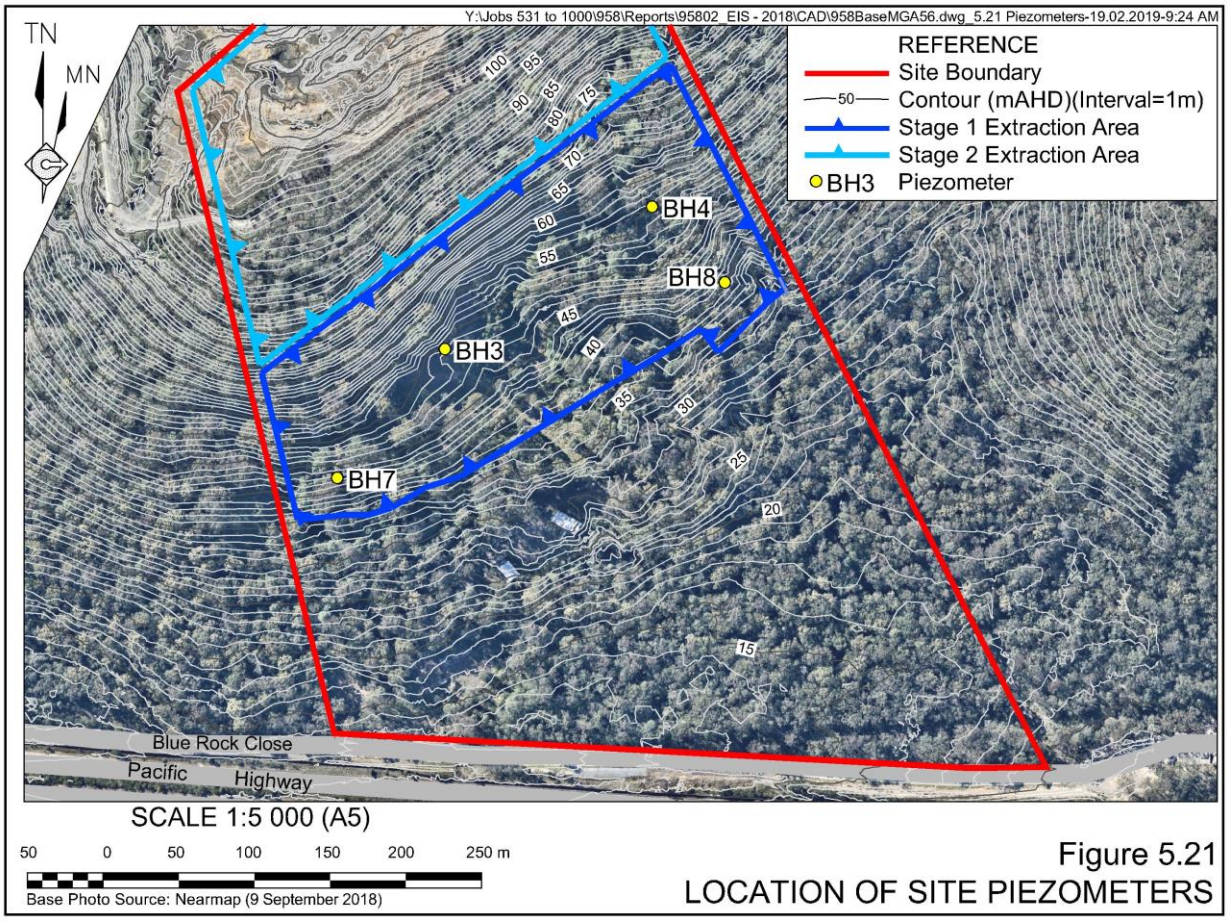
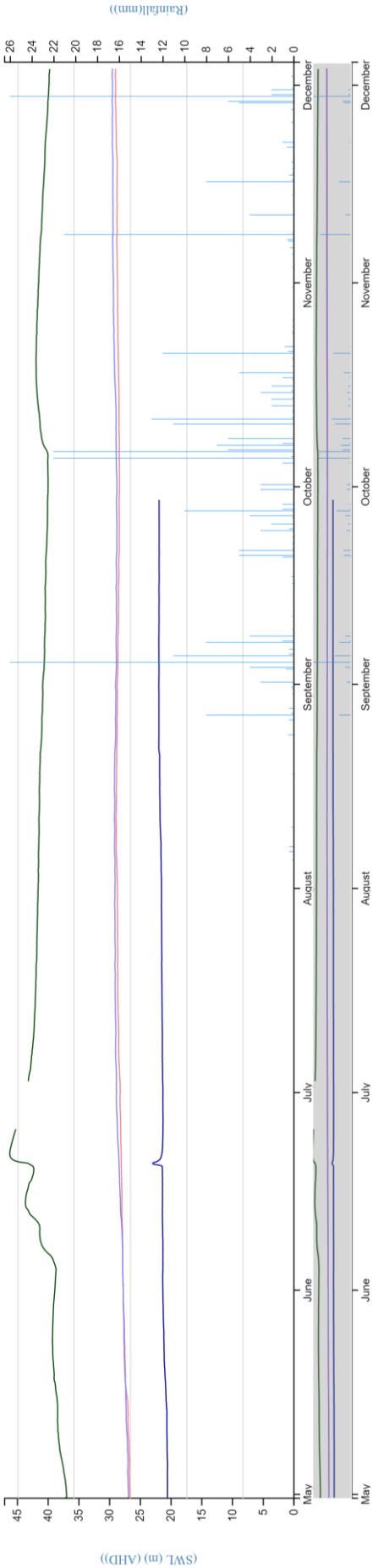



Figure 5.21
LOCATION OF SITE PIEZOMETERS

**Figure 5.22 Groundwater Standing Levels (m AHD) (April 2018 – December 2018)**




Source: Cook (2018) – Figure 9

In summary, the hydrographs for piezometers BH4, BH7 and BH8 reveal a relatively static standing water level with no apparent correlation with rainfall during the 7-month monitoring period. However, the standing water level recorded in BH3 reveals fluctuations and a general rise between early and late June 2018. This is shown on **Figure 5.22** as a gradual decline in water level recorded between late June and early October 2018. The water level is then observed to rise between early and late October 2018 in response to a 44mm rainfall event over two days on 5 and 6 October 2018 the water level then gradually drops towards the end of the monitoring period. It is noted that the water level in BH3 did not respond to a 26mm rainfall event on 4 September 2018.

#### 5.7.2.4 Groundwater Quality

Baseline groundwater sampling and analysis was carried out in the four piezometers (see **Figure 5.21**) in October 2018. The objective of the groundwater sampling and water quality analysis was to establish a baseline set of water quality data for the rhyodacite aquifer system. The results are presented in full as Table 6 (Cook, 2018) however, in summary:

- results for pH were all slightly acidic with values ranging from 5.9 to 6.8.
- results for electrical conductivity (EC) were between 270 to 510µS/cm.
- concentrations of total metals were either less than the analytical detection limit or at trace levels. The exceptions were low levels of zinc (between 1µg/L and 200µg/L) and iron (between 10µg/L and 640µg/L).

Hydrochemical classification, based on the major ion composition of the groundwater identifies the groundwater as being sodium chloride dominant and therefore representative of a groundwater system receiving recharge from rainfall.

No existing industry or activity in the vicinity of the Site is impacting groundwater quality.

#### 5.7.2.5 Groundwater Dependent Ecosystems

No Groundwater Dependent Ecosystems (GDEs) or Groundwater Sensitive Ecosystems (GSEs) have been identified on the Site or within close proximity. However, the Site is approximately 1.1km northeast of the Yalimbah Creek system that hosts Coastal Wetlands listed under the State Environmental Planning Policy (Coastal Management) 2018 (see **Figure 4.1**).

#### 5.7.2.6 Groundwater Users

Whilst review of WaterNSW records identified that there are no registered bores within 3km of the Site, a search of the Bureau of Meteorology's Groundwater Explorer identified a production bore (GW201611), approximately 3km northwest of the Site (refer Section 10.3, Cook, 2018). However, this bore is situated up gradient of the Site and the depth of the screened interval is below the floor of the extraction area.

### 5.7.3 Conceptual Hydrogeology

#### 5.7.3.1 Aquifer Recharge

Cook (2018) considered that aquifer recharge was primarily by way of excess precipitation (rainfall) infiltration and suggested that the proportion of rainfall recharge to the aquifer is likely to be between approximately 1% and 5%.

#### 5.7.3.2 Aquifer Discharge

Whilst Cook (2018) identified that the surface water and groundwater systems in the vicinity of the Site are disconnected, natural discharge of shallow groundwater (interflow) may occur on the Site as a result of topography and the relatively permeable colluvial material that has developed on the Site and which overlies the less permeable rhyodacite.

By definition, these shallow groundwater systems are contact springs and although the discharges from these contact springs are interpreted to vary in response to seasonal and climatic factors, anecdotal evidence indicates that they are low volume semi-permanent flows.

#### 5.7.3.3 Aquifer Properties

##### 5.7.3.3.1 Hydraulic Conductivity

The hydraulic conductivity values of the rhyodacite aquifer are dependent upon the orientation, interconnectivity, frequency and size of any secondary defects as the result of structural deformation. An attempt was made to carry out short-term pumping tests in the four piezometers, located within the proposed extraction area (see **Figure 5.21**), to establish a set of representative aquifer parameters including hydraulic conductivity and transmissivity. However, none of these piezometers could sustain continuous periods of pumping (<1hr).

Falling head aquifer tests carried out by Coffey on the rhyodacite aquifer of the Karuah East Quarry Site adjacent to the Site (Coffey, 2012) varied between $5 \times 10^{-6}$ m/s and $9 \times 10^{-6}$ m/s.

##### 5.7.3.3.2 Specific Yield

Whilst specific yield is an important aquifer storage parameter, this is predominantly in aquifers that exhibit primary porosity.

Subsequently, as the Site is located within the Water Sharing Plan (WSP) for the North Coast Fractured and Porous Rock Groundwater Sources, for the purpose of the assessment under the NSW Aquifer Interference Policy (2012) and in regard to the minimal impact considerations, under this policy, the groundwater source category for the rhyodacite aquifer in the Site was interpreted to be "Less Productive".

### 5.7.4 Management and Mitigation Measures

#### 5.7.4.1 Introduction

Whilst the less productive nature of the rhyodacite aquifer has led to an absence of groundwater users within 3km of the Site, the following measures with regard to monitoring would be adopted to ensure that any potential impacts to groundwater resources are identified as soon as practicable so that mitigation strategies may be implemented. It is recognised that, as extraction operations progress, the monitoring network may need to be supplemented with additional piezometers being established, as existing piezometers are removed. The need to replace the piezometers would depend upon results of the monitoring program and the exposures of groundwater, if present, within the active extraction area If required, the final locations of any additional piezometers would be determined in consultation with DoI – Water. The location of the existing piezometers is shown on **Figure 5.21** with details of the piezometers presented in **Table 5.17**.

**Table 5.17**
**Groundwater Monitoring Network**

| Piezometer | Easting* | Northing* | Elevation (m AHD) | Depth (m BGL) | Purpose |
|---|---|---|---|---|---|
| BH3 | 0406622 | 6389254 | 49.20 | 40.67 | Water level measurements and water quality testing |
| BH4 | 0406759 | 6389348 | 55.10 | 40.70 | Water level measurements and water quality testing |
| BH7 | 0406551 | 6389169 | 42.80 | 40.15 | Water level measurements and water quality testing |
| BH8 | 0406807 | 6389298 | 39.20 | 33.67 | Water level measurements and water quality testing |
| Note: * MGA 56 | | | | | |
| Source: Modified after Cook (2018) – Tables 5 and 8 | | | | | |

### 5.7.4.2 Groundwater Level Monitoring

Whilst it is recognised that any significant decrease in water level in the piezometer network may be a consequence of interference from extraction operations a number of external factors such as reduced rainfall and aquifer recharge may also lead to a decline in standing water levels.

Notwithstanding this, the Operator would continue to collect automated measurements of standing water levels in the piezometer network (see **Figure 5.21**) in order to build on the existing database to allow for the development of a set of trigger levels over time as this is considered to be an important component of the long-term assessment of potential impacts from extraction operations on the local groundwater system and environment.

In the event that the established trigger levels are ‘exceeded’ and an impact is indicated, action would include an immediate assessment of rainfall data and standing water levels in other piezometers to identify any trends and ascertain whether there is a correlation or otherwise with extraction operations.

### 5.7.4.3 Groundwater Quality Monitoring

The Operator would continue the groundwater quality monitoring program by undertaking sampling and analysis for groundwater quality in the four piezometers on a quarterly (3 monthly) basis for an initial period of 24 months. Analysis of the results would identify any trends in water quality and natural variation. The recommended list of analytes and tests for quarterly sampling is provided in Table 9 of Cook (2018). The water quality data would be reviewed every year to ensure only meaningful data is being collected and to allow for the establishment of trigger levels for the long-term assessment of potential impacts from extraction operations on the local groundwater system and receiving environment. In the event data from the piezometers and observations in the extracted areas indicate little groundwater is present, the monitoring program should be curtailed or abandoned.

In the event that the trigger levels are ‘exceeded’ and an impact is indicated, action would include an immediate assessment of rainfall data and standing water levels in other piezometers to identify any trends and ascertain whether there is a correlation or otherwise with extraction operations.

#### 5.7.4.4 Rainfall Monitoring

The Operator would collect rainfall data from an on-site meteorological station that would be established on the Site (see Section 4.3.1). Rainfall data would be collated in an electronic database for evaluation with the groundwater monitoring data to assist in the development of a greater understanding of the local groundwater system and its response to rainfall.

#### 5.7.4.5 Groundwater Inflow

Although secondary defects are known to exist in the rhyodacite aquifer, the evidence from several years of extraction in the Karuah Quarry immediately north of the extraction area indicates the existence of 'dry' quarry conditions. As a result, it is not anticipated that significant groundwater inflow to the extraction area would occur. However, the Operator proposes to monitor for groundwater inflows and record the volumes entering the extraction area, if practicable. Should it be established that sustained groundwater inflow is occurring, the Operator report this to DoI – Water and, if required, arrange for a water access licence to cover groundwater inflow, at a volume agreed upon with DoI – Water.

### 5.7.5 Assessment of Impacts

Potential groundwater impacts may include impacts to the local and regional groundwater system, water supply bores including any proximal neighbouring bores, GDEs and culturally significant sites that are dependent on groundwater. Thresholds for minimal impact considerations have been developed for the Aquifer Interference Policy and relate to impacts on the groundwater table and pressure, and to groundwater and surface water quality.

Five potential impacts associated with the Project are listed below.

- Local and regional groundwater system;
- Local groundwater users;
- Local creek flow;
- Groundwater chemistry; and
- Groundwater Dependent Ecosystems

#### 5.7.5.1 Local and Regional Groundwater System

The aquifer system is considered to be 'less productive' with groundwater occurrence associated with discrete discontinuous sub-vertical fractures that dissect the rock mass and provide preferential, but discontinuous, groundwater pathways for percolated rainfall.

Based on the existing hydrogeological conditions in the existing Karuah Quarry and the relatively 'low-yielding' fracture aquifer system it is concluded that whilst minor amounts of groundwater may flow into the proposed extraction area and any impact to the local and regional groundwater system would be limited.

#### 5.7.5.2 Local Groundwater Users

Whilst review of WaterNSW records identified that there are no registered bores within 3km of the Site, a search of the Bureau of Meteorology's Groundwater Explorer identified a production bore (GW201611), approximately 3km northwest of the Site and up gradient. It is therefore concluded that the Project will not adversely impact any neighbouring registered bores.

#### 5.7.5.3 Local Creek Flow

Groundwater flow within the rhyodacite aquifer predominantly occurs within secondary defects (fractures and shear zones) which are recharged from rainfall infiltration. These fracture systems are discontinuous and considered to be disconnected from watercourses.

#### 5.7.5.4 Groundwater Chemistry

Any groundwater inflow into the extraction area is predicted to be 'low flow', 'low salinity', non-toxic and effectively diluted by rainwater. That is, the chemistry of any residual water retained in the final void would be dominated by rainwater.

Whilst review of WaterNSW records identified that there are no registered bores within 3km of the Site, a search of the Bureau of Meteorology's Groundwater Explorer identified a production bore (GW201611), approximately 3km northwest of the Site. However, due to the up gradient location of this bore and the depth of the screened interval, it is concluded that the proposed extraction area is predicted not to impact on the chemistry of the groundwater quality of any neighbouring bore.

#### 5.7.5.5 Groundwater Dependent Ecosystems

No Groundwater Dependent Ecosystems or Groundwater Sensitive Ecosystems have been identified on the Site (Ecoplanning, 2019) or within close proximity. However, the Site is approximately 1.1km northeast of the Yalimbah Creek system that hosts Coastal Wetlands listed under the State Environmental Planning Policy (Coastal Management) 2018.

Coffey (2012) in assessing the then proposed Karuah East Quarry, noted the potential for contaminants to migrate down gradient to the wetlands but also noted that the extent of dissolved phase groundwater contaminant plumes migrating from potential contaminant source/s from small sites rarely exceeds 100m.

It is therefore concluded that it is highly unlikely that potential contaminants could reach the estuarine section of Yalimbah Creek.

### 5.7.6 Monitoring

Groundwater monitoring would involve the measurement of groundwater levels in the four existing piezometers using the continuous loggers and the biannual collection of water samples to establish water quality variations, if present.

The extent of monitoring would be reviewed annually given little groundwater is present within the Site and little value obtained from an ongoing monitoring program.

All groundwater monitoring results would be posted on the Operator's website and included in each Annual Review.

### 5.7.7 Conclusion

As there are no registered groundwater users within 3km of the Site and groundwater flow is typically limited to within secondary defects, it is considered that minimal impacts would occur upon the limited groundwater occurrences surrounding the Site.

The location of the extraction area and baseline groundwater chemistry indicates there is no evidence to suggest that a significant change in water quality would result from the Project.

## 5.8 ABORIGINAL CULTURAL HERITAGE

### 5.8.1 Introduction

The SEARs for the Project identify "*Heritage*" as a key issue for assessment in the EIS requiring "*an assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including evidence of appropriate consultation with relevant Aboriginal communities/parties and documentation of the views of these stakeholders regarding the likely impact of the development on their cultural heritage*". In addition, OEH has requested an assessment of impacts to Aboriginal cultural heritage objects. A summary of the SEARs and requirements of the OEH are listed within **Table A2.2**, **Appendix 2** together with a record of where each requirement is addressed in the EIS.

An Aboriginal Cultural Heritage Assessment for the Project was undertaken by Biosis Pty Ltd. The resulting report is presented as Part 7a of the *Specialist Consultant Studies Compendium* and is hereafter referred to as Biosis (2018a).

This subsection describes the regional Aboriginal cultural heritage context and the results of previous surveys throughout the area surrounding the Site. It also describes the results of Aboriginal consultation and subsequent field investigations undertaken for the Project. Potential risks to Aboriginal cultural heritage are identified along with recommended management and mitigation measures.

### 5.8.2 Stakeholder Consultation

Consultation with the Aboriginal community was undertaken in compliance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW, 2010). Following the completion of Steps 4.1.2 and 4.1.3 of these requirements, the following three groups registered their interest in the Project.

- Didge Ngunawal.
- Divine Diggers.
- Karuah Local Aboriginal Land Council (LALC).

Responses to registration from Aboriginal parties are provided in Appendix 2 of Biosis (2018a).

Mr Ron Tisdell and Ms Colleen Perry from the Karuah LALC were present throughout the field assessment of 17 May 2018 and provided input and feedback throughout.

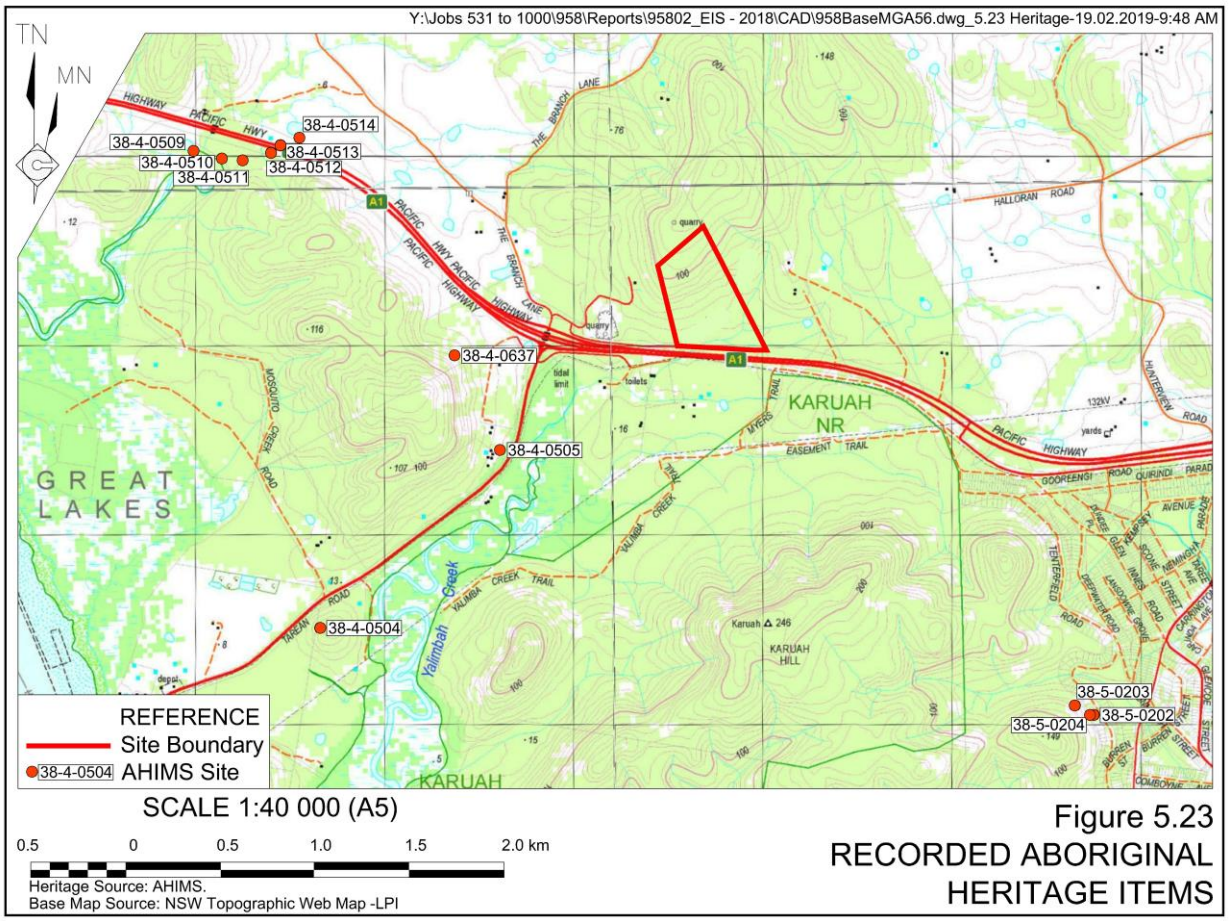
A copy of the draft Aboriginal Cultural Heritage Assessment was distributed to the three Registered Aboriginal Parties (RAPs), however, no comments were received.

## 5.8.3 Existing Environment

### Previously Recorded Aboriginal Cultural Heritage Site

No previously recorded Aboriginal cultural heritage sites are recorded within the Site on the OEH Aboriginal Heritage Information Management System (AHIMS) database.

A total of 12 Aboriginal cultural heritage sites registered on the AHIMS database are located within approximately 5km of the Site (**Figure 5.23**). The closest of these registered sites is located approximately 850m to the southwest of the Site. The sites in the area surrounding the Site primarily comprise artefact scatters and scarred (modified) trees.



### Field Surveys

A field survey was undertaken on 17 May 2018 over a largely undisturbed area within the Site referred to as the "Study Area" by Biosis archaeologist, Ms Taryn Gooley, in the company of Aboriginal RAPs from the Karuah LALC.

The objectives of the survey were to:

- provide RAPs with an opportunity to view the Study Area and to discuss previously identified Aboriginal object(s) and/or place(s) in or within close proximity to the Study Area;
- undertake a systematic survey of the Study Area targeting areas with the potential for Aboriginal heritage;
- identify and record Aboriginal archaeological sites visible on the ground surface; and
- identify and record areas of Potential Archaeological Deposits (PADs).

The archaeological survey was conducted on foot and by vehicle. The pedestrian survey followed the random meander method, and targeted areas of increased visibility such as access tracks, vegetation clearings, and areas of erosion. A total of four random transects were walked across the three landforms within the Site during the field survey (see Figure 7 in Annexure 6 of Biosis, 2018a).

Recording during the survey followed the archaeological survey requirements of the *Code of practice for the archaeological investigation of Aboriginal objects in NSW* and industry best practice methodology. Information that was recorded during the survey included:

- survey coverage;
- any resources that may have potentially been exploited by Aboriginal people;
- landform;
- photographs of the site indicating landform;
- evidence of disturbance; and
- Aboriginal artefacts, culturally modified trees or any other Aboriginal sites, if present.

## 5.8.4 Survey Results

No Aboriginal sites were recorded during the archaeological survey.

Despite restricted visibility over much of the Site, Biosis (2018a) concluded that the results of the survey are likely to be representative of the entire Site and Aboriginal sites are unlikely to occur within the Site. This is primarily due to a lack of higher order streams and resource gathering sites within the Site boundary. This conclusion is consistent with the predictive models developed for the Port Stephens region which indicate that Aboriginal sites are more likely to occur adjacent to permanent fresh water sources and other resource gathering sites.

The shallow soil profiles and previous land uses (e.g. logging and land clearance) across the Site were also found to limit the opportunity for any subsurface archaeological deposit to have survived.

### 5.8.5 Design and Operational Safeguards

Avoidance of impact to archaeological and cultural heritage sites through design of the Project is the primary mitigation and management strategy that should be implemented where practicable. Biosis (2018a) assessed that the Project would not impact on any Aboriginal sites or objects. Further management and mitigation measures are therefore not required.

Based on the results of the Aboriginal Cultural Heritage Assessment undertaken by Biosis (2018a), and consultation with representatives of the local Aboriginal community, the Operator would implement the following recommended management measures.

- Should any Aboriginal objects be encountered during works associated with the Project, works in the vicinity of the find would cease immediately. The object would not be moved until assessed by a qualified archaeologist who would provide further recommendations which may include notifying OEH and relevant Aboriginal stakeholders.
- If any suspected human remains are discovered during activities being undertaken on Site, all activities at that location would cease immediately and the remains would not be further moved or disturbed. Both the NSW Police and OEH would be notified of the location and details of the remains. Work would not recommence at that location unless authorised in writing by OEH.
- The Operator would continue to inform the RAPs about the management of any Aboriginal cultural heritage sites discovered within the Site throughout the life of the Project.

### 5.8.6 Significance Assessment

The two main values addressed when assessing the significance of Aboriginal sites are cultural values to the Aboriginal community and archaeological scientific values. Further discussion on these values is documented in Biosis (2018a).

#### 5.8.6.1 Social or Cultural Significance

No Aboriginal sites or PADs were identified within the Site and no previously recorded sites are located within, or in close proximity to the Site. The archaeological significance of the Site has been assessed as low as the Study Area is unlikely to retain intact or extensive evidence of past Aboriginal use.

No specific information on the cultural significance of the Site has been provided by the RAPs. The historic and aesthetic significance of the Site have both been assessed as low. Overall, the assessment demonstrates low Aboriginal cultural heritage significance.

#### 5.8.6.2 Archaeological / Scientific Values

No Aboriginal sites or PADs were identified within the Study Area and no previously recorded sites are located within, or in close proximity to the Study Area. The archaeological potential of the Site has therefore been assessed as low. There is a low likelihood of Aboriginal cultural heritage with archaeological scientific value occurring within the Site and the scientific significance has therefore been assessed as low.

### 5.8.7 Assessment of Impacts

Approximately 78% of the Site is likely to be impacted by the proposed Project. However, no Aboriginal sites or PADs were identified within the Study Area and no previously recorded sites are located within, or in close proximity to the Study Area. The archaeological potential of the entire Site has been assessed as low. Accordingly, impacts to Aboriginal sites or areas of archaeological potential are unlikely.

## 5.9 HISTORIC HERITAGE

### 5.9.1 Introduction

The SEARs for the Project identify "Heritage" as a key issue for assessment in the EIS requiring "identification of historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items". In addition, OEH have requested an assessment of impacts to historic heritage. A summary of the SEARs and requirements of the OEH are listed within **Table A2.2**, **Appendix 2** together with a record of where each requirement is addressed in the EIS.

A historic heritage assessment for the Project was undertaken by Biosis Pty Ltd. The resulting report is presented as Part 7b of the *Specialist Consultant Studies Compendium* and is hereafter referred to as Biosis (2018b).This subsection of the EIS provides a summary of the impact of the Project on the historic heritage of the Site and surrounds, concentrating on those matters raised in the SEARs.

### 5.9.2 Methods

The *Heritage Act 1977* (the Act) is a statutory tool designed to conserve environmental heritage in NSW. It is used to regulate development impacts on the State's historical heritage assets. The Act defines a heritage item as 'a place, building, work, relic, moveable object or precinct'. The Act also distinguishes between items of local and State heritage significance.

In order to assess the significance of potential historic heritage items located within the Site and surrounds, a desktop search of heritage listed items was completed, as well as a search of the recorded history of the land on which the Site is located. Finally, a field survey of the Site was undertaken to provide a physical assessment of the area for potential items of historic heritage significance.

### 5.9.3 Desktop Review

A search of statutory heritage databases and listings was completed during the completion of the Historic Heritage Assessment. The following databases were included.

- NSW State Heritage Register.
- National Heritage List.
- Commonwealth Heritage List.
- Section 170 Registers.
- *The Great Lakes Local Environmental Plan 2014* – Environmental Heritage Schedule.

There are currently no listed non-Indigenous heritage items within or near the Site.

### 5.9.4 Land History

A comprehensive review of the history of the land on which the Site is located and the surrounding area was undertaken by Biosis (2018b). The following provides a brief overview of this history.

Land title records indicate that the Australian Agricultural Company owned the Site from 1848 to 1910 as part of the private Company Parish of Carrington. During this time, the Parish was subdivided into portions, with the current Site comprising part of Portion 22, with an area of 304 acres (approximately 123 hectares)[2]. There are no records of any structures or agricultural use of the land during this period.

In 1910, the Australian Agricultural Company sold Portion 22 to John Oscar Johnson, an employee of the NSW Government residing at nearby Sawyers Point, for the sum of 174 pounds and seven shillings.[3] John Oscar Johnson (1855-1919) was employed as a ferryman, rowing people across the Karuah River at the current location of the Karuah River Bridge until around 1914, when a hand-winch punt was installed.

An Australian Army ordinance survey map dated 1911 shows details of infrastructure, buildings and roads within the Port Stephens area. The survey map shows two iron humpies directly west and south-west of the boundaries of Portion 22, however no buildings were recorded within the Site. A telephone wire and associated poles appear to be the only structures located within the Site at this time.

John Oscar Johnson's son, John William Johnson, sold Portion 22 to Allan George Johnson and Albert John Johnson for the sum of 900 pounds on 27 September 1955. Albert John Johnson operated a number of sawmills in the Karuah area. Previous investigations of the area suggest that Portion 22 was never clear felled, but rather, selectively logged[4]. A sawmilling company bearing Albert Johnson's name still operates in Karuah today[5].

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[2] NSW Land Registry Services, Carrington Parish Map, 1962
[3] NSW Land Registry Services, Book 1110 No.292
[4] Graham A Brown & Associates 2012, 58
[5] Raymondterrace.com.au, Albert Johnson Pty Ltd, http://www.raymondterrace.com.au/listing/timber-traders-retailers/albert-johnson-pty-ltd/514360/, accessed 21/5/2018

A 1962 Main Roads Survey Plan for the Pacific Highway indicates that a small area on the southern part of Portion 22 was resumed in 1961 as 'Lot 10' by the then NSW Department of Main Roads for 'road purposes'. The survey plan records that two structures, a 'WB Sawmill' and 'WB Shack' (WB indicating 'weatherboard') were located on Lot 10[6]. These structures are assumed to have been destroyed during subsequent road building activities. The Johnsons sold Portion 22 in 1975, after which it was subdivided into three lots, the current Site comprising Lot 221, DP 573153. The Site was purchased by John Edward Anthony White and Coleen Joy White in early 1977 and then sold to John Reinard Pacey later the same year[7]. M. Kiely purchased Lot 11 DP 1024564 in 1988.

## 5.9.5 Field Survey

### 5.9.5.1 Methodology

A field survey of the Site was undertaken on 17 May 2018 in conjunction with the Aboriginal cultural heritage survey, attended by Biosis archaeologist, Ms Taryn Gooley, in the company of Aboriginal RAPs from the Karuah LALC. The principal aim of the survey was to identify heritage values associated with the Site including any heritage items.

The methodology adopted for the field survey is summarised in Section 5.8.3 and detailed in Annexure 6 of Biosis (2018a).

### 5.9.5.2 Results

The field survey did not identify any items or places of historic heritage significance within the Site.

## 5.9.6 Assessment of Impacts

The Historic Heritage Assessment undertaken by Biosis (2018b) identified that there may be archaeological material present within the Site related to historical uses of the land, including agriculture and logging. Potential archaeological material located within the Site may include fencing post holes or footings, informal farm outbuildings, remnant logging camps and logging trails. However, if present, these archaeological materials have been assessed as not holding heritage significance.

Impacts to historic heritage have been assessed as acceptable, as no items of heritage significance would be impacted by Project-related activities. It is noted that this assessment is contingent on the implementation of an unexpected finds protocol which would be implemented by the Operator to identify and record any archaeological material encountered during the proposed construction and operations.

[6] NSW Land Registry Services, Crown Plan 6838.3070
[7] NSW Land Registry Services, Cancelled Title Volume 12737 Folio 131

# 5.10 LAND RESOURCES

## 5.10.1 Introduction

The SEARs for the Project identified Land Resources as a key issue requiring that the EIS include a detailed assessment of:

- potential impacts on soils and land capability (including erosion and land contamination) and the proposed mitigation, management and remedial measures (as appropriate);
- potential impacts on landforms (topography), paying particular attention to the long term geotechnical stability of any new landforms; and
- the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements in Clause 12 of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries)* 2007, paying particular attention to the agricultural land use in the region.

The following sub-sections present a summary of the land resources for the Site, identifying specific constraints and opportunities that might affect the proposed design, establishment, operation and post-operative rehabilitation of the Project.

## 5.10.2 Site Soils

### 5.10.2.1 Soil Landscapes

Based on information provided in the eSPADE database, the Site includes the following soil landscapes.

- Gan Gan Soil Landscape.
- Gan Gan (variant A) Soil Landscape.
- Nungra Soil Landscape.

**Figure 5.24** displays the spatial distribution of soil landscapes present within the Site. **Table 5.18** identifies the key characteristics and occurrence relationships of the soil landscapes.

**Table 5.18**
**Description and Occurrence Relationships of Site Soil Landscapes**



| Soil Landscape | Soil material | Description | Occurrence Relationships |
|---|---|---|---|
| Gan Gan | gg1 —Stony brownish black weakly pedal sandy loam | This is a stony brownish-black weakly pedal sandy loam with weakly pedal, subangular blocky (10–20 mm) structure and rough-faced porous ped fabric. This material occurs as topsoil (A1 horizon). Soil colour is brownish black (10YR 2/2, 10YR 3/2) to greyish yellow brown (10YR 4/2). Gravel- to boulder-sized substrate rock fragments are abundant. Roots are common. | Steep hills on ignimbrites of the Nerong Volcanics. Slope gradients >25%, local relief 100–200 m, elevation 60–260 m. Crests are peaked, upper slopes occasionally precipitous, rocky and narrow; slopes are steep, uneven, and boulder strewn, drainage lines are narrow. Cliffs, scarps and in situ rock outcrop are occasionally present. Predominantly uncleared open-forest |
| | gg2—Bleached stony hardsetting light sandy clay loam | This is a bleached, stony, hardsetting sandy clay loam. It occurs as an $A_2$ horizon. The texture is light sandy clay loam to sandy clay loam, occasionally increasing to a sandy clay with depth, with a massive to weakly pedal, 20–50 mm sub-angular blocky. Soil colour is greyish yellow brown (10YR 5/1, 10YR 5/2, 10YR 6/2) moist, bleached light grey (10YR 8/1, 10YR 7/1) to dull yellow orange (10YR 7/2) dry. Few faint orange mottles occasionally present. Gravel- to boulder-sized substrate rock fragments are abundant. Roots are rare. | |
| | gg3—Whole coloured well-structured light clay | This is a light clay, occasionally sandy clay loam with strong prismatic, 50–100 mm peds breaking down to 20–50 mm angular blocky and smooth-faced dense ped fabric. This material usually occurs as subsoil (B horizon). Colours include orange (7.5YR 6/8), yellowish brown (10YR 6/8) and dull yellowish brown (10YR 5/3). Angular substrate rock fragments are occasionally encountered, along with fine to coarse roots. | |
| Gan Gan (variant A) | As above | As above | Steep colluvial footslope deposits along the bases of Gan Gan soil landscape. These steep hills have deep, hummocky, stony colluvial deposits often forming short footslopes. |

**Table 5.18 (Cont'd)**
**Description and Occurrence Relationships of Site Soil Landscapes**



| Soil Landscape | Soil material | Description | Occurrence Relationships |
|---|---|---|---|
| Nungra | ng1 | This is a greyish yellow brown or brownish black silty loam with a weak to moderate sub-angular blocky (5-20mm) structure and rough-faced porous peds. This material occurs as a topsoil (A1 horizon). Soil colour is greyish yellow brown (10YR 4/2, 10YR 4/2) or brownish black (10YR 3/2). Occasional gravel-sized charcoal fragments. Common fine roots. | Gently inclined footslopes and drainage plains on Quaternary alluvium. Slope gradient <3% and local relief <10m. Long (up to 2000m), gently inclined footslopes with broad ill-defined drainage lines grading into broad drainage plains (100-2000m width). Predominantly cleared tall open-forest. |
| | ng2 | This is a bleached hardsetting silty clay loam with a massive structure and earthy fabric. This material occurs as a subsoil (A2 horizon). Soil colour is brownish grey (10YR 4/1 , 10YR 5/1, 10YR 6/1) or greyish yellow brown (10YR 4/2, 10YR 5/2) moist, light grey (10YR 7/1) or dull yellow orange (10YR 7/2) dry. Few fine charcoal fragments and roots. | |
| | ng3 | This is a greyish yellow brown mottled silty clay with a massive to weakly pedal structure and an earthy fabric. This material occurs as a subsoil (B horizon). Soil colour is commonly greyish yellow brown (10YR 5/2, 10YR 4/2) but ranges from brownish grey (10YR 5/1) to light grey (10YR 7/1), distinct orange mottles common. Few coarse fragments. Common fine roots. | |

Source: Murphy 1995, pp. 52-54 and pp. 92-94

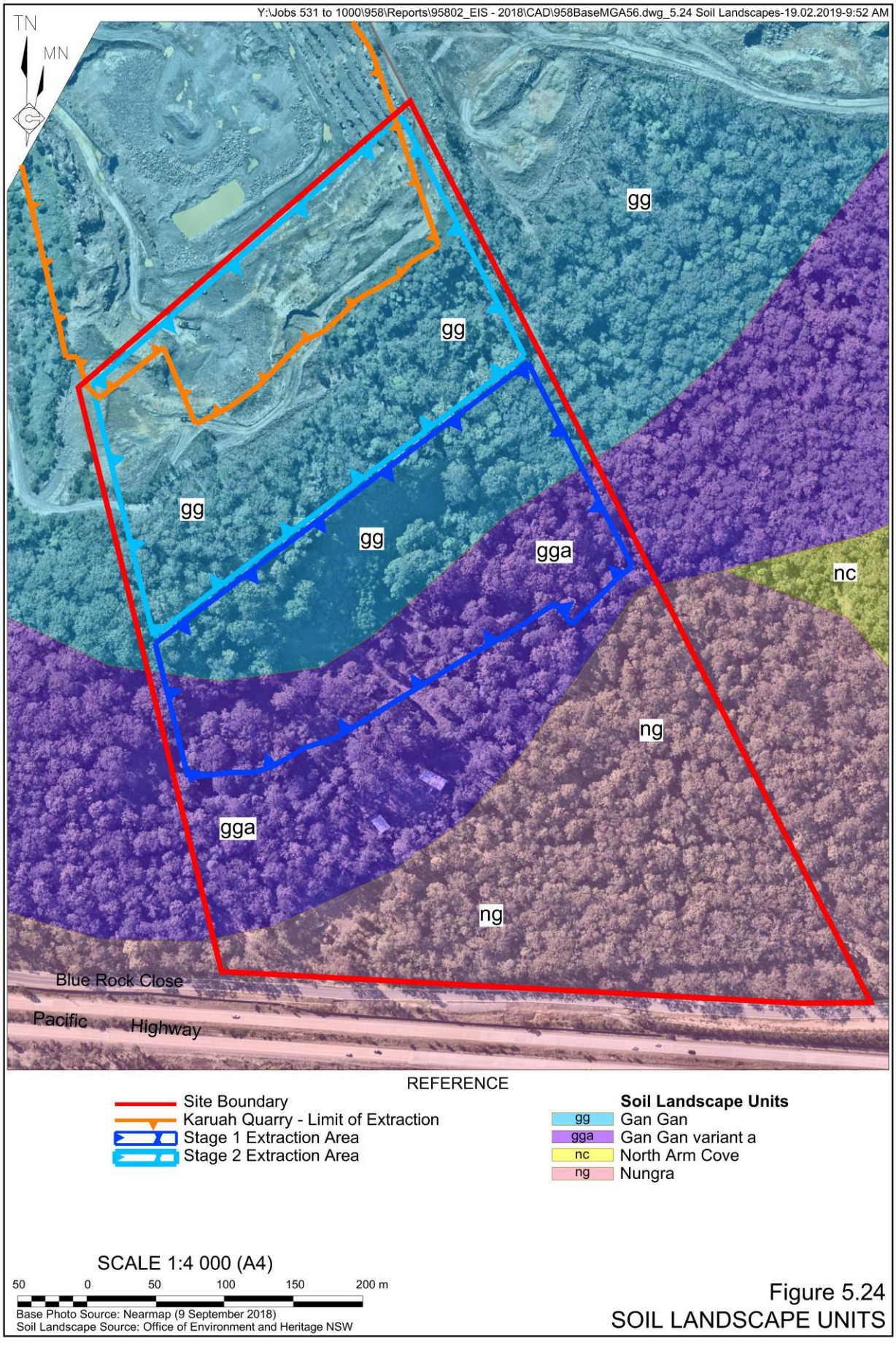


Figure 5.24
SOIL LANDSCAPE UNITS

Based on *The Land and Soil Capability Assessment Scheme – Second approximation* published by Office of Environment and Heritage in 2012, the soils of the Site may be classified as follows.

- Steeply Inclined Slopes

  Class 7 – Very low capability land: Land has severe limitations that restrict most land uses and generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations not managed. There should be minimal disturbance of native vegetation.

- Steeply Inclined Footslopes

  Class 6 – Low capability land: Land has very severe limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation.

- Gently Inclined Footslopes

  Class 5 – Moderate-low capability land: Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation. Land capable for a limited set of land uses (grazing, forestry and nature conservation, some horticulture).

#### 5.10.2.2 Acid Sulfate Soils

Based on information provided by the NSW Planning Portal on-line mapping tool, the Site does not contain any soils classified as acid sulfate soils.

### 5.10.3 Management and Mitigation Measures

The Operator would implement the following management and mitigation measures throughout the life of the Project to minimise the potential for unacceptable soil and land capability-related impacts.

- Clearly mark areas for stripping and stockpiling.
- Strip soil from all areas of disturbance and store in stockpiles orientated parallel to the contours no more than 2m high.
- Refrain from stripping or placing soil during wet conditions.
- Ensure that the soil stockpile surfaces have a surface that is as ‘rough’ as possible, in a micro-scale, to assist in surface water runoff control and seed retention and germination.
- Spread seed of a suitable cover crop on all soil stockpiles to facilitate revegetation.

- Ensure that soil stockpiles are constructed with side slopes of 1:3 (V:H) or less and that the surface of all stockpiles achieves an effective 70% cover within 10 days of formation. This may be achieved through the use of mulches, spray on polymer-based products or hessian that would allow a vegetative cover to become established.
- Signpost the soil stockpile and limit operation of machinery on the stockpile to minimise compaction and further degradation of soil structure.
- Rip or scarify all areas to be respread with topsoil to allow the respread material to be keyed into the underlying material.

### 5.10.4 Impact Assessment

Adherence to the recommended soil and growth medium stripping, handling, stockpiling procedures and other management practices, together with appropriate rehabilitation practices would result in a minimal impact to soils and land capability within the Site. The Project would not impact adversely on the agricultural potential of the land given the existing land uses both within and immediately surrounding the Site and the prevalence of moderate-low to very low capability soils.

## 5.11 PUBLIC SAFETY HAZARDS

### 5.11.1 Introduction

The SEARs for the Project require an assessment of the potential impact of the Project on Public Safety, with specific reference to potential bush fire risk and the transport, handling, storage and use of any hazardous or dangerous goods. The specific hazard-related impacts that may result as a consequence of the Project (without the implementation of the safeguards, controls and mitigation measures presented in this assessment section) and therefore require an assessment relate primarily to:

- the handling, storage and disposal of hydrocarbons (see Section 5.11.2); and
- potential for bush fire (see Section 5.11.3)

### 5.11.2 Handling Storage and Disposal of Hydrocarbons

#### 5.11.2.1 Controls and Safeguards

In order to minimise the potential for hydrocarbon contamination, the following controls and safeguards would be implemented.

- Hydrocarbons and hazardous materials would only be received by licensed suppliers for the transport of dangerous goods in accordance with *Dangerous Goods (Road and Rail Transport) Act 2008 No 95*.

- Diesel would be stored on the Site in a self-bunded container and in accordance with *AS 1940 – 2004 and Amendment – 2004 The Storage and Handling of Flammable and Combustible Liquids*, or updated or replacement standard.
- Hydrocarbon waste would be disposed of by a licenced waste contractor to a licenced waste facility.
- Hydrocarbon spill kits would be appropriately located to ensure spill response and clean up can be carried out immediately following the detection of any spills.
- In the event of a hydrocarbon leak or spill, the Operator would implement the following spill management procedure.
  - Phase 1 – Source Control: isolate the source of spill or leak and stop the leak either by maintenance or placing the leaking item within or over the fuel/oil storage area.
  - Phase 2 – Recovery: recover as much as possible at the source by pumping free hydrocarbon from the surface and excavating hydrocarbon-contaminated materials. Contaminated materials would be stockpiled on site under cover and on an impermeable surface, e.g. a high-density polyethylene sheet. This material would later be bio-remediated on site and/or transported to an approved waste facility.
  - Phase 3 – Remediation: transport the contaminated material to a facility licensed to accept and treat hydrocarbon contaminated material.
- Spills or leaks of other pollutants would be handled in accordance to the relevant Materials Safety Data Sheet.

#### 5.11.2.2 Impact Assessment

It is anticipated that with the proposed controls and safeguards that potential hazards as a result of hydrocarbon and hazardous materials to be used on the Site would be minimised.

### 5.11.3 Bush Fire Hazard

#### 5.11.3.1 Introduction

Section 4.14 of the EP&A Act 1979 details the requirement for developments to conform to the specifications and requirements of the document entitled "*Planning for Bush Fire Protection*" (RFS, 2006), however, Sub-section (1B) states that Section 4.14 does not apply to State significant development. While the requirement for a bush fire assessment in accordance with RFS (2006) is not required, the procedure detailed in that document has been adopted to identify the potential hazard for the Project. The addendum to Appendix 3 of RFS (2006), published by the Rural Fire Service (RFS) in 2010 has also been considered for assessment of the bush fire attack level (RFS, 2010). Proposed management of the identified hazards is also described.

The bush fire assessment was prepared by R.W. Corkery & Co. Pty Limited based, in part, on information on local vegetation provided in Ecoplanning (2019). Vegetation communities identified within the Site are described further in Section 5.5.

#### 5.11.3.2 Bush Fire Management Objectives

The objectives of RFS (2006) considered in this assessment are to:

- afford occupants of any building adequate protection from exposure to a bush fire;
- provide for a defendable space to be located around buildings;
- provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent direct flame contact and material ignition;
- ensure that safe operational access and egress for emergency service personnel and residents is available;
- provide for ongoing management and maintenance of bush fire protection measures, including fuel loads in the Asset Protection Zone (APZ); and
- ensure that utility services are adequate to meet the needs of fire fighters (and other assisting in bush fire fighting).

#### 5.11.3.3 Assessment of Bush Fire Hazard

##### 5.11.3.3.1 Introduction

The following sections use the RFS (2006) and RFS (2010) procedure to determine the Category of Bush Fire Attack (or bush fire hazard) for the ancillary components area. This area comprises the Quarry office, parking facilities and workshop and has been identified as the primary Quarry component at risk of Bush Fire Attack.

##### 5.11.3.3.2 Vegetation Formation

Vegetation within the Site has been classified in accordance with RFS (2006) using the vegetation descriptions provided in Ecoplanning (2019), as follows.

- Wet sclerophyll forest (Tall open forest) – maximum fuel load of 30t/ha.
- Dry sclerophyll forest (Open forest) – maximum fuel load of 25t/ha.
- Rainforest (Closed forest) – maximum fuel load of 10t/ha.

**Figure 5.25** displays the classification of the vegetation within the Site based upon the classifications provided in RFS (2006) and the field surveys undertaken by Ecoplanning (2019).

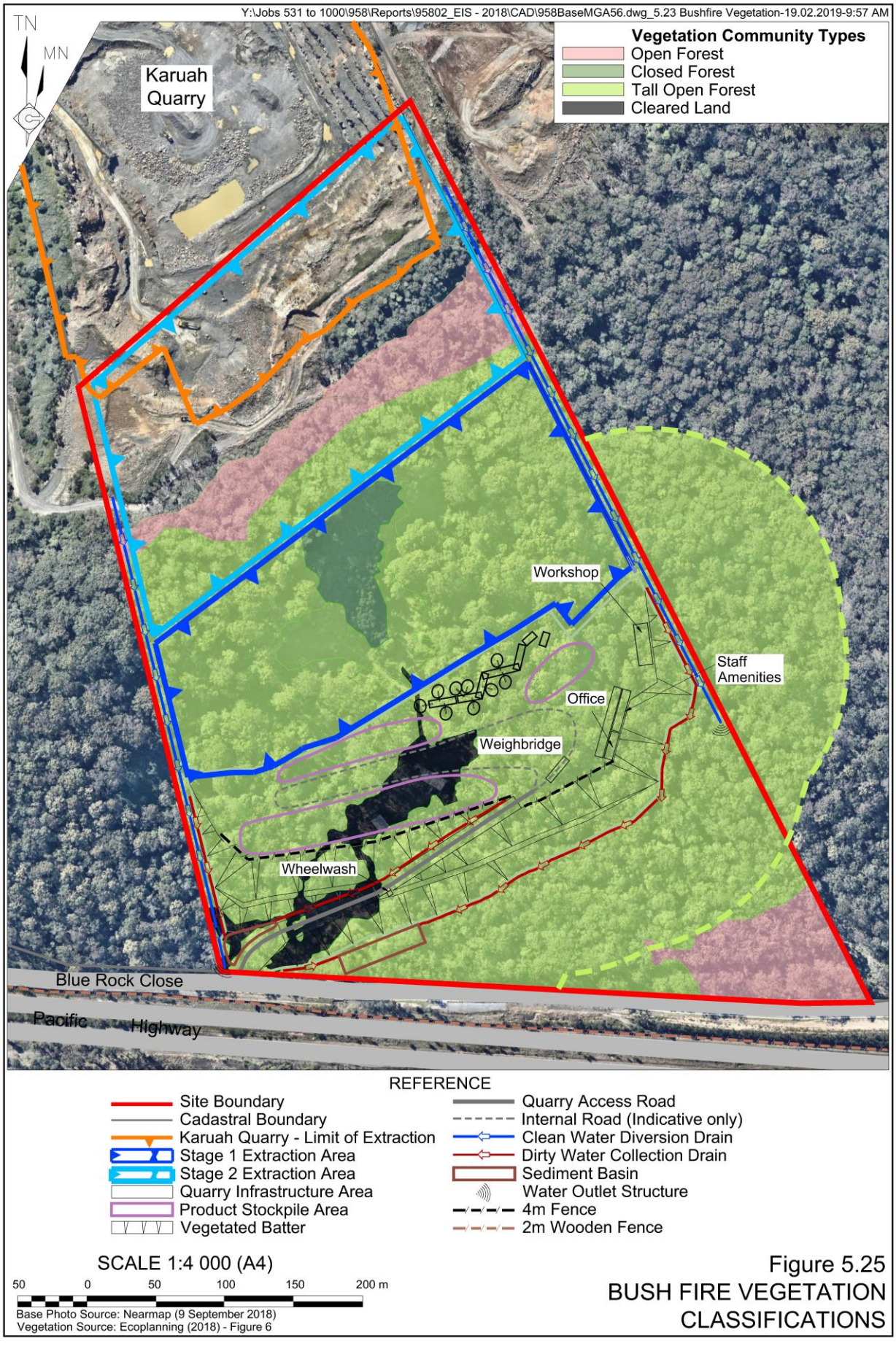


Figure 5.25
BUSH FIRE VEGETATION CLASSIFICATIONS

It is noted that following the conversion of vegetation classifications in accordance with Table A3.5.1 of RFS (2010), all vegetation within 100m of the ancillary components area is classified as "Forest".

#### 5.11.3.3.3 Effective Slope

The Site covers a variety of landforms from steeply inclined slopes and footslopes to gently inclined footslopes. Within 100m of the ancillary components area, the slopes are no greater than approximately 20° although it is noted that slopes are typically <10°. **Figure 5.26** displays the slopes within 100m of the ancillary components area.

#### 5.11.3.3.4 Fire Weather

The MidCoast LGA occurs within the North Coast NSW Fire Area and is designated a Fire Danger Index of 80 (RFS, 2006).

#### 5.11.3.3.5 Hazard Assessment

It is possible to calculate the bush fire hazard (referred to as the Bush Fire Attack Category in RFS, 2006 and RFS, 2010) for activities within 100m of vegetation from a combination of the vegetation formation, Fire Danger Index, the effective slope and the proximity of activities to the bush fire hazard. The results of the Bush Fire Attack level assessment are displayed on **Figure 5.26** for the vegetation adjacent to the ancillary components area. **Table 5.19** identifies the Bush Fire Attack Levels (% of total area) within 100m of this area.

**Table 5.19**
**Bush Fire Attack Levels (BAL) within 100m of Ancillary Components Area (% of total area)**

| Project Component | BAL-FZ (%) | BAL-40 (%) | BAL-29 (%) | BAL-19 (%) | BAL-12.5 (%) |
|---|---|---|---|---|---|
| Ancillary Components Area | 4.7 | 3.1 | 7.3 | 10.6 | 74.4 |
| Source: Based on RFS (2010) and AS3959.2009 | | | | | |

Activities located further than 100m have a Category of Bush Fire Attack classification of "low".

The following descriptions of the predicted bush fire attack and levels of exposure are provided for the Category of Bush Fire Attack (or bush fire hazard) in AS2959.2009.

- BAL-Low: There is insufficient risk to warrant specific construction requirements.
- BAL-12.5: Ember attack.
- BAL-19: Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux.
- BAL-29: Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux.

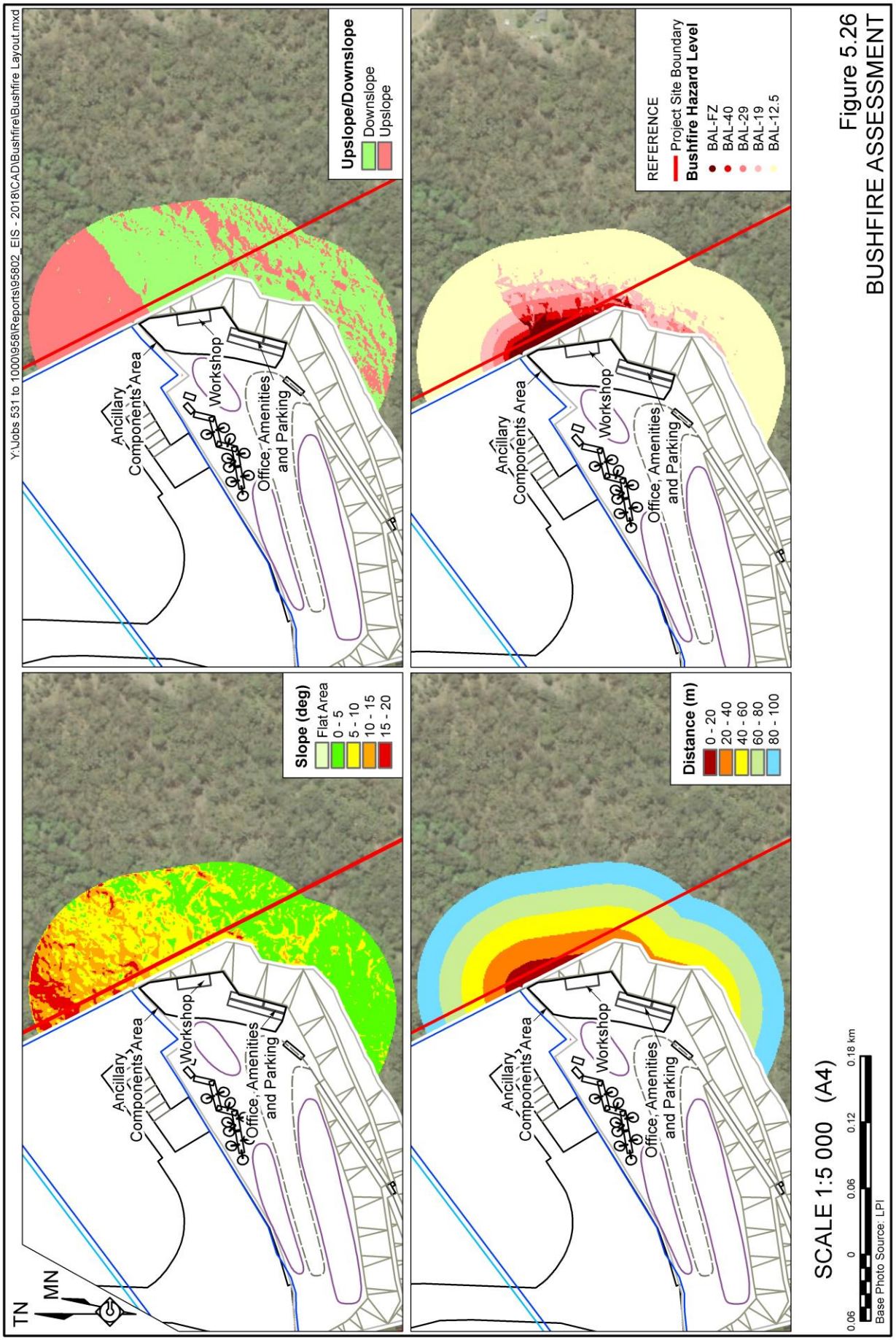


Figure 5.26
BUSHFIRE ASSESSMENT

- BAL-40: Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux with the increased likelihood of exposure to flames.
- BAL-FZ: Direct exposure to flames from fire front in addition to heat flux and ember attack.

Approximately 74% of vegetation within 100m of the ancillary components area is categorised as BAL-12.5 and poses a risk of ember attack. However, some areas within the ancillary components area are more susceptible to bush fire attack and fall into a higher risk category. Of particular note is the area adjacent to the workshop at the eastern extent of the ancillary components area. It is noted that approximately 7.8% of the vegetation within 100m of this area is categorised as BAL-40 or BAL-FZ.

Based on an average effective slope of <10°, and in accordance with Table A2.5 of Appendix 2 of RFS (2006), an Asset Protection Zone (APZ) of 30m between any infrastructure constructed within the ancillary components area and the adjoining vegetation is recommended.

#### 5.11.3.4 Operational Safeguards, Controls and Management Measures

It is recognised that, even after vegetation is cleared from the Site, the area is directly adjacent to a heavily wooded area, and therefore the potential for bush fire to spread both within the Site and adjacent to the Site would be high if management measures are not adopted to mitigate this hazard.

In terms of potential impacts, the assets considered at risk include employees, adjoining quarry operations and the local community. In order to protect these assets, a proposed bush fire management plan would be documented in a *Landscape and Rehabilitation Management Plan* that would be prepared in consultation with the local Rural Fire Service. The bush fire management section of the *Landscape and Rehabilitation Management Plan* would include the following.

- A review of bush fire hazards and identification.
- A summary of controls and management measures including fire response equipment and locations.
- Emergency contact details.
- Training requirements.

Various activities that may increase the risk of fire on the Site and transport route, and the controls proposed to limit the risk posed by these are presented in **Table 5.20**.

More general bush fire management measures to assist in the event of a local bush fire event are as follows.

- Asset Protection Zones would be maintained with a tree canopy of less than 15% with trees located greater than 30m from any part of the roofline. Trees would have lower limbs removed up to a height of 2m above the ground.

**Table 5.20**
**Bushfire Hazard – Activities and Controls**

| Activity | Possible Ignition Source | Safeguards and/or Controls |
|---|---|---|
| Refuelling | Spilt fuel or dry grass ignited by spark. | • Refuelling undertaken within cleared area of the Site.<br>• Engines in all vehicles to be turned off during refuelling.<br>• No smoking policy to be enforced in designated areas of the Site.<br>• Fire extinguishers maintained within all site vehicles and mobile equipment. |
| General Activities | Cigarettes, Rubbish, e.g. glass, metal. | • No smoking policy to be enforced in designated areas of the Site.<br>• No throwing cigarette butts from product trucks along the product delivery route.<br>• Focus on housekeeping to be maintained by the Quarry Operator.<br>• Water cart available.<br>• All site vehicles and mobile equipment to carry a fire extinguisher. |

- All employees would be trained in the proper use of fire fighting equipment held on the Site.
- Water would be especially set aside for fire fighting on Site and the on-site water cart made available for fire fighting purposes.
- A protocol would be developed for restricting work in forested areas during high fire danger periods of the bush fire season (in accordance with the hazard category notifications).
- Procedures for hot works would be developed to prevent ignition sources for a bush fire.
- The local Rural Fire Service would be consulted prior to each bush fire season.
- Site fire fighting equipment would be made available to the local Rural Fire Service, if required, in the event of a bush fire on the land surrounding the Site.
- Firebreaks would be developed and maintained within the proposed extraction areas at the edge of forested areas as required and in consultation with the local Rural Fire Service.
- The local Rural Fire Service would be consulted regarding any controlled burns planned by these agencies for asset protection and / or ecological management.

Emergency and Evacuation Management Procedures would be developed that would include procedures in the event of a local bush fire.

#### 5.11.3.5 Assessment of Impacts

With the implementation of the proposed safeguards and controls, it is considered that the bush fire hazard associated with the Project would be acceptable and would not significantly contribute to raising the risk of bush fires impacting the community, property or environmental assets.

# 5.12 ECONOMIC IMPACTS

## 5.12.1 Introduction

The SEARs request an assessment of the following economic impacts related to the Project.

- The significance of the resource.
- The costs and benefits of the Project; identifying whether the development as a whole would result in a net benefit to NSW.

The following qualitative assessment of the economic impacts and benefits of the Project was undertaken by R.W. Corkery & Co. Pty Limited. A review of relevant management measures and commitments to achieve worthwhile, positive economic impacts is also provided.

## 5.12.2 Significance of the Resource

The significance of the 11 million tonnes of hard rock within the Site is best described in terms of the benefits of regional considerations and its contribution to the construction of local infrastructure and housing.

### Regional Considerations

A worthwhile benefit of the Project would be the provision of an increased supply of aggregates, road pavement materials and manufactured sand for projects in the Hunter and Greater Sydney Regions. It is noted that the building and construction industry in the Greater Sydney Region is fully dependent upon crushed rock products produced in hard rock quarries in regions around Sydney as there are no operating hard rock quarries within the Greater Sydney Region.

Whilst substantial hard rock resources are known to exist within the Hunter Region, the Project offers an opportunity for an individual construction company to operate its own quarry and produce its own quarry products to meet their specific requirements. The significance of the resource, whilst minor in the context of other resources in the Hunter Region and those supplying the Greater Sydney Region, would contribute positively to the overall supply of crushed rock products, particularly in the event it is operated by an individual construction company.

The Site is strategically located within a "quarry precinct" which provides convenient access to the Pacific Highway. The Site is located approximately 40km from Newcastle and 200km from Sydney and is well placed to contribute to the supply of aggregates, road pavement materials and manufactured sand throughout the MidCoast and Port Stephens Local Government Areas. The proximity of the Site to the Pacific Highway and the Hunter and Greater Sydney Regions would allow for transportation costs to be minimised and crushed rock products to be delivered at competitive rates. This, in turn, would ensure that downward pressure is applied to costs associated with infrastructure and construction projects within the Hunter and Greater Sydney Regions.

### Local Infrastructure

Both MidCoast and Port Stephens Councils maintain extensive local road networks with road assets valued at approximately $947 million and $407 million, respectively (MCC, 2018; PSC, 2018). The total expenditure on road projects throughout MidCoast and Port Stephens LGAs in 2018 has been reported as approximately $29 million and $8 million, respectively (MCC, 2018; PSC, 2018). A large proportion of these costs are directly attributable to the purchase of road pavement materials and selected aggregate. The Project would ensure competition within the construction materials sector is maintained and provide an additional source of aggregates, road pavement materials and manufactured sand for both MidCoast and Port Stephens Councils and a range of industrial/commercial enterprises within the LGAs.

### Local Housing

MidCoast Council has prepared a Community Strategic Plan entitled *MidCoast 2030: Shared Vision, Shared Responsibility – Community Strategic Plan 2018-2030* (referred to hereafter as the Plan), published in April 2018. The purpose of the Plan is to serve as the guiding document for the community, to provide a framework and direction for activities, programs and projects undertaken to work towards the vision set forth in the Plan. The Plan identifies that the MidCoast LGA is expected to experience high levels of population growth from a population of approximately 92 000 people (as of the 2016 Census) to 112 962 by 2036. It is noted that the total number of dwellings in the region increased by 2 184 between 2011 and 2016 to a total of 47 401 reflecting strong population growth.

The *Karuah Growth Strategy 2011* published by Port Stephens Council similarly projects strong population growth and an increased demand for housing within the Karuah area. A total of 595 lots have been identified for future land supply for housing within the township, which aligns with Port Stephens Council's projected demand for an increase of 1 094 residents by 2036. The lots are expected to be developed as detached houses.

The Project would be strategically positioned to supply aggregates, road pavement materials and manufactured sand for local construction projects within the MidCoast and Port Stephens LGAs for the duration of the Project, contributing to cost savings for local housing projects.

## 5.12.3 Cost Benefit Analysis

### 5.12.3.1 Introduction

It is recognised that a number of economic costs and benefits would be associated with the Project. These would principally relate to the following key areas which are considered in more detail in the following subsections.

- Spending associated with site establishment and construction.
- Effects relating to direct and indirect operational employment.
- Flow-on effects relating to non-labour expenditure during operations.
- Tax revenues to both State and Federal Governments and rates to MidCoast Council.
- The supply of construction materials to the Hunter and Greater Sydney Regions.
- Residual environmental and social impacts.

### 5.12.3.2 Site Establishment and Construction

Development of the Project would require a capital investment of approximately $12.11 million which would include all wages, activities, equipment and miscellaneous expenses to allow for the first tonne of crushed hard rock products to be produced and despatched. The equipment and activities required to establish the Project are detailed in Section 2.

This investment by the operator of the Quarry would directly contribute to the regional and local economy.

### 5.12.3.3 Operational Employment

The Operator would directly employ between 14 to 20 persons over the life of the Project. An estimated 10 truck drivers would be employed either by the Operator or its customers to deliver hard rock products from the Site. **Table 2.6** lists the likely employment position/function and the employment levels for production at 300 000tpa and 600 000tpa.

It is likely that the majority of the workforce for the Project would be sourced from the Karuah area and the broader Hunter Region. It is also likely that a proportion of the truck drivers to be employed would be domiciled in the Hunter Region. Increased employment would have flow-on effects through the payment of wages and the subsequent purchase of housing or payment of rent, groceries and spending of disposable income in the Karuah area and broader Hunter Region.

It is anticipated that the average annual wage for the quarry workforce would be approximately $90,000 which would equate to an average payroll for the on-site personnel and truck drivers of between $2.16 million to $2.7 million each year. The anticipated flow-on effects generated by wage expenditure at Local (multiplier = 2.0), State (multiplier = 2.2) and National (multiplier = 2.5) levels have been conservatively estimated as follows.

- Local flow-on effects ($4.32 million to $5.4 million per annum)
- State flow-on effects ($4.75 million to $5.94 million per annum)
- National flow-on effects ($5.4 million to $6.75 million per annum)

Assuming an average of 27 full time equivalent positions, the payments/wages to employees would directly contribute $60.75 million into local and regional economies over the life of the Project. Flow-on effects over the life of the Project would equate to an estimated $121.50 million (Local), $133.65 million (State), and $151.88 million (National).

### 5.12.3.4 Operational Materials and Equipment Expenditure

The operation of the Project would require the ongoing purchase of materials, consumables, equipment and services by the Operator. These costs would largely comprise costs associated with the maintenance and/or replacement of mobile equipment (e.g. excavators, bulldozers etc.), mobile crushing plant equipment, consumables (e.g. fuel, etc.) and services not included under wages (e.g. blast contractors, environmental monitoring etc.). These costs would be ongoing throughout the life of the Project and are estimated at approximately $5 million per year.

The flow-on effects generated by expenditure on operational materials, equipment and services at Local (multiplier = 1.5), State (multiplier = 2.0) and National (multiplier = 2.5) levels over the life of the Project have been estimated as follows.

- Local flow-on effects ($187.5 million)
- State flow-on effects ($250 million)
- National flow-on effects ($312.5 million)

It is noted that material and equipment purchases would be sourced from the Karuah area and Hunter Region wherever possible to enhance flow-on effects within the local area.

#### 5.12.3.5 Tax Revenue

The Operator would pay payroll tax to the State of NSW and income tax to the Federal government. A proportion of income taxes would be effectively received by the State of NSW and the local community through the Federal funding of infrastructure, health and education services. Increased rates would be payable by the landowner to MidCoast Council throughout the life of the Quarry.

#### 5.12.3.6 Economic Costs

Section 5 of the EIS outlines the environmental impacts that are likely to result from the Project. Whilst potential impacts of the Project have been avoided, minimised and/or mitigated as far as practicable, it is acknowledged that there may be some minor economic costs associated with residual impacts to the natural environment and for the local community. Residual impacts of the Project include the generation of dust and operational noise as well as potential changes to water resources, visual amenity and biodiversity that could impact the attractiveness of the local area to tourists and residents.

Comprehensive predictive assessments have been undertaken during the preparation of the EIS to predict and demonstrate potential cumulative impacts. The outcomes of these assessments have confirmed that the Project and surrounding quarry operations would cumulatively operate within the criteria established within the relevant guidelines and legislation.

In addition to costs associated with residual environmental impacts, a range of social impacts may result from the operation. These impacts are described in more detail in Section 5.13. Residual social impacts may also have a cost if they result in lost employment opportunities, impacts to property values, increased health management costs and impacts to tourism. It is not expected that significant economic impacts would result from any residual social impacts of the Project.

### 5.12.4 Management and Mitigation Measures

In addition to the environmental mitigation measures and management procedures identified throughout Section 5 and summarised in Section 6, the Operator would implement the following management and mitigation measures to ensure that economic benefits to the Karuah and district community arising from the Project are maximised and adverse impacts are minimised.

**Employment and Training**

- Where appropriate, give preference when engaging new employees to candidates who live within the Karuah area over candidates with equivalent experience and qualifications based elsewhere.
- Encourage and support participation of locally-based employees and contractors in appropriate training or education programs that would provide skills and qualifications that may be of use at the Site (and potentially elsewhere within the extractive, mining or related industries).

**Economic Contribution and Development**

- Give preference, where practicable, to suppliers of equipment, services or consumables located within the Hunter Region.

### 5.12.5 Conclusion

The Project provides for the extraction, processing and despatch of aggregates, pavement products and manufactured sand to markets within the Hunter and Greater Sydney Regions. The extraction of this resource would assist to exert downward pressure on costs associated with construction material supply and influence market costs associated with construction and infrastructure projects. The Project would further assist in generating local employment and contribute to local, regional, state and National economies through flow-on effects.

It is concluded that the net economic benefits of the Project would outweigh the costs as the Project would:

- contribute towards the supply of aggregates, pavement products and manufactured sand in the Hunter and Greater Sydney Regions;
- provide ongoing employment opportunities throughout the MidCoast and Port Stephens LGAs; and
- contribute to the continued economic growth at local, regional, State and National levels through flow-on effects;
- avoid, minimise and/or mitigate environmental and social impacts to the greatest extent practicable which in turn relates to the economic costs of the Project.

## 5.13 SOCIAL IMPACTS

### 5.13.1 Introduction

The SEARs request an assessment of social impacts related to the Project to address those issues that may affect or concern people, whether directly or indirectly. Any real or perceived impacts of the Project may have social consequences and therefore the assessment of these impacts needs to look beyond technical assessment.

A Social Impact Assessment for the Project has been prepared by R.W. Corkery & Co. which is hereafter referred to as RWC (2019b). The following subsections provides a summary of the social impacts that may result from the Project with an emphasis on matters raised during consultation with local community members and government agencies. The Social Impact Assessment (SIA) is included as Part 8 of the *Specialist Consultant Studies Compendium*.

## 5.13.2 Stakeholder Identification

Stakeholder identification undertaken as part of the SIA (RWC, 2019b) relied upon a variety of information sources that include community consultation, publicly available information relating to previous development applications in the area and the Applicant's familiarity with members of the local community. The following key groups were identified through consultation and engagement for the Project.

- The planning and development staff within MidCoast Council and Port Stephens Council.
- Landowners and residents in the area directly surrounding the Site.
- Members of the local community action group – Ironstone Community Action Group (ICAG).
- Landowners, residents and business owners within the township of Karuah.
- Landowners and residents in the broader community including North Arm Cove, Limeburners Creek, Tahlee, Carrington and Tea Gardens / Hawks Nest.

The local Aboriginal community in Karuah were also identified as a potential stakeholder group. However, discussion with the Karuah Local Aboriginal Land Council identified that the existing operations were not affecting the local Aboriginal community. The views of the Aboriginal community regarding the Aboriginal cultural heritage aspects of the Project are presented in the Aboriginal Cultural Heritage Assessment (Part 7a of the *Specialist Consultant Studies Compendium*)

## 5.13.3 Existing Social Context

### 5.13.3.1 Local Context

The Site is located adjacent to the Pacific Highway approximately 4km northeast of Karuah. The property on which the Site would be located (in addition to adjacent lots) has been subject to quarry development since approximately 1997. Community members have expressed a number of concerns regarding existing quarry operations relating to the following key issues.

- Truck use and behaviour on the Branch Lane.
- Visual impacts from the Pacific Highway.
- Cumulative dust generation and other air quality impacts including dust in tank water.
- Health impacts associated with dust emissions.
- Impacts from noise and blasting vibrations.

- Water quality for the surrounding area
- Flora and fauna impacts and the suitability of offsetting arrangements.
- The need for new processing and other operating areas when these are already available nearby.
- Loss in value for nearby properties.
- Failure of the existing operations to satisfy environmental commitments and trustworthiness of the operator.

Local community stakeholders have been defined geographically. This includes the Principal Amenity Impact Area (**Figure 5.27**), defined to include those community members that would be most likely to experience negative amenity impacts. It is noted that community members outside this area may also experience negative amenity impacts, however, these are not expected as frequently or at the same intensity as those within the Principal Amenity Impact Area.

Amenity impacts currently experienced, and that may potentially result of the Project, influence the way of life of the local community and their sense of place through the experience of physical amenity impacts at their homes.

Land within the Principal Amenity Impact Area includes small to large size lots. Land to the north, east and west of the Site, beyond the immediate area of native vegetation, features mostly cleared agricultural land while land to the south is principally located on the southern side of the Pacific Highway and is used for rural-residential purposes.

The Principal Amenity Impact Area also includes two existing quarries and the Pacific Highway in the vicinity of the Site.

#### 5.13.3.2 Broader Geographic Context

The Site is located within the MidCoast Local Government Area (LGA) in the eastern section of the Hunter Region in New South Wales. Within the MidCoast LGA, the town of Taree is the major commercial and urban centre and is located approximately 90km north of the Site. Other major centres within the MidCoast LGA include Gloucester and Forster.

The township of Karuah, which lies approximately 4km southwest of the Site, is the closest urban centre to the Site and has a population of 1 411 people (as of the 2016 Census). Karuah is situated within the Port Stephens LGA, with the Karuah River effectively forming the boundary between the two LGAs. As the Karuah State Suburb (SSC) encompasses both the Site and the township of Karuah, census data pertaining to the Karuah SSC has been considered.

#### 5.13.3.3 Aboriginal Cultural Heritage and Historic Heritage

An assessment of the Aboriginal cultural heritage and historic heritage setting for the Project was undertaken by Biosis (2018a and 2018b) and is provided as Part 7 of the *Specialist Consultant Studies Compendium*. Sections 5.8 and 5.9 of the EIS provide a summary of the Aboriginal cultural heritage and historic heritage setting for the Project.

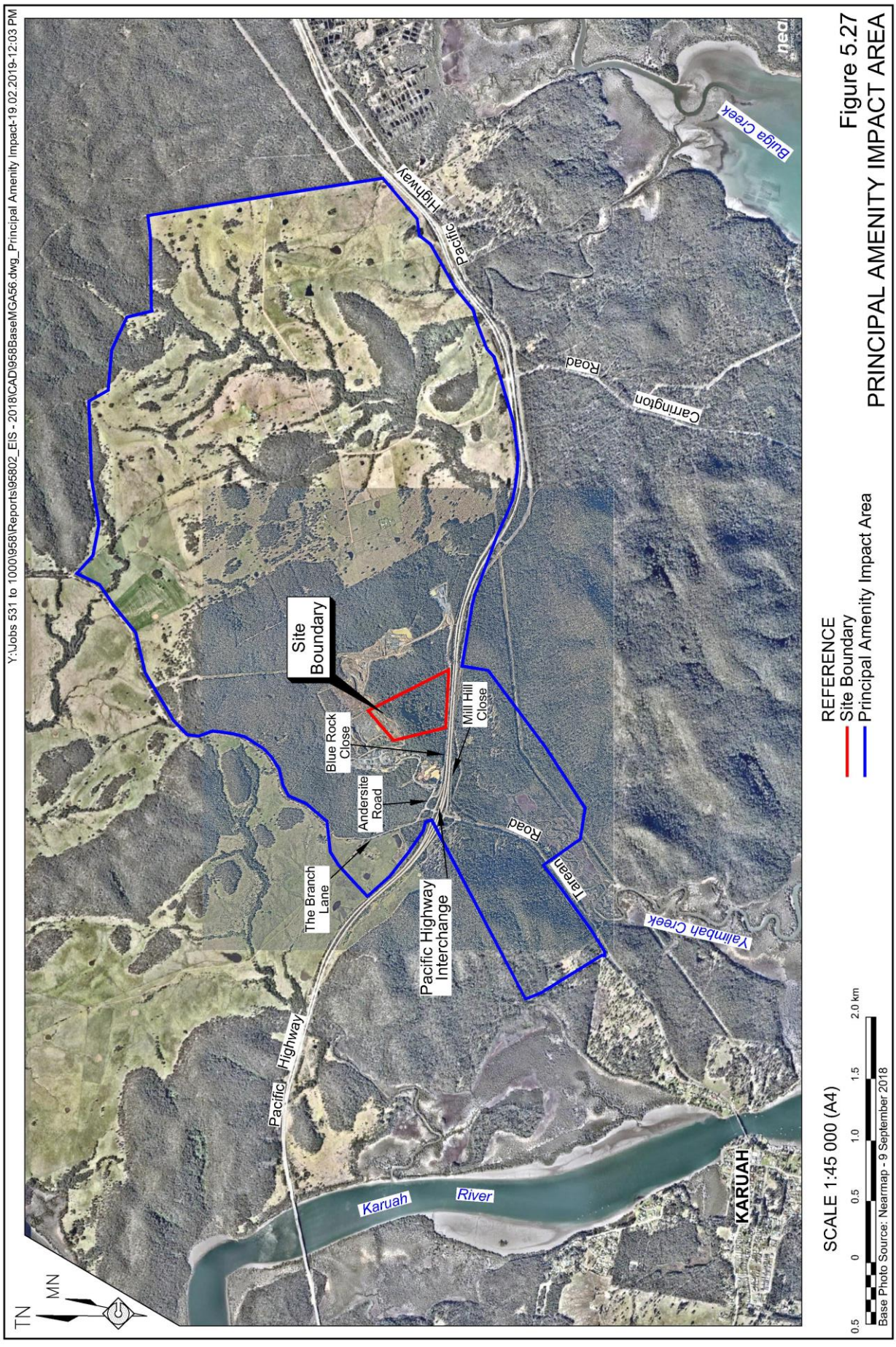
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Figure 5.27
PRINCIPAL AMENITY IMPACT AREA
Site Boundary
Blue Rock Close
Andersite Road
Mill Hill Close
The Branch Lane
Pacific Highway Interchange
Pacific Highway
Karuah River
KARUAH
Buiga Creek
Carrington Road
Taree Road
Yalimbah Creek
REFERENCE
Site Boundary
Principal Amenity Impact Area
SCALE 1:45 000 (A4)
0.5 0 0.5 1.0 1.5 2.0 km
Base Photo Source: Nearmap - 9 September 2018
TN
MN

### 5.13.3.4 Regional Governance

The Site is located within the Hunter Region which is one of the most recognised regional communities in Australia. The Hunter Region is centred on the port city of Newcastle and includes an area as far west as the towns of Scone and Muswellbrook and Taree in the north. The economy of the Hunter Region is diverse and relies on its natural resources both from a mineral, agricultural and biodiversity perspective. The *Hunter Regional Plan 2036* identifies the natural environment and diverse agricultural base as key features of the Port Stephens and MidCoast areas. The importance of nature-based tourism is recognised for the MidCoast area. The sensitivity of water catchments for local oyster farming is also acknowledged. The proximity of the Site to mining areas in the Hunter Valley (particularly coal mining operations) has raised community awareness and objection to mining developments, typified in the establishment of the Ironstone Community Action Group who has expressed an interest in the proposed Karuah South Quarry.

### 5.13.3.5 Local Governance

#### MidCoast Local Government Area

The Site is located within the MidCoast LGA. The MidCoast Council was formed in May 2016 through the amalgamation of the former Great Lakes, Gloucester Shire and Greater Taree Councils. The MidCoast LGA has a population of approximately 92 000 people (as of the 2016 Census) and features 196km of coastline. The coastline is an important feature of the LGA with this natural feature attracting tourists, providing employment and natural resources important to the community.

#### Karuah and the Port Stephens Local Government Area

The closest populated area to the Site is the township of Karuah which is located within the Port Stephens LGA. The social area of influence therefore incorporates a portion of the Port Stephens LGA. The Port Stephens LGA includes the town of Raymond Terrace and the area along the coast directly north of Newcastle to Nelsons Bay and inland to Duns Creek.

The *Karuah Growth Strategy 2011* identifies the importance of the township as a source of employment, goods and services and for residents to meet and socialise. The viability of businesses in the township centre is therefore vital to the survival of the broader community with residents also travelling to larger centres such as Raymond Terrace for groceries and other goods and services. It is also noted that environmental constraints including nearby national parks, reserves and wetlands will limit growth of Karuah, but that preservation of these features may attract tourist activities.

A total of 595 lots have been identified for future land supply for housing in Karuah, which aligns with Port Stephens Council's projected demand for an increase of 1 094 residents by 2036. The lots are expected to be developed as detached houses. Progressive release of housing land would support the strategy of progressive residential growth supported by a prosperous township centre and tourism development.

### 5.13.4 Existing Demographic Profile

In order to gain an appreciation for the structure of the local community and surrounding district, the SIA (RWC, 2019b) presents a detailed analysis of the existing demographic profile within the Karuah SSC and MidCoast LGA. The key trends identified in this analysis are summarised below.

- The population within the Karuah SSC is growing organically, but at a slower rate than the NSW average.
- A relatively high proportion of the community in the Karuah SSC identify as Aboriginal or Torres Strait Islander. This is related to the historic presence of the Karuah Aboriginal Mission in the area.
- There is a relatively high proportion of people in older age demographic groups in both the Karuah SSC and the MidCoast LGA. Connected to this is a relatively high proportion of couples living without children and relatively low presence of couples living with children. This is indicative of a "sea change" or retiree population and the lack of direct opportunities for education and employment that see the younger population leave the area. Consistent with other regional areas, these people often return later in life to enjoy the natural and quieter way of life.
- The population in the Karuah SSC work predominantly in construction, health care and manufacturing which also feature in the MidCoast LGA. This is indicative of a population that drive to their place of work in larger urban areas but choose to live in the Karuah region and accept the commute to work to do this.
- Tourism in the Hunter and NSW North Coast is growing, particularly for the domestic market. This is consistent with feedback from the local community and MidCoast Council representatives who indicated that tourism is an important economic drawcard for the area.
- Residents in the Karuah SSC and the MidCoast LGA on average earn less than the general NSW population but also pay less for mortgages and rentals.
- People within the Karuah SSC often need to travel to other areas to access community infrastructure services such as child care, secondary school and specialist health care. There is ready access to general practice medical service and pharmacies in the area.
- Leisure and recreational activities focus on the proximity to the Karuah River which is also important for oyster farming.
- The data collected for the ABS review of the Socio-economic Indexes for Areas (SEIFA) indicates that the Karuah area is more relatively disadvantaged, and have a relatively lower access to resources, education and employment opportunities than other regions in Australia. This is a relative measure though and does not indicate decline or specific conclusions about the area.

### 5.13.5 Issues Identified in Stakeholder Consultation

Section 3.2 provides a summary of the consultation undertaken with government, industry, local community and Aboriginal stakeholders. Stakeholder engagement for the Social Impact Assessment involved the following methods.

- Direct consultation with Council representatives, local businesses in Karuah and community members through phone, email and one-on-one consultation.
- Community information sessions.
- Information provision through flyers and project summary information.
- Review of formal community submissions.

Through stakeholder engagement a range of potential impacts were identified which included the following.

- Social amenity impacts from noise, dust, water management and the visibility of operations.
- Changes to way of life through how people experience their homes
- Access to public and private infrastructure
- The potential for a decrease in property value
- Impacts to the natural environment.
- Local culture and heritage
- Impacts to decision making systems, particularly the ability of the community to influence matters that impact them.
- Fears and aspirations for how the operations would impact their lives in the future.
- Changes to the local sense and experience of community
- Changes to individual or collective sense of place
- Health and wellbeing

### 5.13.6 Assessment of Social Impacts

The outcomes of the scoping assessment, review of existing socio-economic context and the outcomes of community engagement have been used to inform the evaluation of potential social impacts. Potential impacts were evaluated taking into account the current perception of impacts from the local community and the unmitigated Project outcomes. Impacts were evaluated in terms of the extent, duration, severity and sensitivity of each impact to affected stakeholder groups and at different periods throughout the life of the Project.

Each of the potential impacts was further assessed through a social risk review that considered the potential impact in terms of the social risk consequences and the likelihood of occurrence against a social risk matrix developed in accordance with the Australian Standards for risk analysis (AS/NZS ISO 31000:2009). The risk outcomes were considered in terms of the mitigated risk assessed for the Project and the community expectations of risk outcomes. The social risk review is presented in detail in Section 5.2 of the SIA.

**Table 5.21** presents a summary of the mitigated risk outcomes identified through the SIA and the risk outcomes expected by the community. Discussion of the relevant management or mitigation measures and discussion relating to both outcomes is also provided.

**Table 5.21**
**Summary of Social Risk Outcomes and Mitigation**



| Potential Impact of Risk | Mitigated Risk Outcome | Community Expected Risk Outcome | Mitigation / Discussion |
|---|---|---|---|
| Social amenity | Medium (2D) | High (3B) | Dust and noise generation would be reduced and residual impacts mitigated through a range of measures described in Section 6. In addition, potential impacts to water resources would be minor assuming a range of erosion and sediment controls and water management. Potential visual impacts would be managed and reduced to glimpses of quarry faces during the later stages of the operation once revegetation is well established in visible areas. A plan for rehabilitation of the Site has been proposed to ensure the operation has a positive legacy.<br>The community's lack of trust in quarry operators and regulators will require that amenity impacts are monitored and regularly reported to the community in a manner that is meaningful and easy to understand.<br>Monitoring activities should, where feasible, be done on the basis of trying to understand the cumulative impacts of operations in the area.<br>Demonstrations of operations and management would improve community familiarity with the processes involved in operating a quarry. This will occur through a Community Consultative Committee, regular reporting on monitoring outcomes, Annual Reporting on operations and environmental management and community open day visits to the Site. |
| Way of Life | Medium (2D) | High (3C) | Reported impacts to the community's way of life would be largely resolved through greater confidence and trust in the operators and improved experiences and accountability. As a result, the proposed mitigation, monitoring and reporting as well as creating a loop of feedback and accountability through the annual community meetings is expected to assist in resolving these issues. |
| Access to public and private infrastructure | Low (2E) | Low (2E) | A Drivers Code of Conduct would be implemented to direct and manage driver behaviour on public roads. This code of conduct will make it clear to that unacceptable behaviour will be subject to disciplinary action and possible employment termination. |
| Property Value | Low (2E) | Medium (2C) | Community concerns regarding property value are expected to be resolved through the ongoing management of amenity impacts and communication of these actions to those residents in the Principal Amenity Impact Area. |
| Sense of Community | Low (2E) | Low (2E) | It is not expected that the community interactions, community cohesion or the benefits of community would change under the Proposal. |

**Table 5.21 (Cont'd)**
**Summary of Social Risk Outcomes and Mitigation**



| Potential Impact of Risk | Mitigated Risk Outcome | Community Expected Risk Outcome | Mitigation / Discussion |
|---|---|---|---|
| Sense of Place | Low (2E) | High (4C) | Where the community sense of place is influenced by social amenity outcomes, these are expected to be resolved through ongoing management.<br>Feedback on community sense of place would be recorded during the annual community meetings. |
| Health and Well Being | Low (1E) | Medium (2C) | Community concerns regarding health and wellbeing are expected to be resolved through the ongoing management of amenity impacts and communication of these actions to the community. |
| Natural Environment | Medium (2D) | High (3C) | A range of mitigation and management measures are proposed to avoid, reduce or mitigate impacts to the surrounding including the natural environment.<br>Reporting on these measures would be presented in the Annual Review and at the annual community meetings. |
| Fears and Aspirations | Medium (2D) | Very High (4B) | The existing community fears and concerns regarding the future would be mitigated and to the greatest extent resolved through satisfaction of amenity-based criteria and reporting of these outcomes.<br>Feedback and progress on these concerns would be recorded during the annual community meetings. |
| Decision-making Systems | Medium (2D) | Very High (4B) | The inclusion of annual community meetings are intended to provide the community with a feedback mechanism for impacts being experienced. This would provide the community with greater involvement in the Project and the outcome of environmental management. |
| Culture and Heritage | Low | Low | No social mitigation is proposed for this potential impact. Management of matters of Aboriginal cultural heritage are discussed in Section 5.8 including protocols for the identification of unexpected artefacts or sites. |

The existing social impacts experienced by the community influence the potential for and expectation of cumulative social impacts. The potential amenity impacts of the Project have been the subject of comprehensive technical review that predicts that all quarry operations (including the Project) would operate within acceptable criteria established in NSW guidelines and legislation. Residual social impacts are predicted to occur as a result to changes to local amenity which may influence the existing way of life for some stakeholders. In addition, the community values the local environmental features of the area and impacts to these natural resources has social consequences. Community fears about the operations are likely to remain in the short term.

### 5.13.7 Management and Mitigation Measures

A range of standard social mitigation and ongoing community engagement activities would be implemented for the Project to address potential residual social impacts including the following.

- Establish and support a Community Consultative Committee with meetings to be held twice a year. If supported by Hunter Quarries, one of the meetings of the committee each year would be held in conjunction with the CCC meeting for the Hunter Quarries operations. It would be important that the CCC includes people living within the Principal Amenity Impact Area.
- A complaints management protocol would be established so that complaints are recorded, addressed by the appropriate person and feedback provided to the complainant in a timely manner.
- A Community and Stakeholder Engagement Plan would be developed in consultation with the local community and would describe ongoing consultation commitments.
- A notification register would be established with community members able to register for blast notifications, Project updates and community open days.
- A Drivers Code of Conduct would be developed and implemented to guide driver behaviour.
- Support for community organisations, groups and events would occur on a case by case basis.

Mitigation and management measures in addition to those proposed to mitigate the environmental impacts of the operation and the standard mitigation measures described above include the following.

- A range of social performance criteria would be established in a Community and Stakeholder Engagement Plan and performance against these criteria would be reported in each Annual Review. These criteria would include but not be limited to the following.
  - The number and nature of complaints received.
  - The number of employees and, where appropriate, the number of employees living locally.
  - Compliance with criteria relating to social amenity.
  - The number of traffic incidents or near misses.
  - An overview of community engagement activities undertaken throughout the year including open days or other opportunities to familiarise the community with operations.
- For the first two years of operations, the outcomes of the Annual Review, including environmental management, water management, rehabilitation progress and the social performance of the operation would be presented at a community meeting.

The meeting would provide an opportunity for the community to provide feedback on the activities over the year and the community experience of the operation. This would be an opportunity for direct discussion of the potential conflict between operating expectations and the community expectations. The Annual Review is reviewed and approved by the compliance division of the Department of Planning and Environment and therefore community concerns would be made available to the regulator through this process.

After the first two years of meetings, the activity would be re-evaluated with the local community.

### 5.13.8 Conclusion

The Social Impact Assessment (RWC, 2019b) has identified that the community, particularly within the Principal Amenity Impact Area, currently experiences negative social impacts from the existing quarries in the area. The impacts principally relate to amenity in the local community. In addition, the lack of confidence in the operators and in regulators to effectively manage the operations has created concern for the potential future impacts.

Existing impacts are influencing the community's expectations of the Project and concerns about the appropriate management of the operation are extended to the Applicant. The community expects that the Project would prolong or exacerbate existing impacts, while the location of the Project adjacent to the Pacific Highway has raised concerns for blasting and other impacts.

Careful consideration of the community concerns has been undertaken. However, reporting on the operations of the Karuah East Quarry indicates that the operation is satisfying all relevant assessment criteria. The technical assessments for the Project have taken into account the feedback from the community, have characterised the local environment and made conservative predictions of potential impacts. The results indicate that cumulative residual amenity impacts would be acceptable. Other potential residual social impacts that have been identified relate closely to these amenity outcomes.

In order to resolve the identified conflict between community expectations and predicted operations, a range of mechanisms have been proposed to present information to the community on an ongoing basis and to gather feedback annually for presentation in reporting to regulators. Assuming that this process is successful in alleviating community concerns, the Project would operate with only minor additional social impacts and with acceptable cumulative social impacts. Where community concerns may remain, mechanisms would be established to incorporate this feedback into adaptive management of the operation. This would benefit the social outcomes of both the existing operations and the Project.

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