Figure index

Appendices

1. Introduction

1.1 Overview

A Environmental Impact Statement (EIS) is being prepared by GHD Pty Ltd (GHD) to assess the significance of the potential environmental impacts associated with the establishment of Wattle Vale Quarry. The EIS has been undertaken in accordance with the *Environmental Planning and Assessment Act* 1979 (EP&A Act) and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation). The proposal is being determined under Part 4 of the EP&A Act.

This air quality assessment has been prepared as a supporting document to the EIS. It assesses the potential for impacts on the environmental value of the air environment – principally dust impacts from particulate matter (PM). This is achieved with a Level 2 assessment with consideration of the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (Approved Methods).

1.2 The proposal

Glen Innes Severn Council (Council) proposes to construct and operate a new hard rock quarry to extract up to 300,000 tonnes per year from part of one extraction area, with a total disturbance footprint of 8 hectares (the Project). The quarry will predominately supply materials for use in public road construction and maintenance but will also provide a resource as required for the construction of nearby wind farm

The Project is proposed to be established on the Wattle Vale property, which is owned by Council and is approximately 200 hectares in size, located 13 km west of Glen Innes (the Project site) (see Figure 1-1).

The Project involves the construction and operation of a hard rock quarry within the Project site at one location south of the Gwydir Highway (see Figure 1-22). The Project would involve a potential extraction rate of up to 300,000 tonnes per year of rock and would have an estimated total reserve of 2.1 million tonnes.

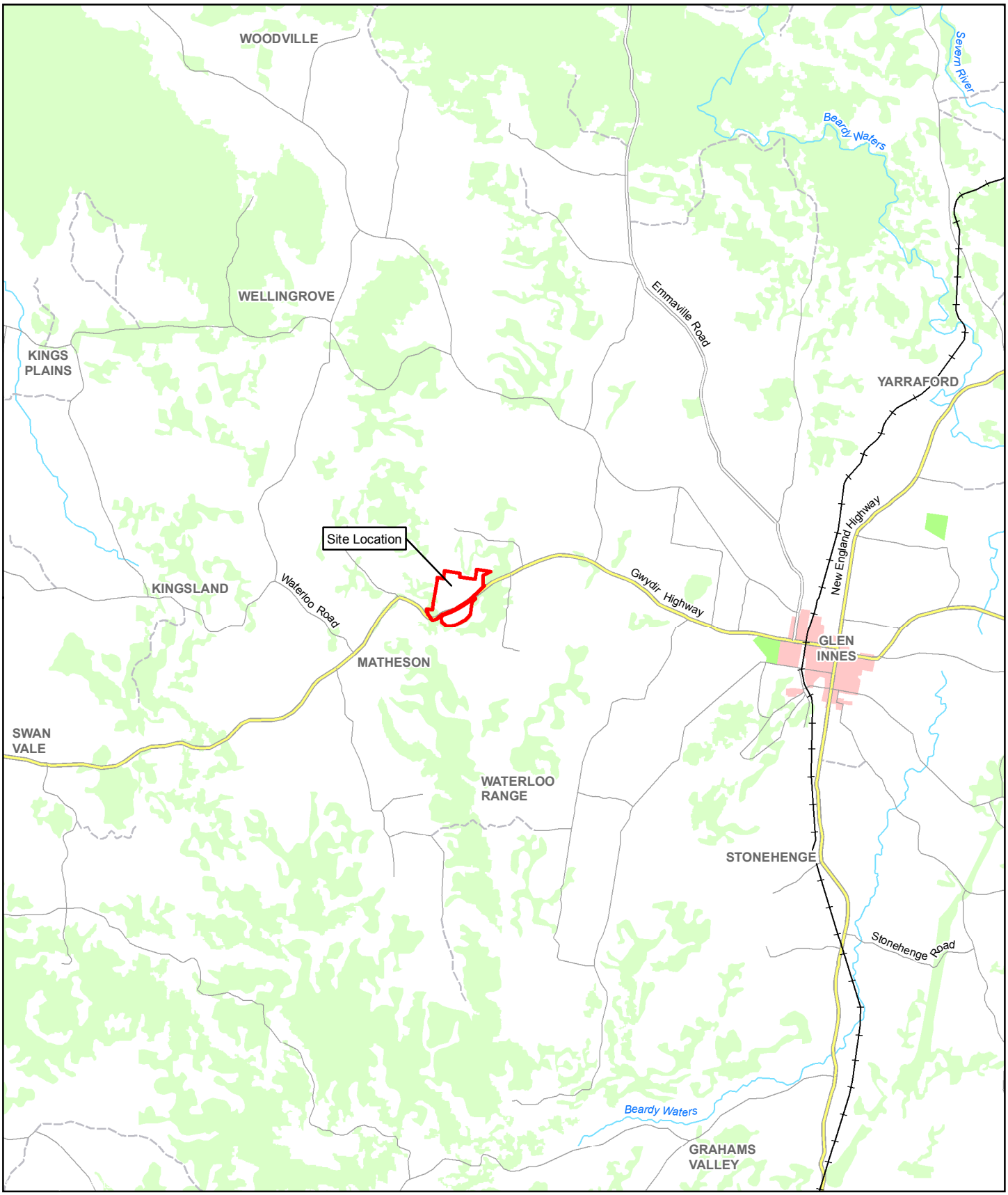
Key activities to be undertaken as part of the Project include:

- Progressive installation of environmental controls including erosion and sediment control measures.
- Construction of the intersection with the highway and signage.
- Construction of fencing.
- Delineation of the site and stockpiling areas.
- Vegetation clearance, soil stripping and stockpiling.
- Construction of temporary drainage controls.
- Expanded quarry operations.
- Establish site office and weighbridge.
- Close and rehabilitate the quarry.

All of the land required for the Project is owned by Council. The Project site is identified as Lots 249, 174, 253, 101, 175, 87 and 113 of DP 753319. The Project site has been used predominately for sheep farming and therefore already cleared land.

The Project would fulfil an anticipated short and medium term demand for aggregate products for the construction of major wind farm projects in the region. In the longer term, the Project will provide a supply of aggregate products to the Glen Innes district to replace the existing quarry east of Glen Innes which has less than 10 years' capacity remaining.

Council is seeking Development Consent for the Project under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), which shall be supported by this EIS.



LEGEND

- Principal Road
- Secondary Road
- Minor Road
- Track
- Railway
- Watercourse
- Built Up Area
- Recreation Area
- Forest Or Shrub
- Project boundary

Paper Size A4

0 0.75 1.5 3 4.5 6

Kilometres

Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxiliary Sphere

N

GHD

Glen Innes Severn Shire Council
Wattle Vale Quarry
Preliminary Environment Assessment

Job Number	22-18380
Revision	0
Date	17 Jun 2016

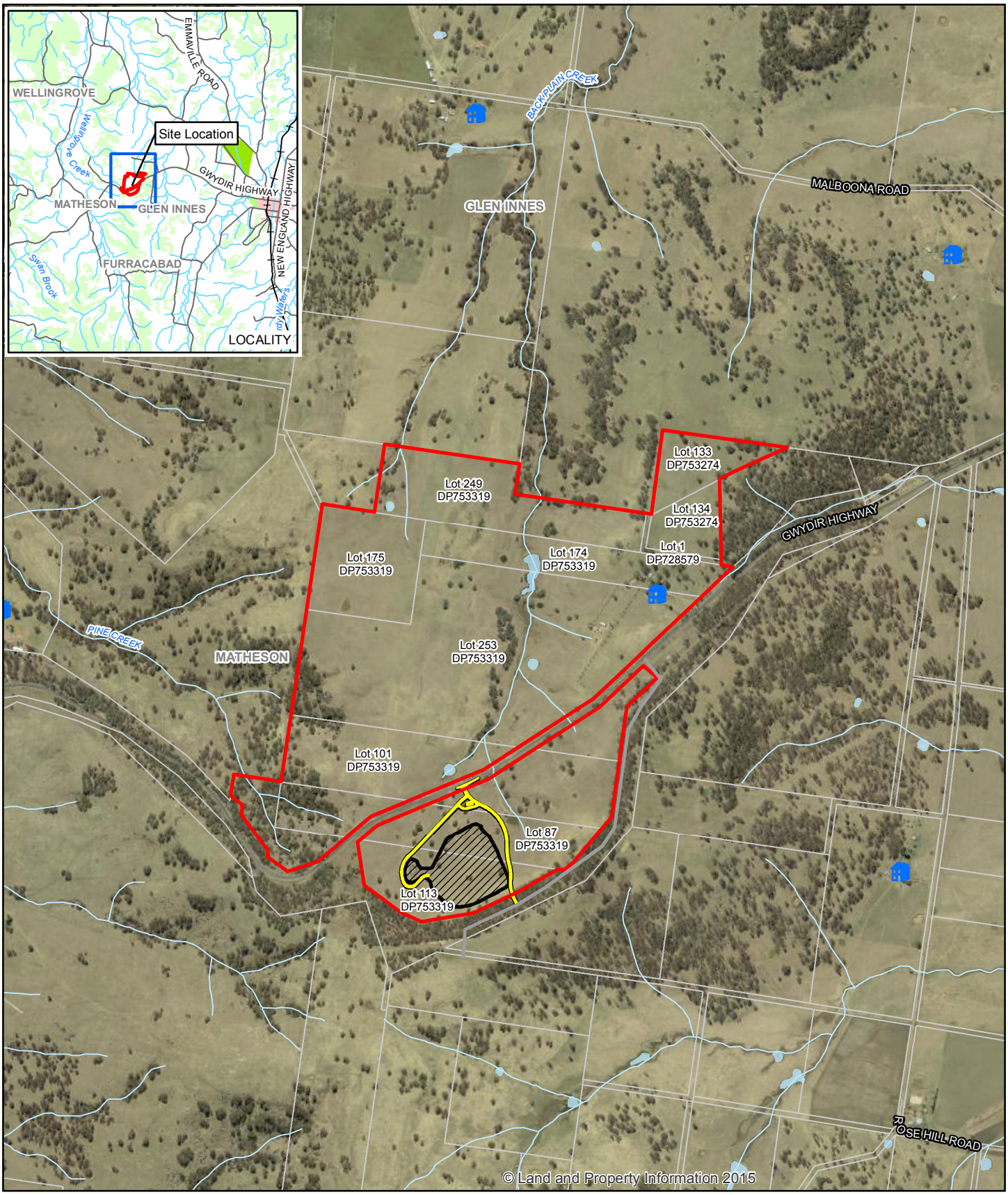
Site location

Figure 1-1

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18380\GIS\Maps\Deliverables\PEA\2218380_PEA001_SiteLocality_0.mxd

Data source: Geoscience Australia: 250k Topographic Data Series 3, 2006. Created by: fmackay



LEGEND

- Project boundary
- Cadastre
- Watercourse
- Waterbody
- Disturbance area
- Site access
- Existing access
- Residences

Paper Size A4

0 80 160 320 480 640

Metres

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

N

Glen Innes Severn Council
Wattle Vale Quarry
Environmental Impact Statement

Job Number 22-18380
Revision A
Date 14 Nov 2016

Site overview

Figure 1-2

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18380\GIS\Maps\Deliverables\SouthernQuarryEIS\2218380_SQEIS002_SiteOverview_A.mxd

Data source: LPI: DCDB & DTDB, 2012,Aerial Imagery, 2016; Geoscience Australia: 250k Topographic Data Series 3, 2006; GISSC: Quarry data, 2016. Created by: fmackay

1.2.1 Proposed extraction method

Initial geological estimates indicate that approximately less than five million tonnes of material have the potential to be extracted from the Project site. The Project has access to a resource of about 2.1 million tonnes. The actual extraction rate per annum will be dictated by demand requirements, however will not exceed 300,000 tonnes in any twelve month period.

The maximum extraction rate of 300,000 tonnes per annum has been selected to allow sufficient capacity to service demand during the construction of the proposed wind farms in the area. Once the wind farms have been constructed, it is anticipated the extraction rate would reduce to less than 100,000 tonnes per annum.

The maximum daily extraction and haul rate would be about 3,000 tonnes but this extraction rate would be rare. Based on the assessment of the underpinning demand and after allowing for downtime from wet weather and breakdowns, it is anticipated that the quarry would operate for around 40 weeks a year.

Extraction will extend to a depth of 1,160m AHD.

1.2.2 Hours of operation

As the demand for product from the site will vary depending on the progress of certain major projects and fluctuating market conditions, it is not possible to put firm durations on each stage of activity. However, the quarry is expected to commence operation in late 2016 and be in operation for at least 30 years.

Operations would generally be limited to the following times:

- Monday to Friday: 7.00 am to 5.00 pm
- Saturday: 8.00 am to 4.00 pm
- No work on Sundays or public holidays

1.2.3 Dust suppression

During dry conditions, it is proposed to control dust from exposed area by water being sprayed from a water cart as required.

1.2.4 Access roads

Access to the Project from the Gwydir Highway will most likely include a 6 m wide unsealed access road with basic right and left hand turn (BAL/BAR) junctions onto the Gwydir Highway.

1.2.5 Rehabilitation

Following completion of quarrying, areas that are no longer in use will be landscaped and progressively rehabilitated. Rehabilitation will generally involve:

- Removal of all structures, equipment and other materials from the works area.
- Earthworks and landscaping to reform the land to maximum 3:1 batter slopes:
  - The base of the southern pit will be landscaped to a 0.5% grade to allow free drainage to a small existing farm dam to the west which will act as a sediment basin.
  - The base of the northern pit will be landscaped to a 0.5% grade to allow free drainage to a small existing farm dam to the east will act as a sediment basin.
- Revegetation will use native species to match existing conditions.
- Erosion and sedimentation control would remain in place until the site is appropriately reinstated and revegetated.

- Following consultation with the owner of the surrounding land, access roads may be retained for future uses.

1.3 Purpose of this report

This air quality impact assessment, has the following scope of works which can be considered for the EIS and summary chapter on air quality impacts:

- Review of existing environmental studies, as applicable, in particular information such as sensitive receptors, site location, access roads, prevailing meteorology etc.
- Derive an emission inventory for the proposed quarry with which to identify significant sources of air pollution, the type of air pollutants emitted from each source and an estimation of the emission rate of these pollutants. Emission rates will be characterised using emission factors published in the National Pollutant Inventory (NPI) *Emission Estimation Technique Manual (EETM) for Mining V 3.1*. The focus of this air quality impact assessment would be on potential impact from particulate (dust) emissions, in particular; total suspended particulates (TSP), fine particulates less than 10 micrometres in equivalent aerodynamic diameter PM_{10} and dust deposition.
- Undertake one dust modelling scenario using the regulatory atmospheric dispersion model AUSPLUME. Model predictions to be presented as contours of predicted ground level particulate concentrations and deposition rates, which are then overlaid upon an aerial photograph or cadastral image. These results are also used to determine the extent, if any, of the predicted impact on the surrounding environment and sensitive residences.
- Recommend in-principle mitigation and management measures to reduce dust impacts and, if warranted, recommend air quality monitoring programmes. If large exceedances are predicted, a second dispersion model incorporating dust mitigation measures to reduce impacts to compliance levels will be undertaken. Given the greater than 500 m distances involved (source to receptor) this is expected to be unlikely.
- Prepare this *Air Quality Impact Assessment* report to be appended to the EIS, with consideration to the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DECC, 2005) detailing the findings of the above.

1.4 Limitations

This report has been prepared by GHD for Glen Innes Severn Council and may only be used and relied on by Glen Innes Severn Council for the purpose agreed between GHD and Glen Innes Severn Council as set out in Section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Glen Innes Severn Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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

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

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer Section 1.4 and 1.6 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Glen Innes Severn Council and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.5 Definitions

For the purposes of this assessment, the following definitions are employed:

- **Proposal –** the proposed quarry establishment and associated works, as described in Section 1.2 and the main EIS document
- **Study area** – includes the entirety of Lots 249, 174, 253, 101, 175, 87 and 113 of DP 753319., which comprise the property on which the quarry is situated
- **Subject site** - is the area to be directly affected by the proposed works as described above. It encompasses the area shown in Figure 1-22 (red line of Project boundary)
- **Locality** – the area within a 10 km radius of the proposal

1.6 Assumptions

The primary source of air emissions from quarry operations is expected to be dust as particulate matter. Due to the location of the receptors around the site, it is expected that a quantitative dust assessment only is sufficient to define the air quality impact.

The prevailing meteorology at the site can be considered as site representative with use of the automatic weather station (AWS) operated by the Bureau of Meteorology at the Glenn Innes Airport – approximately 9 km to the north-east.

2. Legislative context

2.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) forms the legal and policy platform for proposal assessment and approval in NSW and aims to 'encourage the proper management, development and conservation of natural and artificial resources'. All development in NSW is assessed in accordance with the provisions of the EP&A Act and EP&A Regulation 2000. The proposal will be assessed under Part 4 of the EP&A Act with Glen Innes Severn Council as the determining authority.

2.2 Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales

The *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* set assessment criteria for emissions of air pollutants from 'stationary sources'. These are referred to in the *Protection of the Environment Operations (Clean Air) Regulation 2010* as Part 5: Emission of Air Impurities from Activities and Plant. A quarry can be considered both 'stationary' and an 'activity' – see Table 2-1.

Table 2-1 POEO Act Shedule 1, Part 1 Premises based activities

Clause	Activity	Threshold criteria
16 Crushing, grinding or separating	The processing of materials, including sand, gravel, rock or minerals, but not including waste of any description.	Capacity to process more than; 150 tonnes of material per day or 30,000 tonnes of material per year.
19 Extractive activity	Land based extractive activity. Extraction, processing or storage of extractive materials, either for sale or re-use, by means of excavation, blasting, tunnelling, quarrying or other such land-based methods.	Extraction, processing or storage of more than 30,000 tonnes per year of clay, sand, soil, stone, gravel, rock, sandstone or similar substances.

Source: Protection of the Environment Operations Act 1997 No 156 – NSW Legislation, current version of 1 June 2016 to date, accessed 28 July 2016 at 10:35.

Particulate matter (PM) is the most relevant emission from an extractive activity that needs to be assessed with the *Approved Methods*. Gaseous emissions from the exhausts of mobile plant are also involved but these are dispersed, intermittent and of a low enough initial concentration so as to be easily negligible within a few metres of the various sources. Table 2-22 provides the dust and particulate matter assessment criteria from the *Approved Methods*.

Table 2-2 Approved Methods impact assessment criteria

Pollutant	Averaging period	Threshold concentration
PM_{10}	24-hours Annual	50 µg/m^3 30 µg/m^3
Total suspended particulates (TSP)	Annual	90 µg/m^3
Deposited dust (insoluble solids)	Annual – maximum increase (above 'background') Annual – maximum total	2 g/m^2/month 4 g/m^2/month

Source: Table 7.1 of *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (New South Wales Government Gazette of 26 August 2005).

3. Existing environment

3.1 Site description

The Project site is approximately 200 hectares in area and sits on undulating pasture land on the edge of the Waterloo range, a low lying north-south belt of hills to the west of Glen Innes (see Figure 1-1). The total disturbance area of the quarry is 8 hectares which includes an extraction area of approximately 6 hectares.

The surrounding area is relatively sparsely populated. The closest residence lies approximately 1200 m to the east of the Project site.

The nearest population centre to the Project site is Glen Innes which is located approximately 13 km to the east. Other residences and settlements in the vicinity of the Project site include:

- A small hamlet 1.3 km to the north of the Project site on Malboona Road
- Individual farm properties:
  - 1.7 km west at the entrance to Pitlochry Road
  - 1.5 km east Rose Hill Road
  - 2 km north-east on Malboona Road
  - 2.3 km east of on the Gwydir Highway

The proposed Glen Innes Wind Farm is located to the immediate south of the Project site. The wind farm has a current project approval for the construction and operation of up to 25 wind turbines each with a potential capacity of 3 Megawatts (MW), to produce enough energy to power approximately 47,000 homes (One Wind, 2016). The wind farm is currently moving into the construction phase.

The Director-Generals requirements (DGR's) for the OneWind Australia Glen Innes Wind Farm did not require consideration of dust or air quality. However, the larger proposed and approved Sapphire Wind Farm[1] just to the west did require air quality considerations in the DGR's. However, the SLR specialist report did not consider background levels of ambient dust or climatic conditions[2].

White Rock Wind Farm[3] also did not have air quality in the DGR's.

Various sensitive receptor locations as isolated rural residences have been identified within a few kilometres of the operating pits. These residential locations are identified in Table 3-13.

[1] http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=3245 – Appendix 22
[2] ttps://majorprojects.affinitylive.com/public/84a2085983ce18b6e66bb9ed014200b0/Appendix_22_Air_Quality_Assessment_EX_WEB.pdf
[3] http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=3963

Table 3-1 Sensitive receptor loacations nearby the site

Identifier	Easting (MGA56 m)	Northing (MGA56 m)	Comment
R1	363543	6711686	Isolated rural residence beyond the site boundary
R2	366962	6710690	Isolated rural residence beyond the site boundary
R3	367161	6713036	Isolated rural residence beyond the site boundary
R4	367824	6712406	Isolated rural residence beyond the site boundary
R5	365349	6713572	Isolated rural residence beyond the site boundary
R6	366036	6711745	Council owned residence within the site boundary

3.2 Climate

3.2.1 Rainfall

Rain can act as a natural dust suppressant and thereby affect the emission of particulate matter from stockpiles and other unconsolidated surfaces. The annual rainfall and the number of rain days is used in some elements of the emission inventory (see Section 4). The Glen Innes Agricultural Research Station (BoM site number: 056013) on the Strathbogie Road is slightly closer to the quarry site than the automatic weather station (AWS) at the airport. Moreover, it has a longer climatic record.

Table 3-24 shows that rainfall is both more frequent (more rain days) and heavier (higher monthly means) during the summer months compared to winter. Due to the elevation of the Northern Tablelands, mostly at or above 1000 m, the climate and temperature range can be considered to be ‘temperate’.

Table 3-2 Monthly climate statistics

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Rain (mm)	105.6	92.9	69.5	41.5	48.5	53.1	55.5	48.4	54.2	75.5	91.1	110.1	841.2
Mean number of days of rain ≥ 1 mm	8.9	7.9	6.1	4.9	5.1	6.1	6.5	6.0	5.7	7.2	8.3	9.7	82.4
Mean Max Temp (°C)	25.4	24.7	23.1	20.1	16.4	13.2	12.5	14.1	17.2	20.2	22.5	24.4	19.5
Mean Min Temp (°C)	13.5	13.3	11.5	8.0	4.5	1.9	0.7	1.2	4.1	7.2	10.0	12.1	7.3

Source: Bureau of Meteorology. http://www.bom.gov.au/climate/averages/tables/cw_056013.shtml.

3.2.2 Wind

The Glen Innes Airport AWS (BoM station 056243) has an automatic weather station (AWS) that records temperature and wind data. It also records cloud information after a ceilometer was installed on 19 May 2015. This data has been obtained from BoM and a year -long meteorological dataset compiled with hourly averages of temperature, wind speed, wind direction, atmospheric stability (derivation based on cloud, wind speed and time of day – the Turner Workbook approach) and a mechanical mixing height (using techniques from the *Approved Methods*). An annual wind rose is provided in Figure 3-1. The annual average wind speed is rather high at 4.1 m/s.

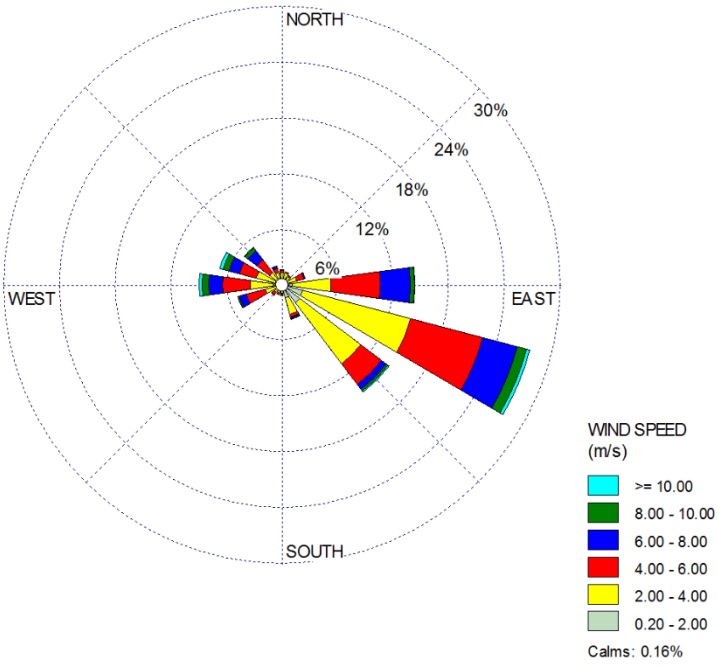


Figure 3-1 Annual wind rose

Atmospheric stability substantially affects the capacity of a pollutant such as particulate matter, to disperse into the surrounding atmosphere upon discharge and is a measure of the turbulent energy in the atmosphere. For a quarry, particulate emissions will have greatest impact downwind during stable conditions, reducing to a minimum impact during unstable conditions. The highest wind speeds have potential to create wind erosion sources but with more energy these winds have neutral stability and greater dispersive characteristics.

There are six Pasquill–Gifford classes (A-F) used to describe atmospheric stability and these classes are grouped into three general stability categories; stable (classes E-F), neutral (class D) and unstable (classes A-C). The climate parameters of wind speed, cloud cover and solar insolation are used to define the stability category and as these parameters vary diurnally, there is a corresponding variation in the occurrence of each stability category. Stability is most readily displayed by means of a stability rose plot, giving the frequency of winds from different directions for various stability classes A to F.

Figure 3-2 shows that stable winds (annually) are dominant from the south-east and (lesser) north-west quadrants and due to the highest frequency of winds from the east (in summer) and west-north-west (in winter) most of these stable flows occur from these directions.

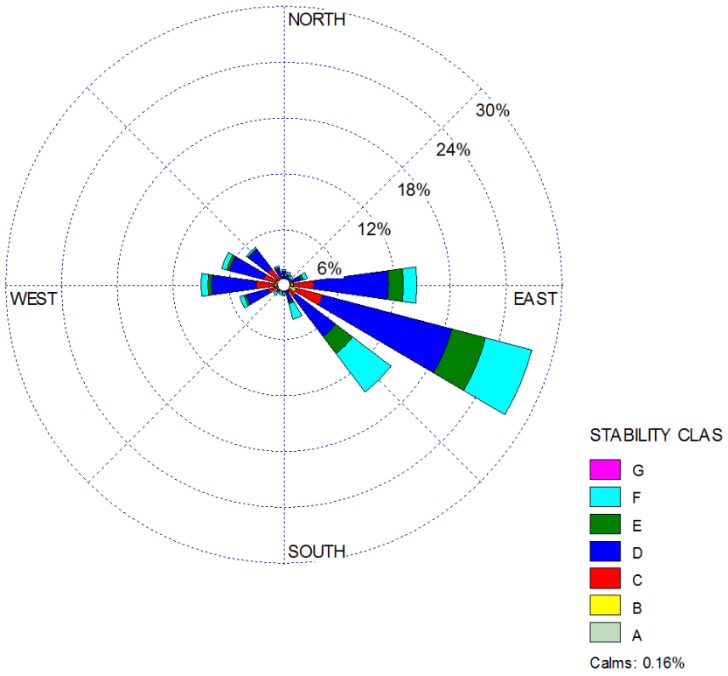


Figure 3-2 Annual atmospheric stability rose

3.3 Air quality

None of the recent environmental assessments for wind farms in the area were required to consider background levels of dust (either as in-air-concentrations or dust deposition). Therefore, default levels have been considered in this assessment. A rural background daily average for PM_{10} can be quantified at 15 µg/m^3. In the *Approved Methods*, deposited dust is required to not exceed 2 g/m^2/month above the background level (see Section 2.2 and Table 2-2), so this limit has been applied and only the incremental dust load is assessed.

4. Emission inventory

4.1 Typical quarry operations

The quarry operations would be carried out in stages and in response to demand.

Stripping would occur in stages prior to excavation, generally stripping each area immediately prior to quarrying. Overburden would either be stockpiled for future rehabilitation works, or placed in final location as voids are created. The total area of the quarry would be stripped with excavation continuing to establish a quarry face of about 7 metres. The base of the quarry would be at approximately 1,160 m Australian Height Datum (AHD).

The main activities during operation of the quarry are described below.

- Progressive installation of environmental controls including erosion and sediment control measures
- Construction of site access road
- Construction of fencing
- Delineation of the site and stockpiling areas
- Vegetation clearance, soil stripping and stockpiling
- Construction of temporary drainage controls
- Commence quarry operations
- Close and rehabilitate the quarry

4.2 Extraction rate

The Project will extract up to 120,000 m^3 (300,000 tonnes) of material per annum. The actual extraction rate per annum will be dictated by demand requirements, however extraction will not exceed 120,000 m^3 in any twelve-month period.

The maximum extraction rate of 120,000 m^3 per annum has been selected to allow sufficient capacity to service the initial demand during the construction of the proposed wind farms in the area.

The maximum daily extraction and haul rate would be about 3,000 tonnes.

4.3 Hours of operation

As the demand for product from the site will vary depending on the progress of certain major projects and fluctuating market conditions, it is not possible to put firm durations on each stage of activity. However, the quarry is expected to commence operation in late 2016 and be in operation for at least 30 years, although separate approval will be required to continue beyond the limits of this application.

Operations would generally be limited to the following times:

- Monday to Friday: 7.00 am to 5.00 pm
- Saturday: 8.00 am to 4.00 pm
- No work on Sundays or Public Holidays

Staff may arrive and leave site before and after these times to ‘start-up’ and ‘shut-down’ the quarry but excavation, crushing or loading would not occur outside the times specified above. Blasting would only occur on weekdays between the hours of 10 am and 3 pm.

4.4 Quarry equipment

Equipment at the quarry will depend on levels of activity which will vary from time to time. A description of the plant and equipment to be used is provided in Table 4-1. The frequency of use is relevant to the periods when the quarry is operating. As an example, when the quarry is operating, the crusher will be operating 100% of the time but when there is no demand for material, no works will occur at the quarry.

Table 4-1 Proposed quarry plant and equipment

Type	Approximate Number	Typical Frequency of use during operation	Description
Dozer	1	10%	Clearing and grubbing of vegetation and stripping of topsoil. Rehabilitation
Excavators	2	100%	Excavating material and stockpiling Clearing and grubbing of vegetation and stripping of topsoil
Screen	1	100%	Only for aggregate/gravel production and overburden screening
Front-end Loader	1	100%	Loading material onto the haul trucks and stockpiling material within the pit floor
Jaw, cone and impact crusher	1	100%	Crushing rock
Haul Trucks	Up to 100/day	100%	Delivery of materials to customers and stockpiling in pit if needed and carting unsuitable to rehabilitation areas.
Water Cart	1	10%	To water haul roads and stockpiles
Water Pump	3	10%	To dewater excavation/basin and to fill watercart from standpipe To water stockpiles and put moisture in products
Hand tools	5	5%	General activities maintaining plant
Light vehicles	Up to 12	20%	Transporting staff to, from and around site

4.5 Access and traffic generation

The majority of traffic to and from the quarry would access the site from the Gwydir Highway via a formed gravel access road that runs to the quarry pits. The layout of the quarry provides an access track from the Highway to the quarry. After loading and exit, all while travelling in a forward direction, trucks either return to the Highway or access the Wind Farm to the south (without Highway travel).

Truck and dog trailer combinations have a capacity of about 32 tonnes. At an average daily production, which would generate a win and haul rate of approximately 400 tonnes per day, the quarry is expected to generate about 14 truck and dog loads (28 movements) per day. At its peak, the quarry is expected to win and haul about 3,000 tonnes per day which could require 100[4] truck and dog loads (200 truck movements) per day. At other times there would be periods when no trucks would be generated by the quarry. 80% of movements during peak production will be for the Wind Farm without access to the Gwydir Highway. So a worst-case scenario is a peak day of 3,000 tonnes being hauled with 80 in and out movements to the south for the Wind Farm and 20 in and out movements to the Gwydir Highway to the east.

The quarry workforce is expected to generate about 16 light vehicle movements per day but with a potential peak of 40 trips per day with additional wind farm construction traffic.

4.6 Dust emissions

This air quality assessment focuses on dust, this being the primary emission to air from the quarry with potential for off-site impact. The particulate matter fractions of interest assessed in this report are airborne concentrations of total suspended particulate (TSP) and fine particulate matter (PM_{10}) as well as total deposited dust.

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

- Rock quarrying e.g. occasional blasting, excavation and bulldozing
- Material processing and handling e.g. crushing, screening and loading
- Vehicle induced dust emissions in pit area and haul road
- Wind erosion of exposed unstable soil surfaces and localised stockpiles

Emission rates from naturally wind borne dust and mechanically induced dust were characterised using emission factors (EFs) provided in the National Pollutant Inventory (NPI) *Emission Estimation Technique Manual (EETM) for Mining*[5]. The techniques used to estimate emissions from mining operations are based primarily on activity rate (e.g. tonnes per hour). The United States Environment Protection Agency Emission Factors and AP-42, *Compilation of Air Pollution Emission Factors* (AP-42) were also utilised, particularly for rock crushing, where they were deemed to be more applicable than the NPI emission factors, which are based on more general mining operations (involving coal and mine overburden).

The proposed maximum material throughput of up to 3,000 tonnes per day equates, on average, to 300 tonnes per hour (tph) over a 10-hour day. Although it is not expected that the quarry would operate at 300 tph consistently, this production rate has been chosen to represent a worst case scenario to derive emission rates.

[4] 100 trucks at 32 tonne/truck produces a higher haulage rate – but some trucks may be of lower capacity (without a dog) or higher truck numbers due to additional cartage from stockpiles.
[5] National Pollutant Inventory (NPI) *Emission Estimation Technique Manual for Mining,* Version 3.1.

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

- Truck and dog trailer combinations have a capacity of 32 tonnes. At the peak production rate of 3,000 tonnes per day, this equates to a conservatively higher 100 truckloads per day. As each haul truck would enter and exit the quarry, this equates to a maximum of 200 haul truck movements per day. Each haul truck was assumed to either travel each way to enter and leave the quarry from the Gwydir Highway at 1,350 m for the Quarry Pit or 495 m for southern access to the Wind Farm. 80% of truck movements on a peak day service the Wind Farm to the south. At the average production rate of 400 tonnes per day, 14 truckloads would be required per day. As this scenario is less than the peak capacity, it was not modelled
- The use of a water truck has been assumed not to generate dust emissions, as its use would act to suppress emissions. Therefore, the water truck has not been included in the emissions inventory
- It was assumed that all rock was processed to primary standard (i.e. 450 tph at peak production input to the crusher) and two thirds of this rock was then processed to secondary standard (i.e. 300 tph at peak production). The screening of overburden and aggregate/gravel was assumed to be the equivalent of tertiary crushing. The 300 tph post-secondary crushing was assumed
- Conservatively, wind erosion emission factors have been applied independent of wind speed. However, control factors for pit retention been applied (5% for PM_{10} and 50% for TSP)
- GHD has conservatively assumed that the entire quarry pit area consists of unconsolidated areas. Therefore, wind erosion was modelled as acting over the entire pit area. The pit has a 6.0 hectares footprint of disturbance
- Ad-hoc blasting activities would be an infrequent event at the proposed pits and as a result have not been included in the dispersion modelling assessment. Blasting events have not been modelled. The drilling activity for each blast event has also not been included as each blast event will be a 30,000 tonne activity – so no more than 2 drilling/blasting events per year

Table 4-2 summarises the emission factors adopted and calculated emission rates for each item of equipment and activity within each of the two pit scenarios. Emission calculations have been supplied for:

- Peak production rate of 300 tph
- Pit disturbance area of 6.0 hectares
- Total haul of 1350 m for highway access and alternative 495 m for Wind Farm access

Table 4-2 Dust emission inventory – Peak production 300 tph

Equipment	TSP emission factor	PM_{10} emission factor	Unit	Application / assumptions	Estimate of TSP emission rate (kg/hr)		Estimate of PM_{10} emission rate (kg/hr)	
					No controls	With controls	No controls	With controls
Excavator	0.00097	0.00046	kg/t	Two excavators, handling 450 tph. Excavating material and/or loading material into crushing plant. No control. ER per excavator.	0.44	0.44	0.21	0.21
Loader[3]	0.00097	0.00046	kg/t	One front end loader, handling 300 tph. Loading material into haul trucks. 50% control applied when water sprays are used on crushers and stockpiles are watered[4].	0.29	0.15	0.14	0.07
Crusher – Primary	0.0167	0.00605	kg/t	450 tph. Controls applied for water sprays: • EF(TSP) = 0.00177 • EF(PM_{10}) = 0.000663	7.52	0.80	2.72	0.30
Crusher – Secondary	0.0167	0.00605	kg/t	2/3 of product crushed to secondary. Therefore, 300 tonnes per hour crushed. Control for watering as per primary crusher.	5.01	0.531	1.82	0.199
Screening	0.0167	0.00605	kg/t	Tertiary crushing; post-secondary at 300 tph. Control for watering as per primary crusher.	5.01	0.53	1.82	0.20
Haul trucks – Wind Farm (unpaved roads)	2.31	0.71	kg/VKT[5]	Maximum 100 trucks per day (200 movements). Haul route 1380 m. 80% split. Equals 220.8 km per day total travel. • 75% controls for Level 2 watering (>2 L/m^2/hr)	51.02	12.76	15.62	3.90
Haul trucks - Highway (unpaved roads)	2.31	0.71	kg/VKT[5]	Maximum 100 trucks per day (200 movements). Haul route 850 m. 20% split. Equals 34 km per day total travel. • 75% controls for Level 2 watering (>2 L/m^2/hr)	7.86	1.96	2.41	0.60
Wind erosion	0.4	0.2	kg/ha/hr	Fixed emission rate independent of wind speed. 'Pit control' of 5% for PM_{10} and 50% for TSP	2.04	0.8	1.2	1.14

Key for Table 4-2:

[1] A soil silt content of 6.2% and moisture content of 2% was used to calculate emission rates. GHD considers these values to be more appropriate for hard rock quarries rather than the default NPI values of 10% and 2%, respectively[6].

[2] Crushing plant emissions include emissions from the screens, the crushers, the surge bin, the feeder and the conveyor belt as integral components.

[3] Loader processes include wheel generated dust emissions and fugitive emissions from loading of material into trucks.

[4] A 50% control factor applied when wet suppression used on crushers. Moisture carry over would mean that processed material in stockpiles would also have higher moisture content. Stockpiles may also be watered.

[5] VKT: Vehicle Kilometres Travelled.

[6] Reference: Maricopa County Air Pollution Control Regulations: Regulation Ii – Permits and Fees, Rule 242, Emission Offsets Generated by the Voluntary Paving of Unpaved Roads 2007.

Figure 4-1 shows the breakdown of emission sources from quarry activities with controls such as water sprays. Emissions are based on peak production rate of 300 tph. It can be seen that haul trucks and wind erosion generate the largest portions of dust emissions.

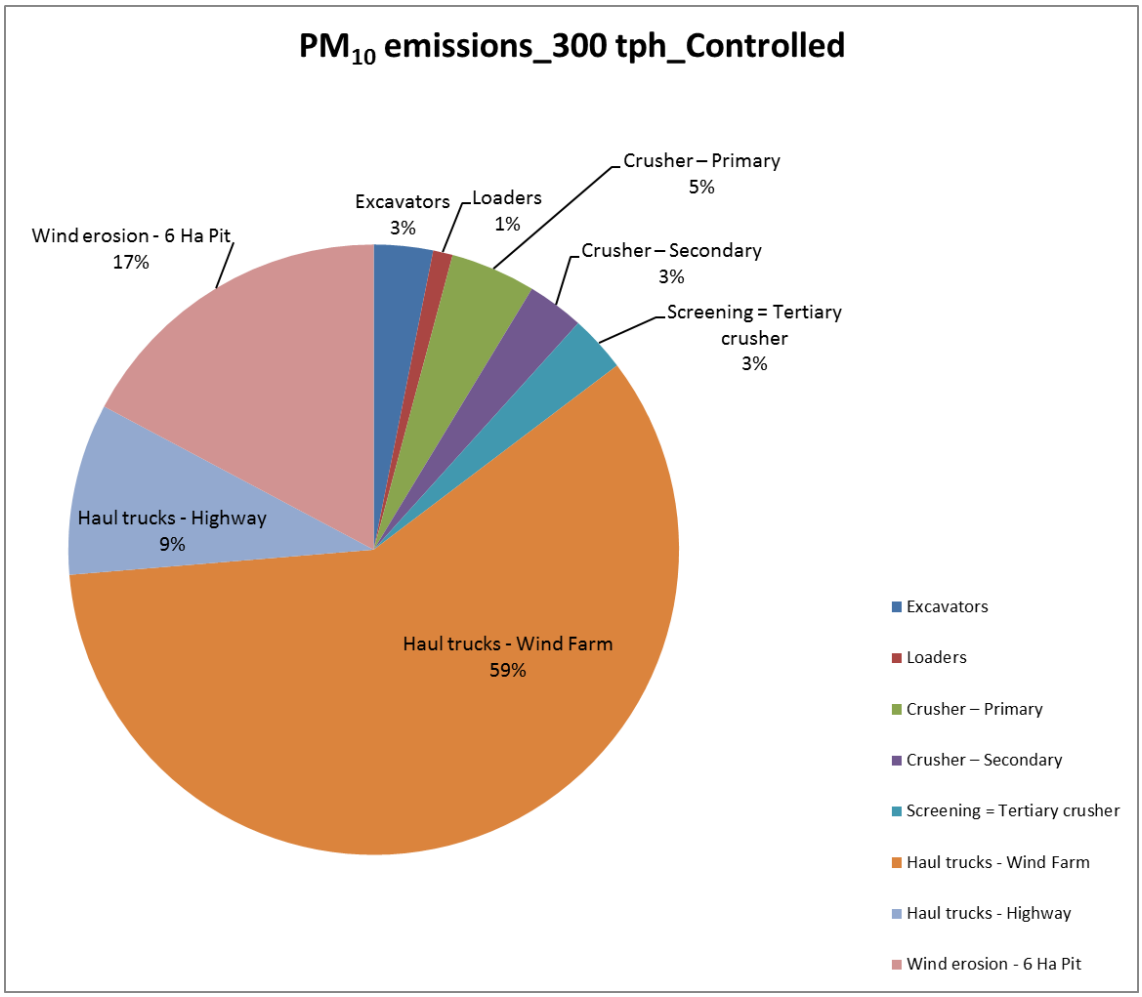


Figure 4-1 Breakdown of PM_{10} emissions

Table 4-3 gives a technical summary of the source characteristics used as input to the dispersion model. All sources have been modelled as volume sources.

Table 4-3 Dust source (model) characteristics

Source	Horizontal spread (m)	Vertical spread (m)	Source height (m)
Crusher/screen	5	3	0
Loader	5	3	0
Excavator	5	3	0
Haul trucks	30	4	0
Wind erosion	80	1	0

4.7 Emissions other than dust

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

5. Dispersion modelling

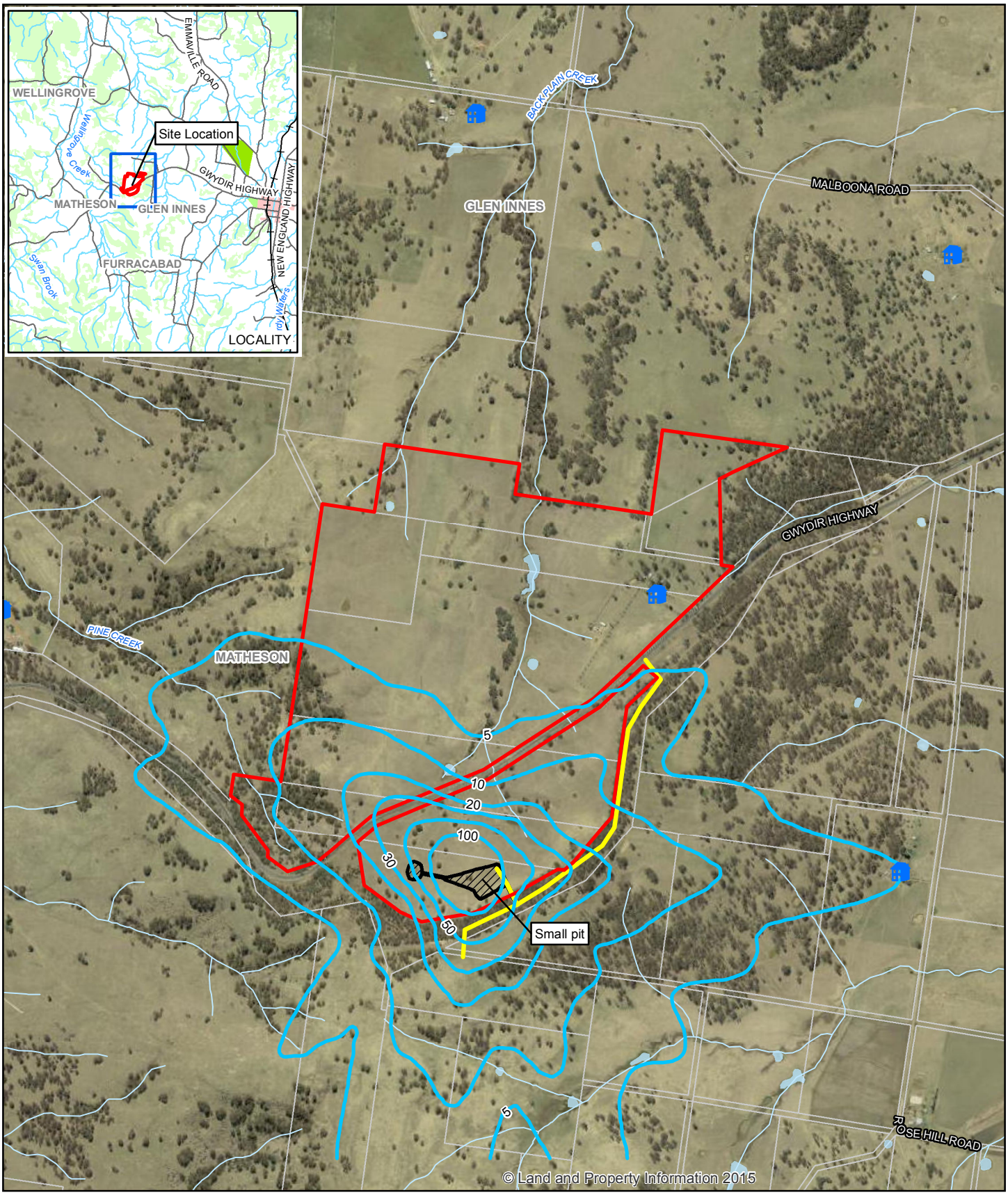
5.1 Daily PM_{10}

The AUSPLUME model was run with the meteorology of Section 3.2.2 and the emission inventory of Section 4.6. The highest daily average for each receptor location (see Table 3-1) and a Cartesian grid (with resolution of 100 m) was calculated.

Table 5-1 provides the predicted maximum incremental impact at each of the sensitive receptors locations nearby the site. All values are comfortably within the impact assessment criterion for daily PM_{10} (50 µg/m^3) of Table 2-2. Figure 5-1 provides a contour plots of the maximum daily dust impact emanating from the pit. This assumes that the quarry was operating at 300 tph for 10 hours on the day corresponding to the worst case meteorology dispersion conditions (i.e. a weekday when maximum throughput for wind farm construction supply is occurring).

Table 5-1 Maximum daily PM_{10} (µg/m^3) impact at sensitive receptor loacations

Identifier	South Pit
R1	7.7
R2	13.2
R3	1.8
R4	2.4
R5	1.2
R6	5.8



LEGEND

- Project boundary
- Cadastre
- Watercourse
- Waterbody
- Disturbance area
- Site access
- Residences
- Site office / weigh bridge
- Incremental daily PM_{10} (ug/m³)

Paper Size A4

0 150 300 600

Metres

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

N

GHD

Glen Innes Severn Council
Wattle Vale Quarry
Air Quality Report

Job Number	22-18380
Revision	0
Date	10 Oct 2016

Small Pit Maximum Daily PM_{10}

Figure 5-1

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18380\GIS\Maps\Deliverables\SmallQuarrySEE\AirQuality\2218380_SAQ001_Small_0.mxd

Data source: LPI: DCDB & DTDB, 2012,Aerial Imagery, 2016; Geoscience Australia: 250k Topographic Data Series 3, 2006; GISSC: Quarry data, 2016. Created by: fmackay, gmcdiarmid

5.2 Dust deposition

Dust deposition AUSPLUME model runs were also performed on the pit scenario. As indicated by Table 5-2, the deposition impact is very low, compared to the criterion in Table 4-2 and likely to be immeasurable.

Table 5-2 Dust deposition impact (g/m^2/month) at sensitive receptor loacations

Identifier	Dust deposition (g/m2/month)
R1	0.08
R2	0.10
R3	<0.01
R4	0.01
R5	<0.01
R6	0.02

6. Discussion

The amenity impact due to dust fallout can only occur at sensitive receptor locations where people are likely to congregate for lengthy periods of time – such as identified sensitive receptor locations. As was found in Section 5.2, the impact at all receptors beyond the site is a mere fraction of a gram per square metre per month. Even the isolated rural residence within the site (to the north of the highway), which has the highest predicted impact, is likely to not have enough dust fallout to be measured.

The human health impact of daily PM_{10} dust-in-air concentrations also requires the particular environmental value to involve people. Workers on the site are subject to protection from Workplace Occupational Health and Safety requirements. The 50 $\mu g/m^3$ PM_{10} daily impact is seen to extend beyond the site boundary for a limited distance to the south in the vicinity of the wind farm access haul road. However, the likelihood of human health impact is very low as these are uninhabited areas.

Due to the assessed dust impacts being low and within acceptable criteria, in-principle mitigation and management measures to reduce dust impacts, other than standard practices already included and air quality monitoring programmes are not required.

7. Conclusion

An assessment of the potential construction and operational air quality impacts of dust from the development of Wattle Vale Quarry has been undertaken. This assessment has led to the following conclusions, which are subject to the limitations outlined in Section 1.4 and 1.6:

- Existing conditions for a rural site with a high annual average wind speed are low; other environmental assessments in the area (for wind farm developments) were not required to consider background dust levels.
- Construction dust impacts are likely to be low due to the ad-hoc nature involved in clearing certain, limited sections without the full operational dust sources that would be higher; such as hauling and quarrying. It is anticipated that dust impacts will be below the threshold of human perception (for human health and ambient considerations) at all identified receptors, given the large separation distance between receptors and the construction works.
- The operational air quality assessment is considered to be conservative with maximum product quarrying, crushing and export occurring on every day modelled. Predicted marginal compliance is expected at only a limited distance beyond the southern site boundary but all human health (PM_{10}) and amenity (dust fallout) impacts were found to be below the threshold of acceptable dust impacts at all identified sensitive receptors.
- No further recommendations above standard dust control measures are required to assist in minimising potential dust impacts.
- No adverse air quality impacts due to dust will affect people, livestock or pasture which are anticipated to result from dust emissions due to the Project.

Appendices

Appendix A – Sample AUSPLUME output text file

1 _____

PM10 (controlled)

_____

Concentration or deposition	Concentration
Emission rate units	kg/hour
Concentration units	microgram/m3
Units conversion factor	2.78E+05
Constant background concentration	0.00E+00
Terrain effects	None
Smooth stability class changes?	No
Other stability class adjustments ("urban modes")	None
Ignore building wake effects?	Yes
Decay coefficient (unless overridden by met. file)	0.000
Anemometer height	10 m
Roughness height at the wind vane site	0.300 m
Use the convective PDF algorithm?	No

DISPERSION CURVES

Horizontal dispersion curves for sources <100 m high Briggs Rural

Vertical dispersion curves for sources <100 m high Briggs Rural

Horizontal dispersion curves for sources >100 m high Briggs Rural

Vertical dispersion curves for sources >100 m high Briggs Rural

Enhance horizontal plume spreads for buoyancy?	Yes
Enhance vertical plume spreads for buoyancy?	Yes
Roughness height	0.300 m
Adjustment for wind directional shear	None

PLUME RISE OPTIONS

Gradual plume rise?	Yes

Stack-tip downwash included? Yes

Building downwash algorithm: PRIME method.

Entrainment coeff. for neutral & stable lapse rates 0.60,0.60

Partial penetration of elevated inversions? No

Disregard temp. gradients in the hourly met. file? No

and in the absence of boundary-layer potential temperature gradients given by the hourly met. file, a value from the following table (in K/m) is used:

Wind Speed	Stability Class					
Category	A	B	C	D	E	F
1	0.000	0.000	0.000	0.000	0.020	0.035
2	0.000	0.000	0.000	0.000	0.020	0.035
3	0.000	0.000	0.000	0.000	0.020	0.035
4	0.000	0.000	0.000	0.000	0.020	0.035
5	0.000	0.000	0.000	0.000	0.020	0.035
6	0.000	0.000	0.000	0.000	0.020	0.035

WIND SPEED CATEGORIES

Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Rural" values (unless overridden by met. file)

AVERAGING TIMES

24 hours

1

Small Pit PM10 (controlled)

SOURCE CHARACTERISTICS

VOLUME SOURCE: PIT

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
365316	6710697	0 m	0 m	5 m	3 m

Emission rates by hour of day in kg/hour:

1 0.00E+00	2 0.00E+00	3 0.00E+00	4 0.00E+00
5 0.00E+00	6 0.00E+00	7 0.00E+00	8 3.60E-01
9 3.60E-01	10 3.60E-01	11 3.60E-01	12 3.60E-01
13 3.60E-01	14 3.60E-01	15 3.60E-01	16 3.60E-01

17 3.60E-01 18 0.00E+00 19 0.00E+00 20 0.00E+00

21 0.00E+00 22 0.00E+00 23 0.00E+00 24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL1

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
365931	6711466	0 m	0 m	30 m	4 m

Emission rates by hour of day in kg/hour:

1 0.00E+00 2 0.00E+00 3 0.00E+00 4 0.00E+00

5 0.00E+00 6 0.00E+00 7 0.00E+00 8 1.49E-02

9 1.49E-02 10 1.49E-02 11 1.49E-02 12 1.49E-02

13 1.49E-02 14 1.49E-02 15 1.49E-02 16 1.49E-02

17 1.49E-02 18 0.00E+00 19 0.00E+00 20 0.00E+00

21 0.00E+00 22 0.00E+00 23 0.00E+00 24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL2

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
365931	6711363	0 m	0 m	30 m	4 m

Emission rates by hour of day in kg/hour:

1 0.00E+00 2 0.00E+00 3 0.00E+00 4 0.00E+00

5 0.00E+00 6 0.00E+00 7 0.00E+00 8 1.49E-02

9 1.49E-02 10 1.49E-02 11 1.49E-02 12 1.49E-02

13 1.49E-02 14 1.49E-02 15 1.49E-02 16 1.49E-02

17 1.49E-02 18 0.00E+00 19 0.00E+00 20 0.00E+00

21 0.00E+00 22 0.00E+00 23 0.00E+00 24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL3

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
365880	6711299	0 m	0 m	30 m	4 m

Emission rates by hour of day in kg/hour:

1 0.00E+00 2 0.00E+00 3 0.00E+00 4 0.00E+00

5 0.00E+00 6 0.00E+00 7 0.00E+00 8 1.49E-02

9 1.49E-02 10 1.49E-02 11 1.49E-02 12 1.49E-02

13 1.49E-02 14 1.49E-02 15 1.49E-02 16 1.49E-02

17 1.49E-02 18 0.00E+00 19 0.00E+00 20 0.00E+00

21 0.00E+00 22 0.00E+00 23 0.00E+00 24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL4

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
365841	6711171	0 m	0 m	30 m	4 m

Emission rates by hour of day in kg/hour:

1 0.00E+00 2 0.00E+00 3 0.00E+00 4 0.00E+00

5 0.00E+00 6 0.00E+00 7 0.00E+00 8 1.49E-02

9 1.49E-02 10 1.49E-02 11 1.49E-02 12 1.49E-02

13 1.49E-02 14 1.49E-02 15 1.49E-02 16 1.49E-02

17 1.49E-02 18 0.00E+00 19 0.00E+00 20 0.00E+00

21 0.00E+00 22 0.00E+00 23 0.00E+00 24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL5

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
365828	6711068	0 m	0 m	30 m	4 m

Emission rates by hour of day in kg/hour:

1 0.00E+00 2 0.00E+00 3 0.00E+00 4 0.00E+00

5 0.00E+00 6 0.00E+00 7 0.00E+00 8 1.49E-02

9 1.49E-02 10 1.49E-02 11 1.49E-02 12 1.49E-02

13 1.49E-02 14 1.49E-02 15 1.49E-02 16 1.49E-02

17 1.49E-02 18 0.00E+00 19 0.00E+00 20 0.00E+00

21 0.00E+00 22 0.00E+00 23 0.00E+00 24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL6

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
365803	6710953	0 m	0 m	30 m	4 m

Emission rates by hour of day in kg/hour:

1 0.00E+00 2 0.00E+00 3 0.00E+00 4 0.00E+00

5 0.00E+00 6 0.00E+00 7 0.00E+00 8 1.49E-02

9 1.49E-02 10 1.49E-02 11 1.49E-02 12 1.49E-02

13 1.49E-02 14 1.49E-02 15 1.49E-02 16 1.49E-02

17 1.49E-02 18 0.00E+00 19 0.00E+00 20 0.00E+00

21 0.00E+00 22 0.00E+00 23 0.00E+00 24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL7

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
365777	6710838	0 m	0 m	30 m	4 m

Emission rates by hour of day in kg/hour:

1 0.00E+00 2 0.00E+00 3 0.00E+00 4 0.00E+00

5 0.00E+00 6 0.00E+00 7 0.00E+00 8 1.49E-02

9 1.49E-02 10 1.49E-02 11 1.49E-02 12 1.49E-02

13 1.49E-02 14 1.49E-02 15 1.49E-02 16 1.49E-02

17 1.49E-02 18 0.00E+00 19 0.00E+00 20 0.00E+00

21 0.00E+00 22 0.00E+00 23 0.00E+00 24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL8

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
365700	6710761	0 m	0 m	30 m	4 m

Emission rates by hour of day in kg/hour:

1 0.00E+00 2 0.00E+00 3 0.00E+00 4 0.00E+00

5 0.00E+00 6 0.00E+00 7 0.00E+00 8 1.49E-02

9 1.49E-02 10 1.49E-02 11 1.49E-02 12 1.49E-02

13 1.49E-02 14 1.49E-02 15 1.49E-02 16 1.49E-02

17 1.49E-02 18 0.00E+00 19 0.00E+00 20 0.00E+00

21 0.00E+00 22 0.00E+00 23 0.00E+00 24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL9

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
365623	6710709	0 m	0 m	30 m	4 m

Emission rates by hour of day in kg/hour:

1 0.00E+00 2 0.00E+00 3 0.00E+00 4 0.00E+00

5 0.00E+00 6 0.00E+00 7 0.00E+00 8 1.49E-02

9 1.49E-02 10 1.49E-02 11 1.49E-02 12 1.49E-02

13 1.49E-02 14 1.49E-02 15 1.49E-02 16 1.49E-02

17 1.49E-02 18 0.00E+00 19 0.00E+00 20 0.00E+00

21 0.00E+00 22 0.00E+00 23 0.00E+00 24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL10

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
365572	6710658	0 m	0 m	30 m	4 m

Emission rates by hour of day in kg/hour:

1 0.00E+00 2 0.00E+00 3 0.00E+00 4 0.00E+00

5 0.00E+00 6 0.00E+00 7 0.00E+00 8 1.49E-02

9 1.49E-02 10 1.49E-02 11 1.49E-02 12 1.49E-02

13 1.49E-02 14 1.49E-02 15 1.49E-02 16 1.49E-02

17 1.49E-02 18 0.00E+00 19 0.00E+00 20 0.00E+00

21 0.00E+00 22 0.00E+00 23 0.00E+00 24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL11

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
365446	6710868	0 m	0 m	30 m	4 m

Emission rates by hour of day in kg/hour:

1 0.00E+00 2 0.00E+00 3 0.00E+00 4 0.00E+00

5 0.00E+00 6 0.00E+00 7 0.00E+00 8 1.49E-02

9 1.49E-02 10 1.49E-02 11 1.49E-02 12 1.49E-02

13 1.49E-02 14 1.49E-02 15 1.49E-02 16 1.49E-02

17 1.49E-02 18 0.00E+00 19 0.00E+00 20 0.00E+00

21 0.00E+00 22 0.00E+00 23 0.00E+00 24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL12

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
365393	6710671	0 m	0 m	30 m	4 m

Emission rates by hour of day in kg/hour:

1 0.00E+00 2 0.00E+00 3 0.00E+00 4 0.00E+00

5 0.00E+00 6 0.00E+00 7 0.00E+00 8 7.99E-02

9 7.99E-02 10 7.99E-02 11 7.99E-02 12 7.99E-02

13 7.99E-02 14 7.99E-02 15 7.99E-02 16 7.99E-02

17 7.99E-02 18 0.00E+00 19 0.00E+00 20 0.00E+00

21 0.00E+00 22 0.00E+00 23 0.00E+00 24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL13

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
365380	6710556	0 m	0 m	30 m	4 m

Emission rates by hour of day in kg/hour:

1 0.00E+00 2 0.00E+00 3 0.00E+00 4 0.00E+00

5 0.00E+00 6 0.00E+00 7 0.00E+00 8 6.50E-02

9 6.50E-02 10 6.50E-02 11 6.50E-02 12 6.50E-02

13 6.50E-02 14 6.50E-02 15 6.50E-02 16 6.50E-02

17 6.50E-02 18 0.00E+00 19 0.00E+00 20 0.00E+00

21 0.00E+00 22 0.00E+00 23 0.00E+00 24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL14

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
365303	6710530	0 m	0 m	30 m	4 m

Emission rates by hour of day in kg/hour:

1 0.00E+00 2 0.00E+00 3 0.00E+00 4 0.00E+00

5 0.00E+00 6 0.00E+00 7 0.00E+00 8 6.50E-02

9 6.50E-02 10 6.50E-02 11 6.50E-02 12 6.50E-02

13 6.50E-02 14 6.50E-02 15 6.50E-02 16 6.50E-02

17 6.50E-02 18 0.00E+00 19 0.00E+00 20 0.00E+00

21 0.00E+00 22 0.00E+00 23 0.00E+00 24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: HAUL15

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
365239	6710440	0 m	0 m	30 m	4 m

Emission rates by hour of day in kg/hour:

1 0.00E+00 2 0.00E+00 3 0.00E+00 4 0.00E+00

5 0.00E+00 6 0.00E+00 7 0.00E+00 8 6.50E-02

9 6.50E-02 10 6.50E-02 11 6.50E-02 12 6.50E-02

13 6.50E-02 14 6.50E-02 15 6.50E-02 16 6.50E-02

17 6.50E-02 18 0.00E+00 19 0.00E+00 20 0.00E+00

21 0.00E+00 22 0.00E+00 23 0.00E+00 24 0.00E+00

No gravitational settling or scavenging.

VOLUME SOURCE: WIND

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
365316	6710697	0 m	0 m	80 m	1 m

(Constant) emission rate = 3.80E-01 kg/hour

No gravitational settling or scavenging.

1

Small Pit PM10 (controlled)

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):

363500.m 363600.m 363700.m 363800.m 363900.m 364000.m 364100.m

364200.m 364300.m 364400.m 364500.m 364600.m 364700.m 364800.m

364900.m 365000.m 365100.m 365200.m 365300.m 365400.m 365500.m

365600.m 365700.m 365800.m 365900.m 366000.m 366100.m 366200.m

366300.m 366400.m 366500.m 366600.m 366700.m 366800.m 366900.m

367000.m 367100.m 367200.m 367300.m 367400.m 367500.m 367600.m

367700.m 367800.m 367900.m

and these y-values (or northings):

6709600.m 6709700.m 6709800.m 6709900.m 6710000.m 6710100.m 6710200.m

6710300.m 6710400.m 6710500.m 6710600.m 6710700.m 6710800.m 6710900.m

6711000.m 6711100.m 6711200.m 6711300.m 6711400.m 6711500.m 6711600.m

6711700.m 6711800.m 6711900.m 6712000.m 6712100.m 6712200.m 6712300.m

6712400.m 6712500.m 6712600.m 6712700.m 6712800.m 6712900.m 6713000.m

6713100.m 6713200.m 6713300.m 6713400.m 6713500.m 6713600.m

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT

1	363543	6711686	0.0	0.0	5	365349	6713572	0.0	0.0
2	366962	6710690	0.0	0.0	6	366036	6711745	0.0	0.0
3	367161	6713036	0.0	0.0	7	365316	6710697	0.0	1.0
4	367824	6712406	0.0	0.0	8	365294	6712016	0.0	1.0

METEOROLOGICAL DATA : Glen Innes met file from hrly averaged data 2015/16,

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At the discrete receptors:

1: 2.05E+00 @Hr24,02/06/16	5: 4.48E-01 @Hr24,03/05/16
2: 3.54E+00 @Hr24,15/07/15	6: 1.53E+00 @Hr24,28/07/16
3: 5.03E-01 @Hr24,28/07/16	7: 4.49E+00 @Hr24,04/07/16
4: 8.62E-01 @Hr24,29/07/16	8: 1.30E+00 @Hr24,23/09/15

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2218380-39230/https://projects.ghd.com/OC/Newcastle/wattlevalequarrypea/Delivery/Documents/2218380-REP_ Air Quality Assessment - Southern Quarry.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	B Cook	J Forrest		M Dunlop		10/10/2016
1	B. Cook	J. Forrest		J. McPherson		23/12/2016

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Appendix H Noise and Vibration Assessment

Glen Innes Severn Council

Noise and Vibration Impact Assessment

Wattle Vale Quarry

September 2016

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Glossary

Term	Description
dB	Decibel, which is 10 times the logarithm (base 10) of the ratio of a given sound pressure to a reference pressure; used as a unit of sound.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels.
INP	Industrial Noise Policy
$L_{Aeq\ (period)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
Rating Background Level (RBL)	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period. This is the level used for assessment purposes. The NSW INP states that where the measured RBL is less than 30 dB(A), the RBL is considered to be 30 dB(A).
$L_{A1\ (period)}$	The sound pressure level that is exceeded for 1% of the measurement period.
$L_{A10\ (period)}$	The sound pressure level that is exceeded for 10% of the measurement period.
$L_{A90\ (period)}$	The sound pressure level that is exceeded for 90% of the measurement period.
L_{Amax}	The maximum sound level recorded during the measurement period.
L_{Amin}	The minimum sound level recorded during the measurement period.
Mitigation	Reduction in severity.
Peak Particle Velocity	Current practice for assessments of the risk of structural damage to buildings use measurements of Peak Particle Velocity (PPV) ground vibration (v_p), which is the maximum vector sum of three orthogonal time-synchronized velocity components. When not directly measured by an instrument, PPV may be determined by: $v_p = \sqrt{(v_x^2 + v_y^2 + v_z^2)}$ Where v_x, v_y, v_z are the instantaneous components of particle velocity of the x, y, z primary axes, respectively.
Rating Background Level (RBL)	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period. This is the level used for assessment purposes.
Receiver	A noise modelling term used to describe a map reference point where noise is predicted. A sensitive receiver would be a home, work place, church, school or other place where people spend time.
RNP	Road Noise Policy
Sound Pressure Level (SPL)	Sound pressure level 20 times the logarithm to the base 10 of the ratio of the root mean square (RMS) sound pressure level to the reference sound pressure level of 20 micropascals.
Vibration	The variation of the magnitude of a quantity which is descriptive of the motion or position of a mechanical system, when the magnitude is alternately greater and smaller than some average value or reference. Vibration can be measured in terms of its displacement, velocity or acceleration. The common units for velocity are millimetres per second (mm/s).

1. Introduction

1.1 Background

Glen Innes Severn Council (GISC) proposes to construct and operate a new hard rock quarry (Wattle Vale Quarry) to extract up to 300,000 tonnes per annum (tpa) over 30 years, with a total disturbance area of approximately 8 hectares (the Project). The site is owned by GISC and is approximately 200 hectares in size, located 13 kilometres west of Glen Innes as shown in Figure 2-1.

1.2 Purpose of this report

The purpose of this study is to assess the potential noise and vibration impacts to sensitive receivers from the construction and operation of the project, and where required, identify feasible and reasonable mitigation measures.

1.3 Scope

The scope of work to conduct the Noise and Vibration Impact Assessment involved:

- A review of the surrounding study area to gain an understanding of local site features and the location and nature of potential sensitive receivers.
- A review of existing environmental studies, as applicable.
- Undertaking noise monitoring at three noise sensitive receiver locations indicative of the local ambient and background noise environment.
- Establishing project specific noise and vibration goals for the proposal with consideration to the following publications:
  - *Interim Construction Noise Guideline* (ICNG) (DECC, 2009)
  - *Industrial Noise Policy* (INP) (EPA, 2000)
  - *Assessing Vibration: A technical guideline* (AVTG) (DEC, 2006)
  - *Technical guidelines to minimise annoyance due to blasting overpressure and ground vibration* (ANZEC, 1990)
  - *Road Noise Policy* (RNP) (DECCW, 2011)
- A review of site operations to identify principal noise sources during operation and their corresponding sound power levels.
- Undertake a worst case operational noise modelling scenario using Computer Aided Noise Abatement (CadnaA) software to predict sound pressure levels emanating from the site.
- Assess potential construction noise and vibration impacts at nearby sensitive receivers.
- Undertaking a desktop assessment of potential road traffic noise impacts from heavy vehicles entering/exiting the site on public roads.
- Providing a summary of the predicted results and outlining recommendations for in-principle noise mitigation measures, where exceedances are predicted.

1.4 Limitations

This report: has been prepared by GHD for Glen Innes Severn Council and may only be used and relied on by Glen Innes Severn Council for the purpose agreed between GHD and Glen Innes Severn Council as set out in Section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Glen Innes Severn Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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

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

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer to Section 1.5 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Glen Innes Severn Council and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.5 Assumptions

The following assumptions were made in this assessment:

- Work on site would be restricted to the following hours:
  - Monday to Friday: 7.00 am to 5.00 pm
  - Saturday: 8.00 am to 4.00 pm
  - No work on Sundays or Public Holidays
- The operational equipment used on site would be limited to those assessed in this report.

2. Existing environment

2.1 Site location

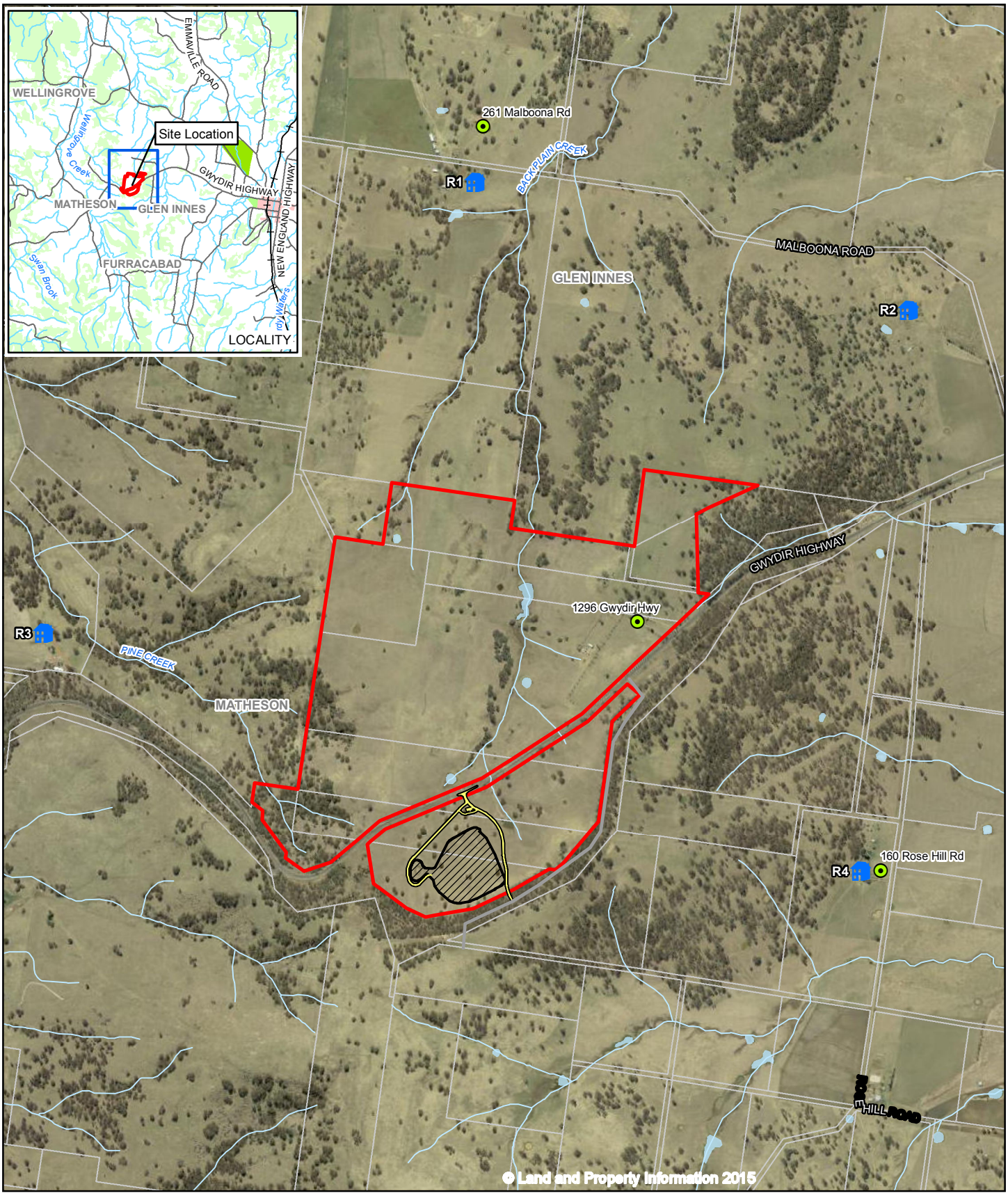
The Project site predominantly consists of cleared land that is currently being used for agricultural purposes. The Project site includes a three-bedroom home and sheds, and is under occupation by the former owners for six months as a condition of the contract of sale. It is understood that future occupants will enter an agreement to acknowledge the presence of the quarry and is therefore not considered as a sensitive receiver in this study.

2.2 Existing noise sensitive receivers

The closest sensitive receivers to the Project have been identified from aerial imagery. Approximate distances have been measured for each identified sensitive receiver from the centre of the extraction area.

Table 2-1 Identified noise sensitive receivers

Receiver	Receiver type	Approximate distance from centre of extraction area (m)
R1	Residential	Greater than 3000 m north of site
R2	Residential	Approximately 3000 m north-east of site
R3	Residential	Approximately 2050 m north-west of site
R4	Residential	1630 m east of site



LEGEND

- Project boundary
- Cadastre
- Watercourse
- Waterbody
- Site access
- Existing access
- Residences
- Noise monitoring location
- Disturbance area

Paper Size A4

0 90 180 360 540 720

Metres

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

N

GHD

Glen Innes Severn Council
Wattle Vale Quarry
Noise and Vibration Impact Assessment

Job Number 18380
Revision
Date 14 Nov 2016

Noise monitoring locations

Figure 2-1

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18380\GIS\Maps\Deliverables\SouthernQuarryEIS\Noise\2218380_SQN001_MonitoringLocations_A.mxd

Data source: LPI: DCDB & DTDB, 2012,Aerial Imagery, 2016; Geoscience Australia: 250k Topographic Data Series 3, 2006; GISSC: Quarry data, 2016. Created by: fmackay

2.3 Existing noise environment

Background noise monitoring was undertaken at three locations between 4 August 2016 and 12 August 2016. These locations were considered to represent the existing ambient and background noise environment in the area and were identified in consultation with the client as being a safe and secure place for equipment, minimising the risk of theft or vandalism. Logger locations are shown in Figure 2-1.

The noise loggers were programmed to accumulate L_{A90}, L_{A10}, L_{Aeq} and L_{Amax} noise descriptors continuously over sampling periods of 15 minutes for the entire monitoring period. Logger calibration was checked before and after measurements and were found to be within acceptable tolerance.

The data collected by the loggers was downloaded and analysed, and any invalid data removed. Invalid data generally refers to periods of time where average wind speeds were greater than 5 m/s[1], or when rainfall occurred. Concurrent 15 minute weather data were sourced from the Bureau of Meteorology's (BoM) Glen Innes Airport automatic weather station (AWS) (8.5 km north-east of the site).

Details of the noise loggers and monitoring locations are provided in Table 2-2.

All sampling activities were undertaken with consideration of the specifications outlined in the AS 1055 (1997) '*Description and Measurement of Environmental Noise'* and the NSW INP.

Table 2-2 Background noise monitoring details

Noise logger	Logger 1	Logger 2	Logger 3
Monitoring location	261 Malboona Rd	1296 Gwydir HWY	160 Rose Hill Rd
Logger type	NL-52	NL-22	NL-21
Logger serial no.	131631	852196	443342
Measurement started	11:45 4/08/2016	13:30 4/08/2016	14:30 4/08/2016
Measurement ceased	12:30 12/08/2016	13:30 12/08/2016	13:15 12/08/2016
Pre measurement calibration check (94.0 dB at 1 kHz)	93.7	94.4	94.6
Post measurement calibration check (94.0 dB at 1 kHz)	94[1]	94.3	94.3
Frequency weighting	A	A	A
Time response	Fast	Fast	Fast

Note 1: A post measurement for the NL-52 unit was not performed immediately after monitoring, but was performed in preparation of another project soon after and was noted to be 94 dB(A) when rounded to the nearest dB.

[1] Wind speed measurements are taken at 10 m height. Noise logger microphones are located at 1.5 m height. To account for the vertical wind profile from 10 m down to 1.5 m (microphone height), noise data was filtered based on 7 m/s wind speeds.

2.3.1 Summary of noise monitoring results

Unattended noise monitoring results

A summary of calculated background L_{A90} and ambient L_{Aeq} (day, evening and night) noise levels for the monitoring periods are provided in Table 2-3 to Table 2-5 for Logger 1, Logger 2 and Logger 3 respectively. Daily charts of the monitoring results and weather data are presented in Appendix A to Appendix C.

Table 2-3 Summary of noise monitoring results – Logger 1, dB(A)

Date	Background L_{90} dB(A)			Ambient L_{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Thursday 4-Aug-16	41	27	24	56	39	46
Friday 5-Aug-16	36	25	16	58	36	31
Saturday 6-Aug-16	27	22	18	46	32	42
Sunday 7-Aug-16	27	24	17	44	34	39
Monday 8-Aug-16	29	24	17	45	32	39
Tuesday 9-Aug-16	27	23	19	44	32	41
Wednesday 10-Aug-16	32	24	20	47	34	42
Thursday 11-Aug-16	34	20	18	48	27	38
RBL	29	24	18	-	-	-
L_{Aeq} Overall	-	-	-	52	34	41

Table 2-4 Summary of noise monitoring results - Logger 2, dB(A)

Date	Background L_{90} dB(A)			Ambient L_{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Thursday 4-Aug-16	36	31	27	51	49	46
Friday 5-Aug-16	30	25	20	53	48	42
Saturday 6-Aug-16	26	20	19	49	46	41
Sunday 7-Aug-16	25	20	19	51	47	45
Monday 8-Aug-16	29	20	19	50	49	45
Tuesday 9-Aug-16	27	22	22	47	45	42
Wednesday 10-Aug-16	29	23	24	47	46	47
Thursday 11-Aug-16	35	23	18	50	47	46
RBL	29	23	19	-	-	-
L_{Aeq} Overall	-	-	-	50	47	45