Issue	Potential key risks	Likelihood	Consequence	Priority category	Comment/response
					The SEARs have also identified this as a key issue requiring assessment. Potential traffic impacts are considered in Section 7.6.
Heritage	Encounter and disturbed items of Aboriginal cultural and historic heritage during construction and operation.	Lower	Lower	C	No heritage sites have previously been identified to occur within or near the Project site, and it is not anticipated that the Project will disturb any sites of heritage significance. The SEARs have identified this as a key issue requiring assessment. This issue has been considered in Section 7.7.
Visual amenity	Visibility of the Project reducing the amenity of nearby sensitive receivers.	Medium	Lower	C	The Project will disturb an area of 8 hectares and create a 20 metre excavation which would change the topography of the site. The Project would also create stockpiles, access roads and temporary and permanent structures which will be visible from the Gwydir Highway. The SEARs have identified this as a key issue requiring assessment. Potential visual impacts are considered in Section 7.8.
Waste management	Production and inappropriate disposal of waste generated from the Project.	Lower	Lower	C	The Project will generate a number of waste types, with potential for on-site and off-site impacts including: • Contamination of land • Pollution of waterways • Air pollution • Overuse of scarce resources

Issue	Potential key risks	Likelihood	Consequence	Priority category	Comment/response
					• Human and animal health impacts. The SEARs have identified this as a key issue requiring assessment. Waste management is considered in Section 7.9.
Hazards and risks	Dangerous or hazardous materials or scenarios causing harm to the environment or people.	Lower	Lower	C	Potential hazard scenarios associated with the operation of the Project may include: • Occupational health and safety associated with drilling, blasting and rock extraction handling • Fly-rock risks associated with blasting • Fire and pollution risk from storage and handling of fuels • Road traffic risks associated with truck movements Controls and procedures will be implemented to ensure hazards and risks are managed on site. The SEARs have also identified this as a key issue requiring assessment. Potential hazards and risks are considered in Section 7.10.
Socio-economic	Amenity impacts during construction and operation.	Lower	Lower	C	There is potential for some amenity impacts during construction of the Project. These are addressed in various specialist studies and chapters of the EIS. The Project includes design features and mitigation measures to reduce the potential for amenity impacts.

Issue	Potential key risks	Likelihood	Consequence	Priority category	Comment/response
					Once operational, the Project is likely to result in positive impacts for the community, including increased employment (and sustaining several existing jobs associated with the existing quarry operation). The Project will also provide a facility where local residents and businesses have continued access to new aggregate products. The SEARs have also identified this as a key issue requiring assessment. Potential socio-economic impacts are considered in Section 7.10.

7. Environmental assessment

7.1 Land resources

This section provides a description of the landform, geology, soils and land use of the Project site.

7.1.1 Existing environment

Landform

The Project site occurs on land with a gentle slope ranging from 1,090 m AHD, up to a ridge with an elevation of approximately 1,190 m AHD. The surrounding environment is undulating with surrounding plains having a general elevation of approximately 1,000 m AHD.

The proposed extraction area occurs close to the top of a ridge at around 1,180 m AHD. An unnamed tributary of Backplain Creek runs through the Project site in a northerly direction. Backplain Creek is a tributary of the Wellingrove Creek, which flows into the Severn River to the north. A number of small farm dams are located throughout the Project site.

Geology and soils

Reference to the Grafton 1:250,000 Geology Series Sheet produced by the Geological Survey of NSW (1976) for the area indicates that the site is underlain by Tertiary-aged materials. The geology of the area is comprised of basalts and dolerites which are largely extrusive.

Review of the eSPADE application (OEH, 2016) has found soil data collected in 2000, 2007 and 2013 for three different sites located within 10 kilometres of the Project site. These sites are located to the west/north-west, east and north-east respectively. The soil data collected in 2000 to the west indicates the soil type as being haplic eutrophic brown chromosols, with a dark brown light clay loam A1 horizon and dark yellowish-brown medium clay B1 horizon. The 2000 soil data to the north-west indicates the soil type as self-mulching grey vertosol with a dark brown clay loam A1 horizon and dark yellowish-brown medium clay B1 horizon. The soil data collected in 2007 to the north-east of the Project site indicates the soil type as being haplic self-mulching black vertosols, with clay A1 and B2 horizons. The soil data collected in 2013 to the west of the Project site did not provide an indication of soil types; however, the A1 horizon is identified as dark brown light clay underlain by greyish brown light-medium clay.

The Project site is regionally mapped as primarily Dermosols, with areas of Ferrosols on the northern and southern boundaries of the Project site and in association with the proposed extraction area. Dermosols are red, brown, yellow, grey or black and have loam to clay textures. They lack strong texture contrast between A and B horizons and are found in imperfectly drained sites. Ferrosols are well drained soils with red or yellow-brown colour and have clay-loam to clay textures. This soil is usually associated with previous volcanic activity and lack strong texture contrast between A and B horizons.

Land and soil capability

Land and soil capability (LSC) is the ability of the land to sustain a range of land uses and land management practices in the long term without degradation of soil, land, air and water resources (OEH, 2012). In particular, the LSC assessment scheme is designed to provide regional scale information about land and soil capability as applied to broad scale, dry-land agricultural uses.

The LSC classes identify limitations on the type and intensity of use as a result of the severity of constraints related to the physical attributes of the soil and the extent to which intensive management is required to prevent on and off site degradation under varying land uses. The LSC assessment scheme requires that each tract of similar land is assessed for each of the hazards and ranked from 1 to 8 where Class 1 represents the least hazard and Class 8 the highest hazard. From this, the overall LSC Class is determined by the ranking of the most limiting hazard.

It is important to note that the classification does not necessarily reflect existing land uses; rather, it indicates the potential of the land for different agricultural purposes, while maintaining the quality of natural assets.

Table 7-1 provides a rationale and definitions for the LSC classes contained within the Project site, based on broad scale (1:250,000 scale) mapping.

Table 7-1 Land classification interpretations

LSC class	General information	Present in the Project site (based on regional scale mapping)
Land capable of a variety of uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)		
3	**High capability land (moderate limitations)**: Land has moderate limitations and is capable of sustaining high impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation.	17.13 hectares within Project site. On the northern and southern boundaries of the Project site, including in association with the proposed access road and extraction area.
4	**Moderate capability land (moderate to severe limitations)**: Land has moderate to high limitations for high impact land uses. Will restrict land management options for regular, high impact land uses such as cropping, high intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.	68.30 hectares within Project site.

LSC class	General information	Present in the Project site (based on regional scale mapping)
Land generally incapable of agricultural use (selective forestry and nature conservation)		
7	**Very low capability land (extremely severe limitations)**: 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 are not managed. There should be minimal disturbance of native vegetation	126.94 hectares within Project site. Throughout the Project site, including in association with the proposed access road and extraction area.

Source: OEH, 2012.

Land use

The Project site is zoned RU1 (Primary Production), the surrounding area is also predominately zoned RU1 (Primary Production) under *Glen Innes Severn* LEP. Land zoned E3 (Environmental Management) associated with the Gwydir Highway road corridor is located on the south-western, southern and south-eastern boundaries of the Project site.

The majority of the Project site falls within land that has been cleared associated with historical agricultural land uses. Land uses surrounding the Project site are associated with agricultural enterprises, with low connectivity of surrounding vegetation due to historical land clearing activities.

Contamination

A search of the list of NSW contaminated sites notified to the EPA for the Glen Innes Severn LGA identified two contaminated sites listed as ‘under assessment’ on the list of sites notified to the EPA:

- Caltex Service Station, 154 New England Highway, Glen Innes.
- Caltex Service Station, corner of Church Street and Meade Street, Glen Innes.

These notifications are attributed to underground petroleum storage systems at service station properties. Both of these sites are located more than 10 kilometres from the Project site, with the site unlikely to contain any major constraints associated with contamination.

7.1.2 Impact assessment

Landform

The Project would change the topography of the site following closure and rehabilitation. The Project would have a total disturbance area of approximately eight hectares and create an excavation which would change the topography of the Project site.

Geology and soils

Soil would be removed and stockpiled for use in the rehabilitation of the Project site. Erosion of the soil would also be a potential impact of the Project, if appropriate erosion and sediment controls are not undertaken for their storage. The removal of this material would expose the remaining rock to weathering and ultimately inundation with water; however, this is expected to only impact the surface of the rock.

Land and soil capability

The Project site is regionally mapped as LSC Class 3, 4 and 7 land.

Review of the *Land and Soil Capability Assessment Scheme: Second Approximation* (OEH 2012) indicates that LSC Class 3 land has moderate limitations. OEH (2012) indicates cropping and intensive grazing are able to be undertaken, with careful management of limitations to avoid land and environmental degradation. LSC Classes 4 and 7 land have high limitations if used for agricultural land uses more intensive than grazing with limited or no cultivation; with few management practices available to overcome these limitations.

Land use

The Project will have minimal impact on adjacent existing agricultural activities, with the Project expected to coexist with the surrounding agricultural land uses in the locality. The impacts of the Project on the surrounding residences are addressed throughout the relevant sections of this EIS.

The landform of the final quarry would create a void. The benches of the quarry would be rehabilitated, but it is unlikely that mature vegetation could be established for many years and only for species which could adapt to the quarry conditions. As the area is not actively logged or suitable for any intensive agricultural pursuit, this impact is not considered to be significant.

Contamination

Potential sources of contamination during construction and operation of the quarry include:

- Spillage of fuels, oils and chemicals
- Inappropriate disposal of wastes
- Degraded potentially hazardous materials in soils
- Residual fuels, oils or chemicals in soils.

The Project site consists predominantly of cleared land which has been subject to past disturbance through agricultural activities. It is considered that there is low potential for any contaminated material to be present in the soil. If any contamination is present in the soil it is likely to be in small isolated areas. Management measures outlined below would minimise the potential for harm if any area of contamination was identified during site set up or operation.

7.1.3 Mitigation measures

An Environmental Management Plan (EMP) would be prepared prior to the construction phase of the Project. The EMP would describe the measures to be implemented to manage soils and minimise the potential for erosion and sedimentation impacts. The Project would be operated in accordance with a quarry plan detailing processes such as topsoil management, the final landform and rehabilitation.

- Where topsoil is to be disturbed, GISC will implement the following procedures:
  - Topsoil will be stripped prior to quarrying and stockpiled separately for later reuse in rehabilitation activities.
  - Where topsoil stockpiles are expected to remain in place for longer than three (3) months they will be re-grassed with local native seed to inhibit erosion, dust and siltation.
  - Where possible, freshly stripped topsoil will continue to be placed directly onto rehabilitated areas to reduce the potential for loss of soil structure and make best use of soil seed stores.

- Erosion and sediment controls will be implemented in accordance with *Managing Urban Stormwater Soils and Construction – Volume 2e Mines and quarries* (Landcom, 2004).
- Extraction of the resource would be undertaken in stages to minimise the area of disturbance at any one time.
- If obvious signs of contamination such as discoloured soils or odorous soils are encountered during construction, work will stop in the vicinity of the area and, if considered safe to do so, samples will be collected for analysis.
- Fuels, lubricants and chemicals will be stored and, where practicable, used within containment/hardstand areas designed to prevent the escape of spilt substances to the surrounding environment.
- The amount of hazardous material stored and used on site will be kept to the minimum practicable.
- Personnel will be trained in spill containment and response procedures.
- Appropriate spill response material will be kept on site.
- Appropriate maintenance schedules for plant and equipment will be followed to detect and repair leaks.
- Spills will be reported and managed in accordance with legislative and licensing requirements.

7.2 Water resources

The *Water Resources Assessment* (GHD,2016a) (Appendix F) assessed the impacts from the construction and operation of the Project on the water environment, and where required, identified feasible and reasonable management measures.

7.2.1 Existing environment

Surface water

An intermittent unnamed tributary of Back Plain Creek runs through the Project site. The tributary only flows following rainfall events although there are a number of small farm dams located throughout the Project site that hold water. Back Plain Creek is a tributary of the Wellingrove Creek, flowing into the Severn River to the north.

The water quality of the unnamed tributary is unknown but due to the cleared, agricultural use of the catchment it is expected to be contaminated with anthropogenic sources (e.g. sediments, nutrients, manure).

Groundwater

Geological investigations undertaken by SMEC (2016) included drilling eight boreholes three of which were located in the vicinity of the proposed pit. The three boreholes were drilled to depths of 18 m to 25 m below ground level (approximately 4 m to 13 m below the base of the proposed pit). Groundwater inflows were not noted during drilling however some water was noted in the bores on completion of drilling and was attributed to drilling fluid residues (SMEC, 2016).

Groundwater investigations undertaken by GISC between 10 October 2016 and 21 October 2016 included drilling six boreholes in the footprint of the proposed quarry area. Four of which intercepted groundwater at depths ranging 7.5 to 17.4 m BGL (1172.5-1157.6 m AHD). It is noted however that this investigation proceeded after a period of above (double) average

rainfall[1]. The floor of the proposed quarry is 1170 m AHD, indicating that groundwater may be intercepted by the quarry.

As stated in Section 7.1, the proposed pit is located on a ridgeline. The GISC results indicate perched groundwater is present along the ridgeline. Based on the GISC data, groundwater levels within the proposed quarry area vary from approximately 1173 m AHD to approximately 1158 m AHD. Monitoring data indicates a groundwater flow direction from the top of the ridgeline towards the north. The groundwater deposit would be directly recharged by rainfall and discharge at lower elevations on the slopes and drainage lines to the north in the vicinity of the proposed quarry area and the site. GHD considers it is likely that GISC observed groundwater levels above typical levels due to above average rainfall. Following periods of lower rainfall, groundwater levels in the vicinity of the quarry area would be lower. The groundwater intercepted as part of groundwater investigations undertaken by GISC is considered to be an isolated deposit of perched groundwater that is separate from the regional groundwater. The regional groundwater table is not expected to be intercepted by the quarry.

The mapped alluvial sediments are located outside the site boundary. The alluvial sediments lie at lower elevations along creek lines. The proposed extraction will not extract groundwater from the alluvial sediments.

The search identified 14 bores within approximately 5 km radius of the site. The majority of the bores (14) were registered for stock or domestic purposes. The closest stock and domestic bore was located approximately 1 km to the west of the site boundary and approximately 1.8 km to the north west of the proposed extraction area.

Groundwater is likely to be present within the fractured basalt rock aquifer below the base of the pit. The results of the registered bore search, indicate that the yield from the basalt aquifer is typically less than 2 L/s.

The mapped alluvial sediments are located outside the site boundary. The alluvial sediments lie at lower elevations along creek lines. The proposed extraction will not extract groundwater from the alluvial sediments.

7.2.2 Impact assessment

Surface water

Potential risks at the site with relation to surface water were identified based on the nature of the works and the surrounding receiving environment. The key risks identified were:

- Insufficient water available to meet site demands.
- Discharge of sediment-laden water.
- Modification of downstream flow volumes and regimes.

The results of the water balance are indicated on Figure 7-1 with a summary of key results below:

- Based on the size of the basin, the quarry would have insufficient runoff volumes during an average and dry year to supply the operational demands of the quarry. The volume of external water required is estimated to be 0.15ML/year in an average year and 2.18ML/year in a dry year.

[1] Recorded rainfall between June 2016 and September 2016 (the four months preceding groundwater monitoring by GISC) at the Glen Innes Agricultural Weather Station [Bureau of Meteorology (BoM) station number 056013] was 427 mm. Based on a review of long term rainfall recorded at this station between 1910 and 2016, average rainfall from June to September was 212 mm and 95th percentile recorded rainfall from June to September was 361 mm.

- The site would discharge water during all scenarios modelled, although this would be less than without the quarry.

It is likely that the external water use would be even less than the model indicates because water resources would be used more conservatively when the supply is limited. The model is also based on a catchment area of six hectares, so if water supply is limited, diversion drains could be used to increase the catchment area. Likewise, the size of the basin could be increased to hold more runoff. As a last resort, the external water would be sourced from other dams on site or from the existing Glen Innes quarry. It is therefore considered the quarry would have sufficient water supply to operate.

Due to the quarry being located in the upper catchment and the lack of sensitive environments downstream, the reduction in the volume of water is not expected to result in a significant volumetric impact on downstream waterways in comparison with natural flow regimes. This is supported by the maximum harvestable rights.

The erosion and sediment control assessment indicated the rate of sediment generation from the quarry and access roads will be less than 150 cubic metres per year, meaning that a sediment basin is not required in accordance with Landcom (2004). However, a 1.2ML sediment basin has been proposed, in accordance with Landcom (2005), to collect water from the quarry pit. This would collect runoff up to the design rainfall event of 38 mm occurring over a five-day period.

Water quality runoff from the remainder of the site would be managed via controls in accordance with Landcom (2005).

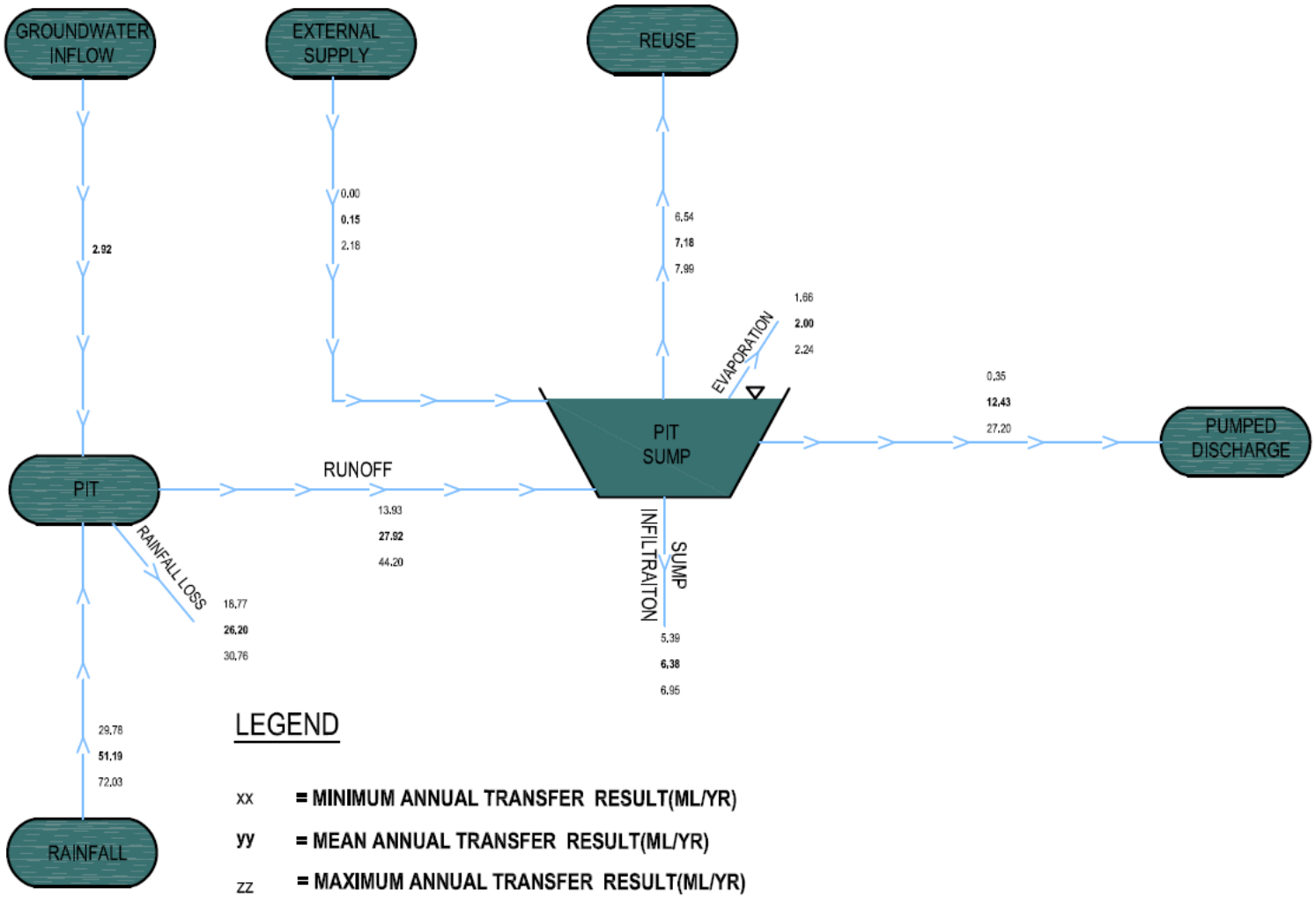


Figure 7-1 Water balance results

Groundwater

Based on reported groundwater elevations and a pit floor elevation of 1170 m AHD, it is possible that groundwater would be intercepted during excavation of the proposed quarry area.

Six inflow scenarios were assessed with the results indicating that groundwater inflows could be between 1.9 m^3/day and 81.2 m^3/day with the most likely estimate considered to be 8.0 m^3/day. Note that the groundwater inflow rates are average long term rates and no groundwater inflow would occur until the quarry pit intercepts the water table.

The radius of influence on groundwater from the proposed quarry is estimated to be between 152 m and 372 m. The most likely estimate for radius of influence is considered to be 195 m.

The NSW Aquifer Interference Policy requires that potential impacts on groundwater sources, including their users and GDEs, be assessed against minimal impact considerations, outlined in Table 1 of the Policy. The below is a summary of the comparison of the Project with these considerations:

- The Project is not predicted to impact any water supply works.
- The Project would not result in impacts to any culturally significant sites.
- The Project would not result in any impacts to high priority GDEs.
- The proposed excavation is not predicted to have any adverse impacts on groundwater quality.

7.2.3 Mitigation measures

General

- An environmental protection licence (EPL) will be obtained for the quarry. All relevant conditions relating to soil and water management will be implemented as required by the EPL.
- An Environmental Management Plan will be compiled for the works which will contain a Soil and Erosion Management Plan. Training will be provided to all quarry staff including relevant sub-contractors on erosion and sediment control practices and the requirements of the Plans through inductions, toolboxes and targeted training.
- If groundwater is intercepted, WaterNSW is to be contacted and a groundwater water access licence (WAL) obtained. Based on the most likely estimate for groundwater inflow of 8.0 m^3/day, an annual allocation of 2.9 ML/year will need to be licenced under the WM Act.

Water supply

- A 4,000 m^3 basin will be required for water supply. Where available, and of appropriate quality, the quarry operation will use recycled runoff for quarry activities.

Erosion and sedimentation control

- Implement erosion and sediment controls in accordance with Managing Urban Stormwater Soils and Construction – Volume 2e Mines and quarries (Landcom, 2004).
- Increase the size of the water supply basin by 1.2ML to act as a sediment basin.

Material storage and management

- Designated impervious bunded facilities will be provided for cleaning and/or maintenance of vehicles, plant or equipment. These facilities will be located at least 20 metres away from natural and built drainage lines.
- All chemicals and fuels associated with the quarry will be stored in roofed and bunded areas. Spill kits will be provided at all chemical storage facilities/compound sites.
- Where refuelling is required onsite, the following management practices will be implemented:
  - Refuelling will be undertaken on level ground and at least 20 metres from drainage lines, waterways and/or environmentally sensitive areas
  - Refuelling will be undertaken within the designated refuelling areas with appropriate bunding and/or absorbent material
  - Refuelling will be via a designated refuelling truck
  - Refuelling will be attended at all times
  - Spill kits will be readily available and all personnel will be trained in their use. A spill kit will also be kept on the refuelling truck at all times
  - Hand tools will be refuelled within lined trays of site vehicles wherever possible
  - An emergency spill kit (such as oil absorbent material) will be available onsite at all times to contain and clean up any accidental hydrocarbon spill
  - Any contaminated material will be disposed at an appropriately licensed facility and used spill kit materials replaced.
- Regular checks of vehicles working at the quarry will be conducted to ensure that no oils or fuels are leaking.

Monitoring

- The basin is to be monitored to confirm it complies with the EPL and Managing Urban Stormwater Soils and Construction – Volume 2e Mines and quarries (Landcom, 2004) requirements.
- To confirm groundwater levels, a series of groundwater wells should be established around the quarry pit.
- A routine monitoring program should be established to include regular inspections and maintenance of erosion controls, especially after rain.

7.3 Noise and vibration

A *Noise and Vibration Impact Assessment* (NIA) (GHD, 2015b) report (Appendix H) was prepared to address the overall noise impacts from the Project. The scope of work for the NIA involved:

- A review of the surrounding study area to gain an understanding of local site features and the location and nature of potential sensitive receivers.
- A review of existing environmental studies, as applicable.
- 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 Project 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.

7.3.1 Existing environment

Existing noise levels in the area surrounding the Project site are low and typical of a rural environment, with the monitoring indicating they were less than 30 dB(A) at each of the three monitoring locations. The rating background level (RBL) for these locations has been set to 30 dB(A) as directed by the INP.

Project specific construction noise criteria for residential receivers is presented in Table 7-2.

Table 7-2 Project specific construction noise criteria for residential receivers

Time period	Management level $L_{Aeq(15\ min)}$
Recommended standard hours: Monday to Friday: 7.00 am to 6.00 pm. Saturday: 8.00 am to 1.00 pm. No work on Sundays or public holidays	Noise affected level: 40 Highly noise affected level: 75
Outside recommended standard hours (Saturday 1 pm to 4 pm):	Noise affected level: 35 Highly noise affected level: 75

Operational industrial noise criteria are derived from the INP. The INP rural residential category has been adopted for all identified receivers to determine the applicable amenity criteria, which is provided in Table 7-3.

Table 7-3 Project specific operational noise criteria – daytime dB(A)

Criteria	Logger 1 (261 Malboona Rd)	Logger 2 (1296 Gwydir Hwy)	Logger 3 (160 Rose Hill Rd)
Rating background level, $L_{A90(Period)}$	29[1]	29[1]	28[1]
Intrusiveness criteria, $L_{Aeq(15min)}$	35	35	35
Amenity criteria (rural), $L_{Aeq(period)}$	50	50	50
Project specific criteria, $L_{Aeq\ (15min)}$	**35**	**35**	**35**

Note 1: The NSW INP notes that "where the rating background level is found to be less than 30 dB(A), then it is set to 30 dB(A).

The road traffic noise target levels applicable to both construction traffic and operational traffic along public roads is presented in Table 7-4.

Table 7-4 RNP traffic noise target levels at residential receivers – dB(A)

Type of development	Day (7 am – 10 pm)	Night (10 pm – 7 am)
Existing residences affected by additional traffic on existing arterial roads generated by land use developments.	$L_{Aeq(1\ hour)}$ 60 (external)	$L_{Aeq(1\ hour)}$ 55 (external)
Existing residences affected by additional traffic on existing local roads generated by land use developments.	$L_{Aeq(1\ hour)}$ 55 (external)	$L_{Aeq(1\ hour)}$ 50 (external)

7.3.2 Impact assessment

Construction noise and vibration impacts

The highest predicted noise level for any receiver due to construction noise is approximately 26 dB(A) at receiver R3. This is less than the background noise level recorded at each of the three monitoring locations, and is also less than the construction noise criteria set out in Table 7-2.

The construction phase is anticipated to generate only minor construction traffic. Therefore, no significant construction noise traffic impacts are anticipated.

Given that all identified receivers are more than 1 km away from construction areas, construction vibration is anticipated to be below the threshold of human perception. Therefore, no significant construction vibration impacts are anticipated.

Operational noise and vibration impacts

Noise levels were predicted based on the operating conditions outlined in Section 0. The predicted noise levels for daytime site operations are shown in Figure 7-2 and Table 7-5.

Table 7-5 Predicted operational noise levels, dB(A)

Receiver ID	Day time noise criteria, dB(A)	Predicted level, dB(A)
R1	35	28
R2	35	22
R3	35	30
R4	35	26

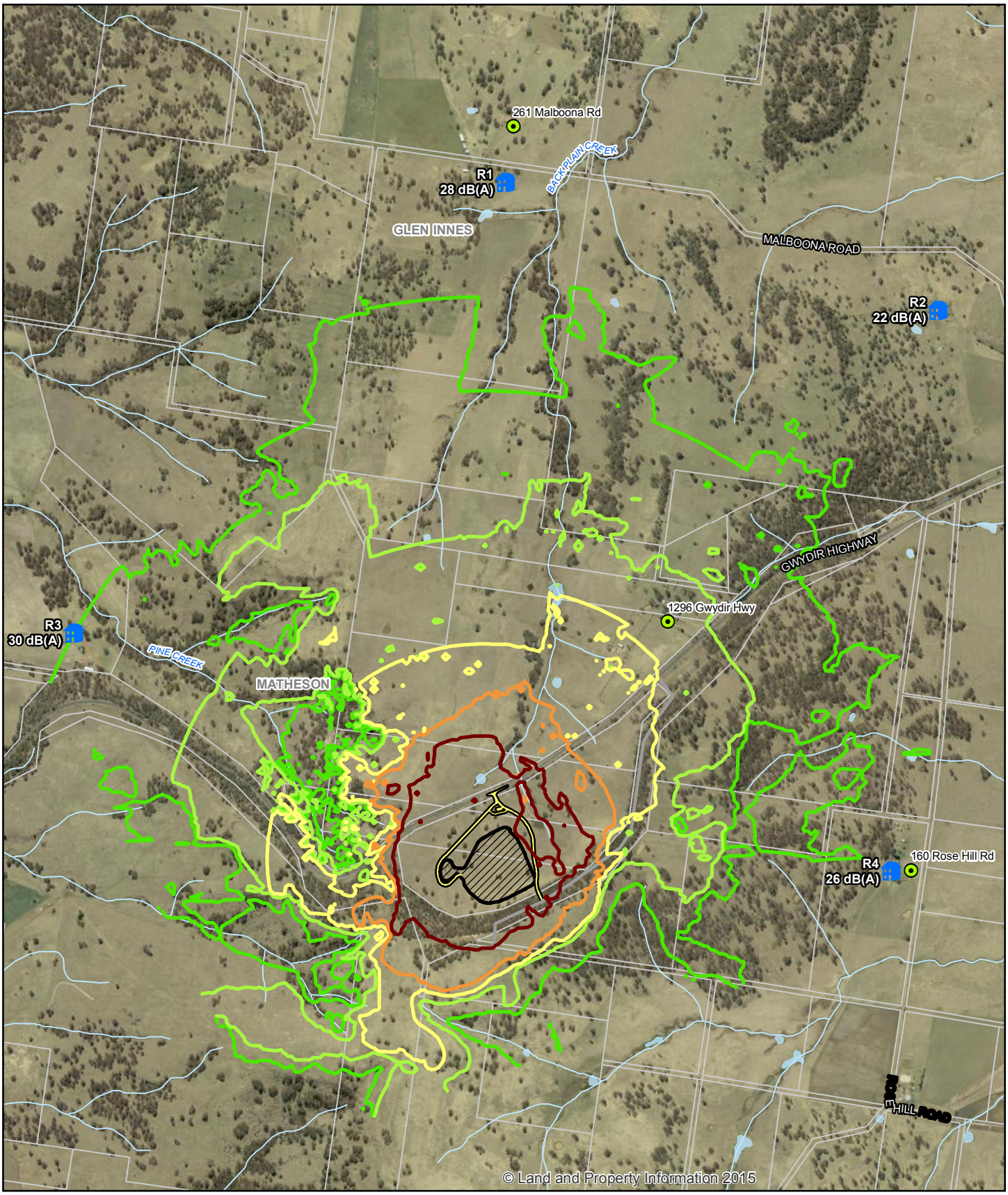
Model results indicate that noise levels generated from quarry operations are predicted to comply with the INP daytime noise criteria at all sensitive receivers. It should be noted that modelling predictions have been based on meteorological conditions that are favourable to noise propagation. This assessment is therefore considered to be conservative.

Noise predictions have been based on operations at the existing ground level. It is noted that as the pit floor is lowered, the quarry walls would offer increasing shielding. Predicted noise levels are therefore expected to reduce as the quarry progresses.

Given that all identified receivers are over 1 km away from operational plant, operational vibration is anticipated to be below the threshold of human perception. No significant operational vibration impacts are therefore anticipated.

Road traffic

The NIA predicts that there will be no road traffic noise impacts due to additional heavy vehicles travelling along the wind farm access road. According to Annual Average Daily Traffic data, additional heavy vehicles travelling along the Gwydir Highway would not be significant compared to existing traffic volumes, and would therefore not trigger the RNP 2 dB increase criterion. The RNP objectives are therefore predicted to be met for additional heavy vehicle movements along either public road.



LEGEND

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

Noise Contours: LAeq
Grid height: 1.5m
Predicted using ISO 9613
No Mitigation Measures

- 30
- 35
- 40
- 45
- 50

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

Predicted operational noise contours

Job Number 18380
Revision
Date 15 Nov 2016

Figure 7-2

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\Noise\2218380_SQN002_NoisePredictions_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, kpsroba

Blasting impacts

Air blast overpressure and ground vibration levels have been predicted for a range of charge masses and are shown in Figure 7-3 and Figure 7-4 for varying distances, assuming average blasting parameters. The distance to comply with the *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (ANZEC, 1990) is also shown.

The predicted results shown in Figure 7-3 and Figure 7-4 indicate that blasting would be restricted by the air blast overpressure rather than the ground vibration levels.

Based on the assumed site specific constants and an approximate distance of 1600 metres from receiver R4, Figure 7-4 indicates that the ANZEC recommended over pressure limit of 115 dB peak approximately equates to a Maximum Instantaneous Charge (MIC) of 120 kilograms.

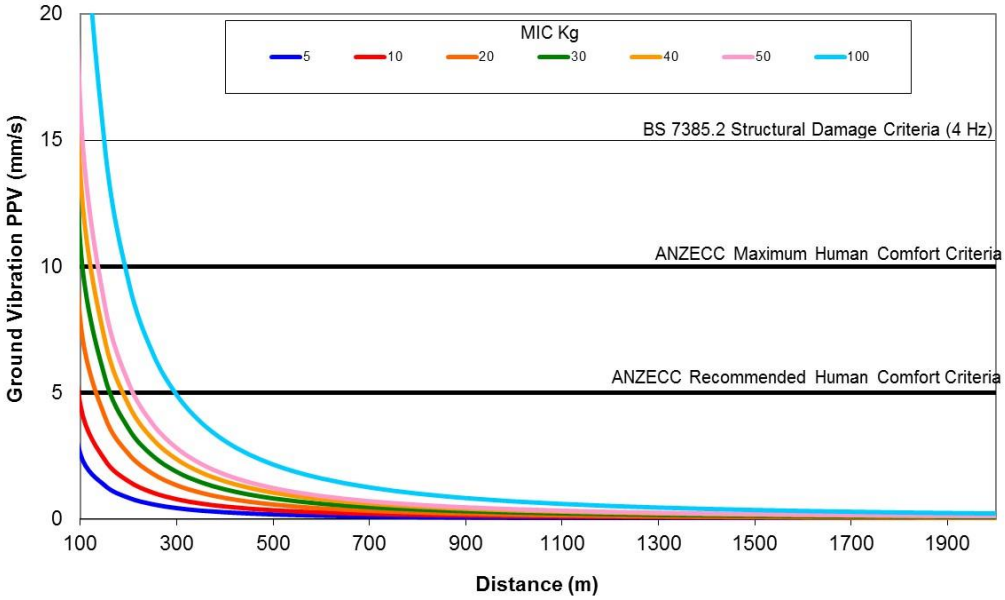


Figure 7-3 Ground vibration predictions for different charge masses and distances

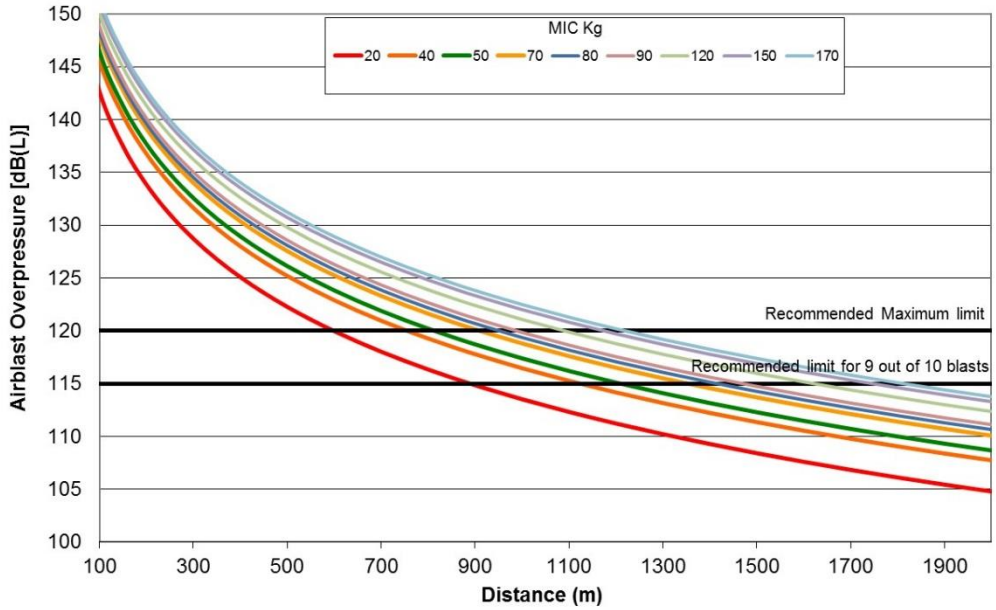


Figure 7-4 Air blast overpressure predictions for different charge masses and distances

7.3.3 Mitigation measures

Although construction and operational noise for the Project is predicted to comply with the relevant noise and vibration criteria, general procedural mitigation measures are below to avoid community disturbance.

Work ethics

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

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

Community relations

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

- The quarry manager would erect a sign at the entrance of the quarry with a phone number and permanent site contact so that noise complaints could be received and addressed in a timely manner.
- Upon receipt of a noise complaint, noise monitoring would be undertaken and reported as soon as possible. If exceedances are detected, the situation would be reviewed in order to identify means to attempt to reduce the impact to acceptable levels.

Blasting mitigation measures

It is recommended that all sensitive receivers be informed when blasting is to be undertaken. Reducing charge mass and increasing distance is the most effective way of reducing blasting impacts. Blasting would only occur between 9 am to 5 pm, Monday to Friday and would not generally take place more than once per day.

Adverse meteorological conditions such as temperature inversions and wind direction can significantly increase airblast overpressure levels. Temperature inversions are most common during night and early morning periods, particularly during winter periods and therefore should not affect blasting during the recommended standard hours.

Due to variability in blasting impacts, it is recommended that monitoring be undertaken during initial blasts at the site to confirm predictions and assess compliance with the ground vibration and airblast overpressure limits.

7.4 Air quality

An *Air Quality Impact Assessment* (AQIA) (GHD, 2015c) report (Appendix G) was prepared to address the overall air quality impacts from the proposed quarry. The scope of work for the AQIA involved:

- 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.

7.4.1 Existing environment

An annual wind rose is provided in Figure 7-5. The annual average wind speed is relatively high at 4.1 m/s and predominately from the east-south east.

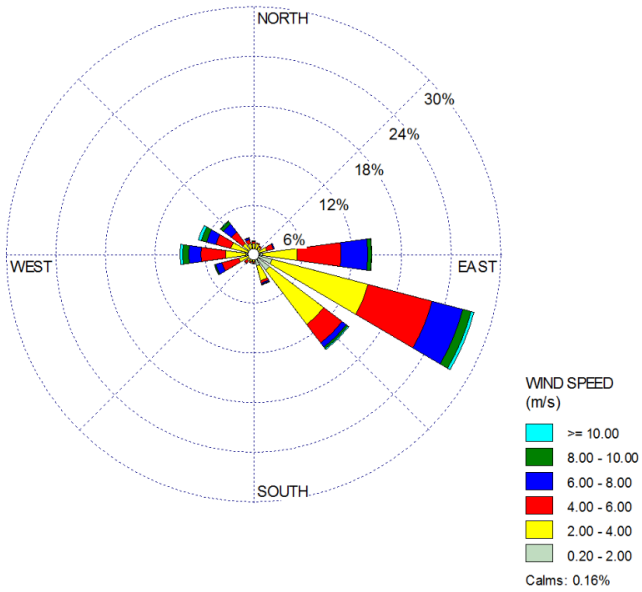


Figure 7-5 Annual wind rose

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 7-6 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.

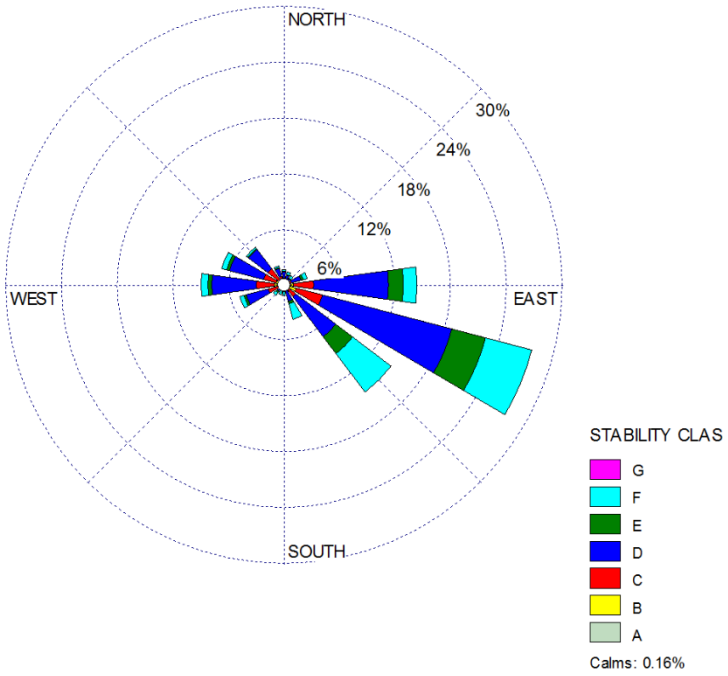


Figure 7-6 Annual atmospheric stability rose

There is limited information available on the air quality of the area, therefore, default levels have been considered in the AQIA. A rural background daily average for PM_{10} can be quantified at 15 µg/m^3.

7.4.2 Impact assessment

The AQIA 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. Table 7-6 provides the dust and particulate matter assessment criteria from the *Approved Methods*.

Table 7-6 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).

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.

Figure 7-7 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.

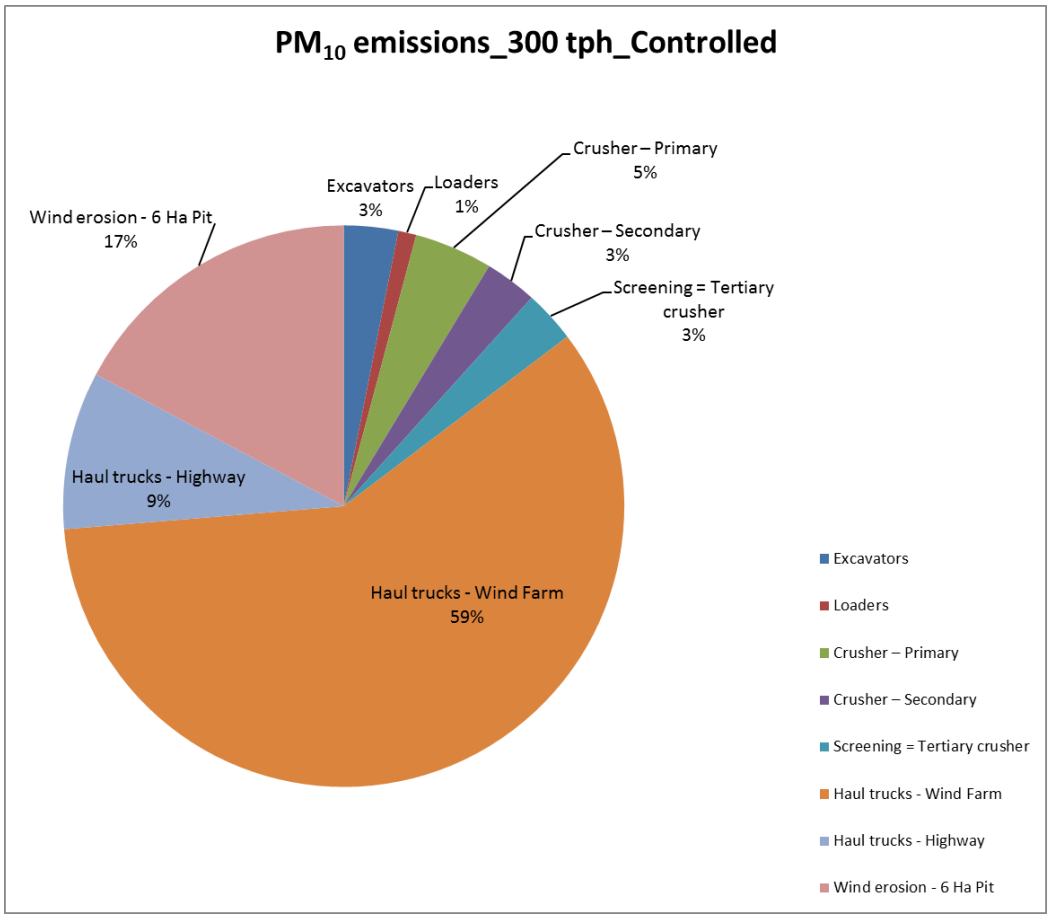
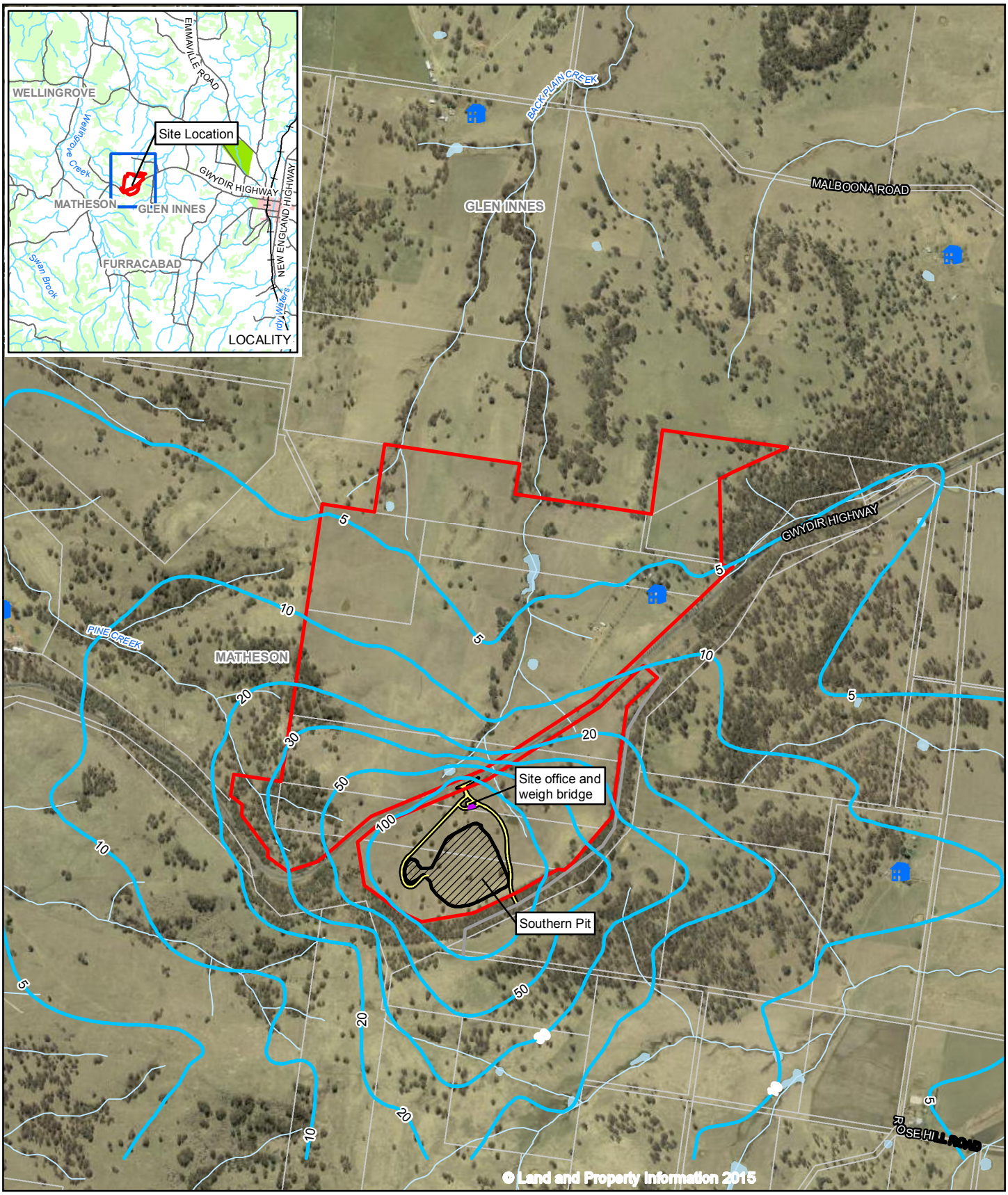


Figure 7-7 Breakdown of PM10 emissions

Table 7-7 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). Figure 7-8 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 7-7 Maximum daily PM_{10} (µg/m^3) impact at sensitive receptor locations

Identifier	PM10 (µg/m^3)
R1	7.7
R2	13.2
R3	1.8
R4	2.4
R5	1.2
R6	5.8



LEGEND

- Project boundary
- Cadastre
- Watercourse
- Waterbody
- Site office / weigh bridge
- Residences
- Existing access
- Site access
- Disturbance area
- Incremental daily PM (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 18380
Revision
Date 23 Nov 2016

Southern Pit Maximum Daily PM_{10} Figure 7-7

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\AirQuality\2218380_SQAQ001_AirQualityContours_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, gmcdiarmid

As indicated by Table 7-8, the deposition impact is very low, compared to the criterion and likely to be immeasurable.

Table 7-8 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

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.

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 some boundaries of the site 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.

Greenhouse gas

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

The following scopes of emissions were considered:

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

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

- Construction emission sources:
  - Fuel consumption during construction activities.
  - Vegetation removal.
- Operation emission sources:
  - Fuel consumption during operation of the plant.
  - Transport of product 50 km off site.

The greenhouse gas emissions are estimated to be approximately 26,700 t CO_2-e over a 20 year life (approximately 1,335 t CO_2-e per annum on average). Emissions associated with the transportation of material from the facility were estimated to be about 66% of emission for the proposal. The next greatest source of emissions at 32% was fuel consumption during operations.

The proposal's likely emissions are minor compared with Australia's and NSW total GHG emissions. In 2011/12 Australia's greenhouse gas emissions were estimated as 554.6 Mt CO_2-e and New South Wales' greenhouse gas emissions were 154.7 Mt CO_2-e. The emissions from the proposal per annum would be approximately 0.0005% of New South Wales' total greenhouse gas emissions and 0.0002% of Australia's total GHG emissions in 2010/11. Emissions during peak operation could be as high as double the average annual emissions. These high emissions would still be minor compared with total emissions for NSW and Australia.

7.4.3 Mitigation measures

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 (i.e., water sprays on crushers and screen, watering stockpiles and watering roads at >2L/m^2/hr), and air quality monitoring programmes are not required.

Mitigation measures to reduce greenhouse gas emissions are:

- Opportunities for the use of biodiesel should be investigated and used where possible.
- Efficient plant and vehicles would be used where reasonable and feasible to do so.
- Turn off engines when not in use.

7.5 Biodiversity

The *Flora and Fauna Impact Assessment* (GHD, 2016d) (Appendix E) has assessed the potential for impacts on ecological values, with particular emphasis on threatened ecological communities, populations and species listed under the TSC Act, FM Act, and MNES listed under the EPBC Act. Mitigation measures to ameliorate potential impacts of the Project are also included.

7.5.1 Existing environment

State-listed threatened biota

Database searches identified one threatened flora species; Austral Toadflax (*Thesium australe*) and one threatened fauna species; Koala (*Phascolarctos cinereus*), which are listed under the TSC Act as potentially occur in the locality of the Project site. Of these, only Austral Toadflax (*Thesium australe*) is considered to have the potential to occur within the study area, based on the presence of suitable habitat.

One state listed endangered ecological community was identified within the study area; Mountain Gum – Ribbon Gum Open Forest of Drainage Lines of the Southern New England Tablelands Region.

Federally listed threatened biota

The database searches identified four threatened ecological communities (TECs), 10 threatened flora species, 19 threatened fauna species and seven migratory species listed under the EPBC Act as potentially occurring in the locality of the disturbance area. Of these, one threatened flora species (*Thesium australe*) and two threatened fauna species (Regent Honeyeater and Swift Parrot) are considered to have the potential to occur within the disturbance area, based on the presence of suitable habitat, previous records or known occurrences within the disturbance area.

Field survey

A total of 37 species of flora from 16 families were recorded, comprising 22 native and 15 exotic species. The Asteraceae family was the most diverse family recorded (9 species), followed by the Poaceae (5 species) and Caryophyllaceae (4 species).

No threatened plants were recorded within the disturbance area, however habitat for one threatened flora species; Austral Toadflax (*Thesium austral*) was identified.

Vegetation within the Project site was linked to landscape position and topography, with two vegetation types identified:

- Low condition – Ribbon Gum – Mountain Gum Grassy Woodland EEC (71.35 ha).
- Low condition – Ribbon Gum – Mountain Gum derived native grasslands and exotic grasslands (141.09 ha).

Vegetation within the disturbance area was in low condition, as a result of historical and ongoing disturbances associated with land clearing, cattle grazing and pasture improvement. The disturbance area had relatively low floristic diversity, as evidenced by the low number of species recorded overall. There were very few groundcover species that would normally be present in moderate/good condition grassy woodland.