Appendix 9

Noise Impact Assessment

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Brandy Hill Expansion Project

Environmental Impact Statement

Appendix 9A

Noise Impact Assessment

Brandy Hill Expansion Project

Environmental Impact Statement

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Hanson Heidelberg Cement Group

Brandy Hill Quarry Expansion

Noise & Vibration Impact Assessment

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EXECUTIVE SUMMARY

Vipac Engineers and Scientists Ltd (Vipac) was commissioned by Hanson Heidelberg Cement Group to conduct a Noise and Vibration Impact Assessment for the proposed expansion of the existing Brandy Hill Quarry, at 979 Clarence Town Road, NSW.

This report presents the Noise & Vibration Impact Assessment that has been prepared to assess the potential impacts associated with the proposed expansion of the Quarry.

A noise impact assessment has been undertaken to determine the potential noise impact associated with the proposed expansion of the existing Brandy Hill Quarry, on noise sensitive receptors in the surrounding area.

Noise prediction modelling has been undertaken for each of the proposed five operational stages associated with the proposed expansion of the quarry, taking into consideration both the neutral and worst-case conditions during the day, evening and night periods. The predicted noise impact associated with the proposed expansion on the noise sensitive receivers ranged between 1 to 41dB(A), which is within the applicable Project Specific Noise Level criteria during the daytime, evening and night period. The results of the noise impact assessment for the construction phases of the proposed quarry expansion also indicate that the predicted noise levels will comply with the applicable noise criteria.

The predicted noise generated by the Brandy Hill Quarry Operations and Quarry Traffic on Brandy Hill Drive would comply with the daytime and night-time noise criteria provided the total number of truck movements on Brandy Hill Drive is kept within the acceptable limit of 584 truck movements during the daytime and 78 truck movements during the night-time periods respectively. The potential sleep disturbance impact from the overall level of road traffic generated noise, including potential traffic movements associated with the proposed Brandy Hill Quarry Expansion would be within the applicable criteria at the nearest noise sensitive receiver, assuming that the total volume of traffic movements as outlined above is not exceeded.

Predicted noise levels associated with all other activities on-site at the proposed Quarry Expansion comply with the applicable noise criteria during the day, evening and night periods. It is therefore Vipac's professional opinion that the proposed Brandy Hill Quarry Expansion is acceptable from an acoustic point of view.

While it is acknowledged that there are no specific mitigation measures required in conjunction with the proposed expansion phases of the Quarry, it is none-the-less recommended that a Noise Compliance Management Strategy should be implemented for the Quarry, which should include provision for a noise monitoring programme to monitor operational phase noise emissions from Brandy Hill Quarry, in accordance with the requirements of NSW EPA

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1 INTRODUCTION

Vipac Engineers and Scientists Ltd (Vipac) was commissioned by Hanson Heidelberg Cement Group to conduct a Noise and Vibration Impact Assessment for the proposed expansion of the existing Brandy Hill Quarry, at 979 Clarence Town Road, NSW.

This report presents the Noise & Vibration Impact Assessment that has been prepared to assess the potential impacts associated with the proposed expansion of the Quarry.

2 GLOSSARY OF TERMS

A list of commonly used acoustical terms (and their definition) used in this report is provided below in ***Table 1***, as an aid to readers of the report.

Table 1: Definition of Acoustical Terms

Term	Definition
$L_{eq,1hr}$	Equivalent Continuous Noise Level - which, lasting for as long as a given noise event, has the same amount of acoustic energy as the given event for the period of one hour.
$L_{A10,1\ hr}$	The noise level, which is equalled or exceeded for 10% of the measurement period of one hour.
$L_{A90,T}$	The noise level, which is equalled or exceeded for 90% of a given measurement period, T. $L_{A90,T}$ is used in Australia as the descriptor for background noise.
$L_{Aeq,T}$	The equivalent continuous A-weighted sound pressure level that has the same mean square pressure level as a sound that varies over time, for a given time period. It can be considered as the average sound pressure level over the measurement period and is commonly used as a descriptor for ambient noise.
L_n	The Sound Pressure levels that is equalled or exceeded for n% of the interval time period. Commonly used noise intervals are L_1, L_{10}, L_{90} and L_{99}%.
$L_{Aeq,15hrs}$	The L_{Aeq} noise level for the 15-hour daytime period extending from 7am to 10pm.
$L_{Aeq,9hrs}$	The L_{Aeq} noise level for the 9-hour night-time period extending from 10am to 7am.

3 PROJECT DESCRIPTION

3.1 SITE LOCATION

The Brandy Hill Quarry is located at 979 Clarence Town Road, Seaham, which is a suburb within the Port Stephens local government area in the Hunter Region of New South Wales. The quarry site is located approximately 12km north-west of Raymond Terrace, 3.5km west of Seaham and approximately 175km north of Sydney.

3.2 EXISTING QUARRY OPERATION

The quarry is located on a property that is approximately 554 hectares in area of which 18.6ha is occupied by the pit, 11.1ha by the plant and 5.3ha occupied by the stockpile area. The surrounding area is predominately zoned as rural landscape with minimal primary production. The quarry produces approximately 620,000 tonnes of material per year, which equates to approximately 150 truck movements each day. The peak period for truck movements is between 6am to 12pm with on average 80% of daily activities occurring between those periods. Road access to the quarry site is off Clarence Town Road at the intersection with Brandy Hill Drive

It is Vipac's understanding that the existing quarry is permitted to operate on a 24-hour basis, but that this does not occur at present. The current typical operational hours of the quarry are outlined in ***Table 2***.

Table 2: Typical Operational Hours

Activities	Operation Hours
Sales	6am to 5pm , Monday to Friday 6am to 12pm , Saturday Sunday as required by market demand
Crushing Plant	6am to 6pm

3.3 PROPOSED QUARRY EXPANSION

The proposed quarry expansion will involve extending the life of the quarry to allow for extraction of additional resources up to 1.5 million tonnes per annum. The proposed extraction area extension includes resources beneath part of the existing quarry infrastructure area. In order to accommodate the proposed extraction area, it is proposed to relocate the existing plant infrastructure approximately 500m south of the current location, as shown in ***Figure 1***.

It is also proposed to receive concrete washout waste from concrete batch plants in order to produce blended recycled aggregates and road base during Stage 1 or Stage 2. Approximately 20,000 tonnes of washout material will be received by the concrete batch plants, through mainly the use of tipper trucks and directly using concrete agitator trucks. The material will be processed with the existing site material to process into recycled road base and other fill and drainage materials and the material will be processed within the quarrying operations area.

The proposed quarry has been divided into 5 Stages. The following summarise the expansion of each stage

STAGE 1

The initial stage will comprise of expanding the western end of the quarry towards the south, creating four broad benches running from the southwest to northeast and will create a large quarry pit floor at RL 22-metres. Overburden from this area will be used to create a bund wall at the southern end of the proposed fixed plant location.

STAGE 2

Stage 2 will further expand the existing western end of the quarry towards the southwest of the proposed expansion boundary. Seven broad benches will be created and the quarry pit floor will be at RL -8metres. Overburden from this area will also be used to build the bund wall at the southern end of the proposed fixed plant location.

STAGE 3

Stage 3 will expand the quarry along the southern extraction boundary towards the existing plant infrastructure. The western dam will be removed and ten broad benches will be created with the pit floor at RL -38metres. Overburden will be used for finalising the bund wall and for rehabilitation of the benches that have reached their final form.

STAGE 4

Stage 4 will entail widening the benches towards the eastern extraction boundary. This stage will involve moving the existing fixed plant and stockpiles to the designated area. The weighbridge, amenities and maintenance building will be relocated to suit the pit form. At this stage, there will be twelve broad benches and the quarry pit floor will be at RL-58metres. This stage is the last stage where previously undisturbed land will be stripped to allow access to the resource material and to make space for the fixed plant and stockpile area. There will also be a 15metres high noise bund along the boundary of the new fixed processing plant.

STAGE 5

The final stage of the planned pit realises the final form of the quarry. This stage will expand the quarry to the proposed extraction boundary at the eastern and southern end. The final pit will consist of fourteen broad benches and the quarry pit floor at RL-78metres. Full rehabilitation can begin whereby the quarry will be allowed to fill through groundwater seepage and rain events up to RL30metres.

3.4 NOISE SENSITIVE RECEIVERS

A list of the nearest potentially affected noise sensitive receivers to the quarry is provided below in ***Table 3***.

Table 3: Noise Sensitive Receivers

ID	Description	UTM Location (m)		Distance from Quarry approx. (km)	Direction from Quarry (°)
		X	Y		
R1	122B Dunns Creek Road	374075	6388164	3.2	310
R2	16 Uffington Road	375376	6390226	4.3	341
R3	60 Green Wattle Creek Road	374057	6387248	2.8	295
R4	34 Timber Top Road	378601	6388683	3.0	31
R5	35 Timber Top Road	378489	6388803	3.1	29
R6	36 Timber Top Road	378524	6388708	3.0	32
R7	13 Mooghin Road	378852	6385492	1.4	90
R8	14 Mooghin Road	378874	6385763	1.4	87
R9	13 Giles Road	375391	6386160	1.2	273
R10	13B Giles Road	375515	6385619	1.1	257
R11	866 Clarence Town Road	375653	6384015	2.0	231
R12	888 Clarence Town Road	376001	6384145	1.6	227
R13	994 Clarence Town Road	377028	6384170	1.1	188
R14	1034 Clarence Town Road	377412	6384283	1.0	176
R15	1060 Clarence Town Road	377624	6384207	1.0	173
R16	1094 Clarence Town Road	377933	6384401	0.8	153
R17	1189 Clarence Town Road	378709	6385138	1.2	96
R18	1203 Clarence Town Road	379027	6385084	1.5	97
R19	25 Brandy Hill Drive	378318	6381515	3.9	150

The location of the existing plant infrastructure is illustrated in the aerial photograph shown in ***Figure 1***. It should be noted that as part of the proposed quarry expansion plans, the existing plant infrastructure will be relocated to the area outlined above in orange (i.e. the Proposed Plant Area). The distances represented in the Blast Impact assessment therefore differ from the distances presented above in Table 3 of the Noise Impact Assessment as the distances presented in the Noise and Vibration Impact Assessment report refer to the separation distance from the residential properties to the overall site boundary of the quarry, and take account of the proposed expansion area pf the quarry and the relocation of the processing plant to the south of the current positions of the processing plant. The Blast Impact Assessment reports separation distances from the residential dwelling to the proposed future quarry pit boundary, as opposed to the overall quarry site boundary, which includes the processing areas, weighbridge and workshop/maintenance areas, etc.

The locations of the noise sensitive receptors located in the surrounding area are shown in ***Figure 2***, ***Figure 3*** and ***Figure 4***. The noise sensitive receivers taken into consideration in this assessment are representative of the nearest existing noise sensitive receptors to both the existing operational Brandy Hill Quarry and the proposed expansion area of the Quarry. The extent of the property boundary with regard to the surrounding

area of land under the ownership of the Quarry owners and operators (i.e. Hanson Heidelberg Cement Group) is also shown in ***Figure 1***. Vipac were advised that there are no third party sensitive receivers located on the parcel of land located to the southeast of the Quarry between the Quarry and Clarence Town Road. It is understood that the owner of this land parcel does not reside on the land parcel. Therefore, there is no vacant land that is significantly closer to the Brandy Hill Quarry than the noise sensitive prediction locations assessed in this report. Any noise emissions associated with the Quarry on Hanson's own property are assessable against occupational criteria to protect the health of employees.

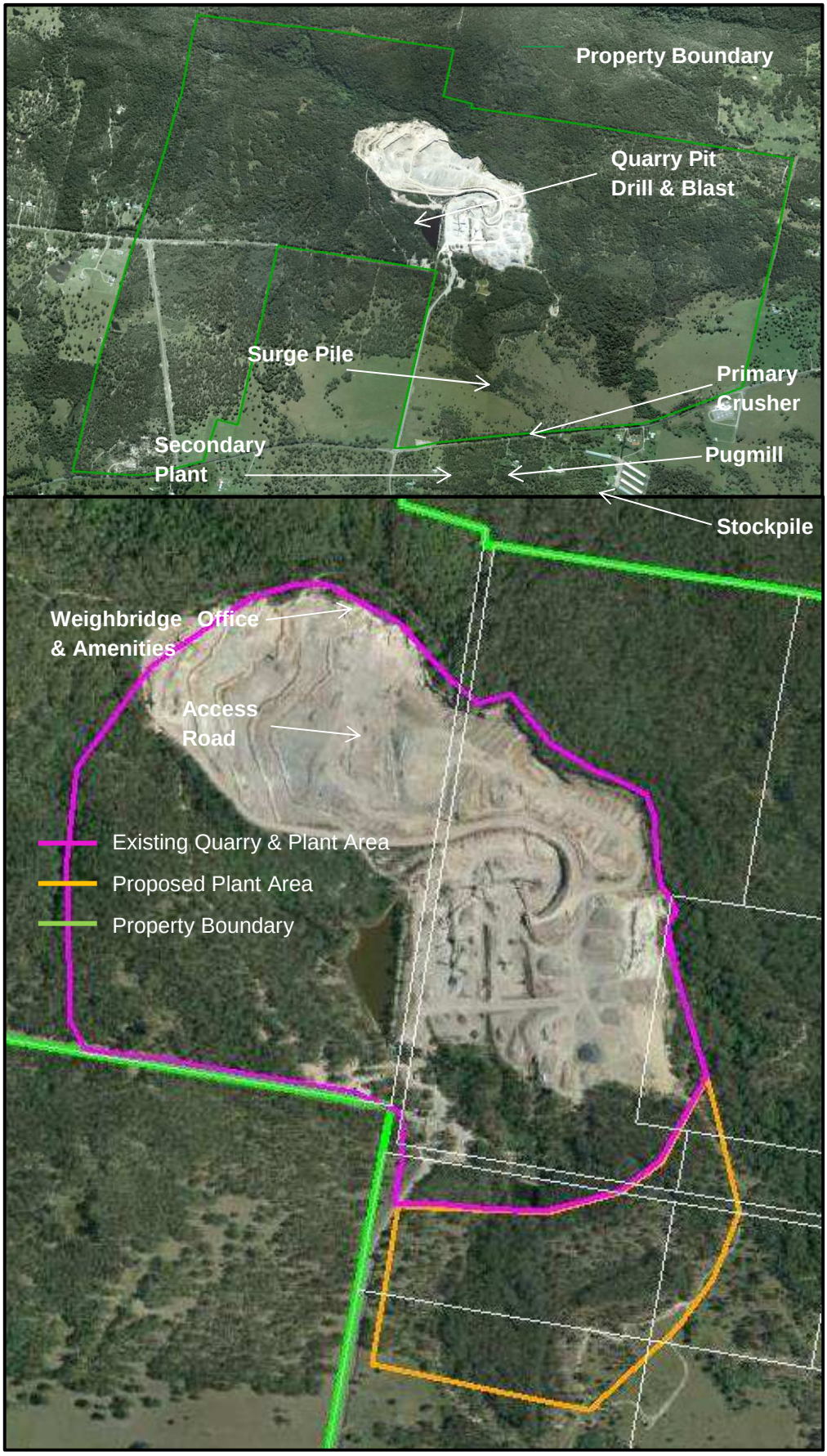

Figure 1: Brandy Hill Property Boundary, Location of Current Infrastructure & Proposed Plant Infrastructure Area

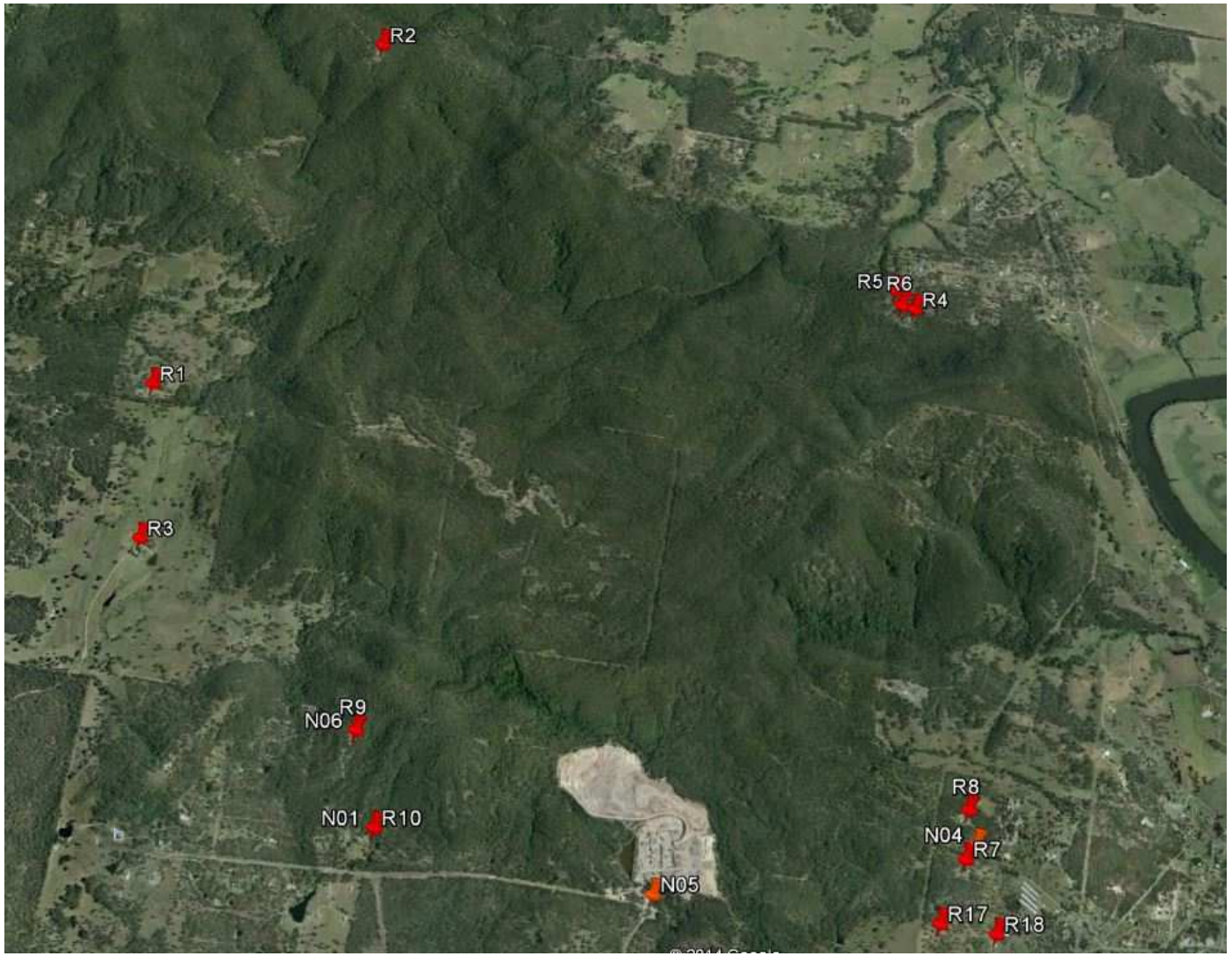

Figure 2: Noise Monitoring Locations (N01, N04, N05 & N06) and Noise Sensitive receivers (R1 to R10 and R17 to R18)

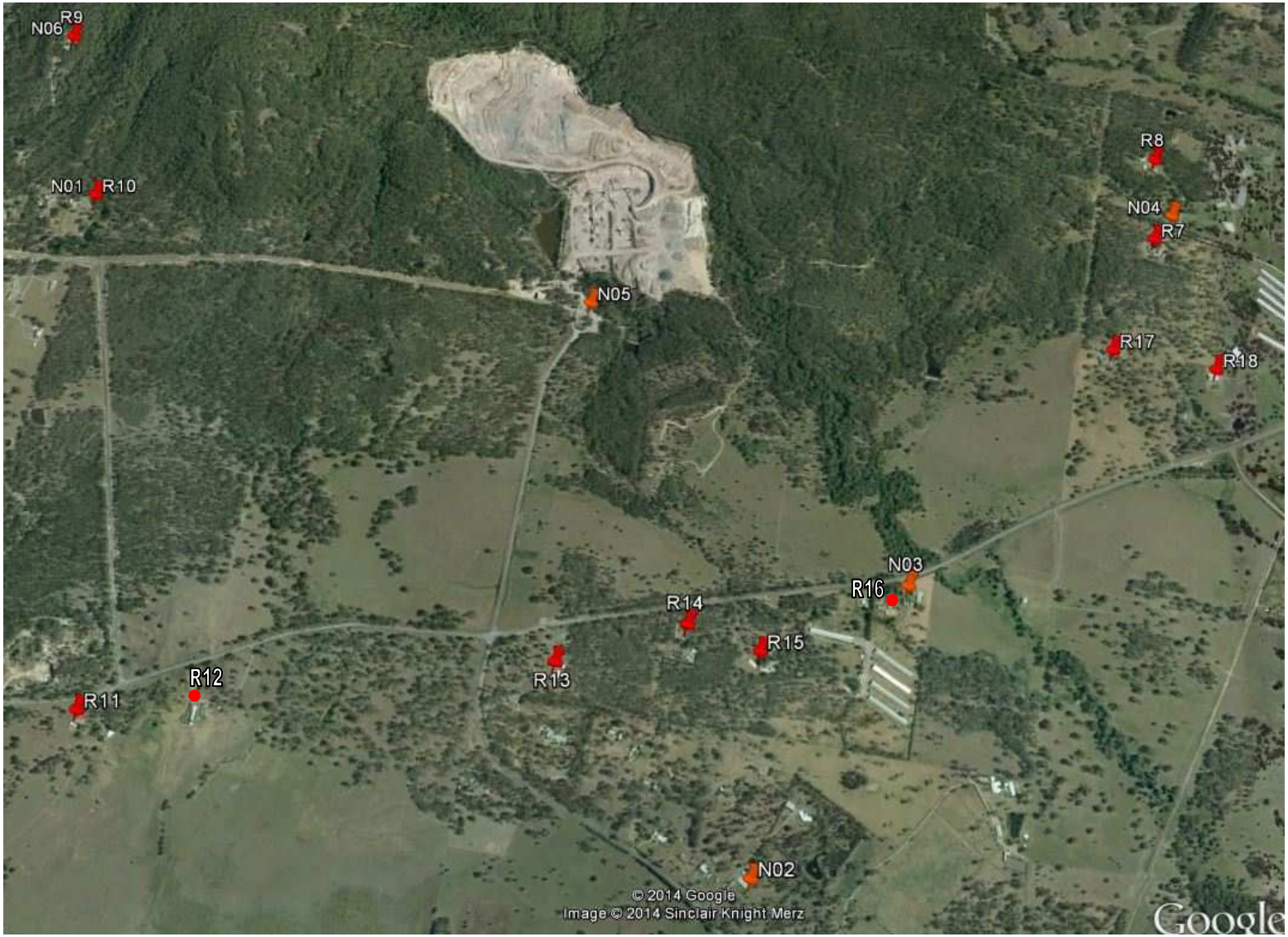

Figure 3: Noise Monitoring Locations (N01 to N06) and Noise Sensitive Receivers (R7 to R18)

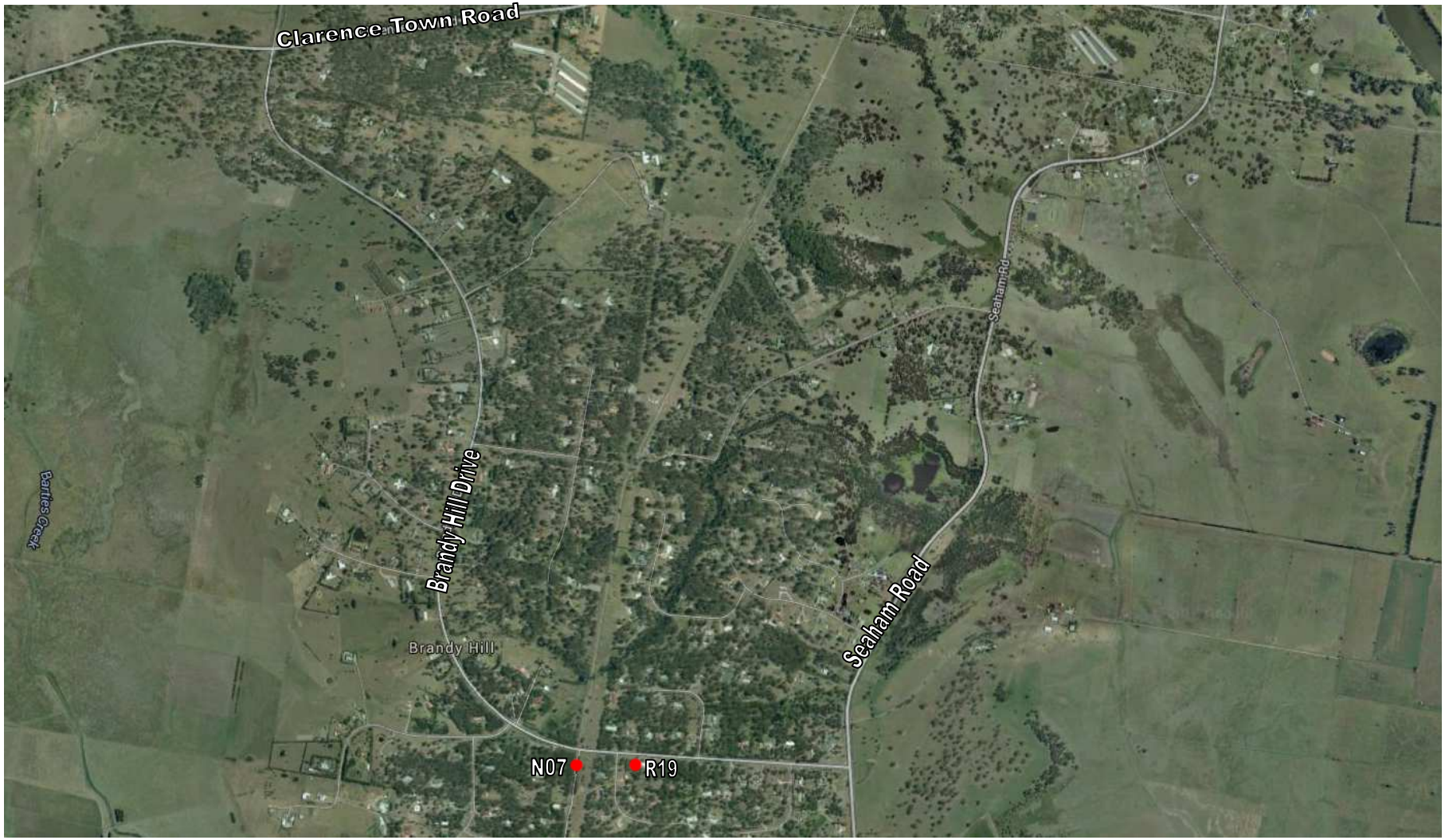

Figure 4: Noise Monitoring Location (N07) and Location of nearest receiver to Brandy Hill Drive (R19)

4 EXISTING NOISE ENVIRONMENT

Vipac installed noise logging equipment at seven locations to measure baseline environmental noise levels at representative noise sensitive receptor locations in the vicinity of the existing (and proposed quarry expansion) site. In addition to the noise sensitive receptors, noise monitoring was also undertaken on-site near the weighbridge at the quarry (N05). The location of the monitoring points are listed in ***Table 4***, and illustrated in ***Figure 2*** to ***Figure 4***.

Table 4: Monitoring Locations

Loc.	Noise Survey Dates	Location / Address	Description	Instrument	Serial No.
N01	09/09/2014 – 17/09/2014	13B Giles Road, Seaham	Residential	LD 870	1464
N02	09/09/2014 – 17/09/2014	90 Brandy Hill Drive, Brandy Hill	Residential	LD 870	1466
N03	16/10/2014 – 24/10/2014	1094 Clarence Town Road, Seaham	Residential	LD 870	1457
N04	16/10/2014 – 24/10/2014	14 Mooghin Road, Seaham	Residential	LD 824	2595
N05	09/09/2014 – 15/09/2014	Brandy Hill Quarry- reference	Quarry site	Duo dB01	10304
N06	17/09/2014 – 23/09/2014	13 Giles Road, Seaham	Residential	LD 870	1465
N07	09/3/2015 – 16/03/2015	33 Brandy Hill Drive, Brandy Hill	Residential	LD 870	1466

The instruments were programmed to accumulate noise data continuously over sampling periods of 15-minutes for the entire monitoring period. Internal software then calculates and stores the Ln percentile noise levels for each sampling period, which can later be retrieved for detailed analysis. Meteorological data during the noise logging survey period was obtained from the Bureau of Meteorology (BoM) Weather Station at Williamtown NSW (061078). Where adverse meteorological conditions such as wind exceeding 5m/s and/or rain were observed in any 15-minutes period, these data were excluded.

The instruments were calibrated using a Rion NC-73 calibrator immediately before and after monitoring and showed a maximum error of 0.5 dB, which is within acceptable tolerances.

A summary of the current ambient noise levels at the monitoring locations as determined for the baseline noise logging surveys is presented in ***Table 5***. The results of the noise logging surveys are presented graphically in ***Appendix A***.

Table 5: Summary of current ambient noise levels (dB(A))

Loc.	Period	L_{Aeq}	L_{A90}	RBL[1]
N01	Day	58	50	48
	Evening	60	53	52
	Night	59	48	47
N02	Day	53	43	42
	Evening	49	43	42
	Night	47	39	36
N03	Day	53	38	37
	Evening	52	45	36
	Night	49	38	33
N04	Day	63	57	56
	Evening	56	52	53
	Night	65	58	56
N05	Day	57	49	48
	Evening	47	44	44
	Night	56	38	33
N06	Day	45	33	32
	Evening	56	29	27
	Night	37	29	23
N07	Day	57	39	38
	Evening	53	40	39
	Night	51	40	36

[1]RBL is the median of the overall assessment background noise level calculated using EPA Industrial Noise Policy methodology as defined in the glossary of acoustic terms

4.1 DISCUSSION OF NOISE LOGGING SURVEY RESULTS

The baseline noise logging surveys were undertaken at monitoring locations representative of noise sensitive receptors located in the vicinity of the quarry site, with the exception of the monitoring point N05, which was undertaken at Brandy Hill Quarry as a reference point location. All of the other baseline noise survey monitoring points (N01 – N04 and N06 – N07) were undertaken at monitoring points representative of residential properties located in the surrounding area. With regard to the summary noise levels and the rated background levels (RBLs) presented in ***Table 5***, it is acknowledged that there are some unusual patterns where in some instances the ambient, background and RBL is raised during the evening and night-time periods, in comparison the levels recorded during the day period.

The variations in the noise logging results for each noise descriptor at each of the monitoring locations are presented graphically in ***Appendix A*** of this report. The variations in the noise levels need to be considered in the context of the monitoring locations and the noise sources apparent at each monitoring location.

In this regard, whereas the setting of each monitoring location was in close proximity to residential properties, it should be noted that while these properties can be described as rural residential properties, three of the monitoring points (i.e. monitoring points N01, N04 and N06) were relatively removed from Clarence Town Road and Brandy Hill Drive, which are the main roads in the area and were less influenced by traffic nosie as a contributor of the overall ambient noise sources noted, while one of the monitoring points was situated in relatively close proximity to Clarence Town Road (i.e. monitoring point N03), and the other two monitoring points were situated in relatively close proximity to Brandy Hill Drive (i.e. monitoring points N02 and N07) and these locations were influenced to a greater extent by intermittent traffic noise during daytime. Of these properties, the most pronounced elevated levels during the evening and night periods were apparent at the monitoring points N01 and N04.

A range of contributory noise sources were noted at all of the baseline noise monitoring locations during the attended daytime noise measurements conducted at each monitoring location as outlined below in ***Section 4.2***. The patterns and the range between the different statistical noise metrics/descriptors (i.e. the L_{A10}, L_{Aeq} and L_{A90} trends) presented in ***Appendix A*** for the noise logging data are notable in that there is a very close correlation between the variations in the L_{A10}, L_{Aeq} and L_{A90} trends for the monitoring locations N01 and N04.

It is noted that the ambient (L_{Aeq}) and background (L_{A90}) levels recorded at N01 during the evening period are raised slightly above the corresponding levels recorded during the day period, this is considered most likely to be associated with the level of insect noise apparent at N01 during the evening period. Similarly, the ambient (L_{Aeq}) and background (L_{A90}) levels recorded at N04 during the night period are raised slightly above the corresponding levels recorded during the day period. These elevated noise levels during the evening and night-time periods are also considered most likely to be associated with the level of insect noise apparent at N04 during the evening and night-time periods. It is also noteworthy that there is a poultry farm located approximately 330m to the south east of the residential property at N04 and there were fans on the western ends of the poultry sheds.

While Vipac did not undertake attended noise measurements at the noise monitoring locations during the evening and night periods, the Vipac Engineers undertaking the noise surveys for the Brandy Hill Impact Assessment, have extensive experience of conducting environmental noise monitoring surveys during evening and night-time periods in similar settings in rural and urban locations in the Hunter Valley and Newcastle regions of NSW. Vipac have experienced similar patterns during attended noise surveys in other rural locations, where elevated noise levels were recorded during evening and night-time periods, due to increased noise associated with insects during these periods, particularly during Spring and Summer seasons, which coincides with the time of year when the noise surveys were conducted at N01 and N04 (i.e. September 2014). An additional notable similarity between the monitoring locations N01 and N04 is that there were freshwater dams/ponds located in close proximity to the residential properties at both of these monitoring locations. Vipac Engineers have experienced elevated levels of insect noise on many occasions during attended evening and night-time noise surveys in close proximity to water features at other locations. It is considered that the patterns whereby elevated levels of background and RBL levels were recorded at a

number of locations during the Brandy Hill baseline noise surveys were attributable to local levels of insect dominated noise in the vicinity of the monitoring points.

4.2 ATTENDED NOISE MEASUREMENTS

In addition to the unattended noise logging surveys, Vipac also conducted short period 15-minute attended noise measurements at the baseline monitoring locations (N01 to N06) to quantify the dominant and contributory noise sources associated with the overall ambient noise levels in the area. The results of the attended noise surveys at each monitoring location are presented in ***Table 6***.

Table 6: Attended Noise Survey results

Loc.	Date & Time	L_{Aeq}	L_{A90}	Description
N01	09/09/2014 11:25	38.9	30.8	Dominant noise source in the area was generally birds chirping. Occasionally, traffic noise on Giles Road and Croft Road was audible at the monitoring position. Two planes at high altitude passed overhead during the survey. Breeze blowing in trees was an influential noise source at times.
N02	09/09/2014 12:21	50.5	36.8	The overall noise environment was dominated by traffic noise on Brandy Hill Drive. Domestic activities such as lawn mowing at a distant property, music playing at a neighbouring property were influential at times during the survey. Additional source was noise from the birds in the area.
N03	09/09/2014 13:31	49.4	32.3	Dominant noise source in the area was traffic noise on Clarence Town Road. Noise from birds in the area was significant at times also. Tractor was working on the farm during the noise survey and was also noted as an influential source.
N04	09/09/2014 15:55	39.7	34.6	The overall noise environment was initially dominated by chainsaw operation at a distance for a period of approximately 2 minutes at the start of the survey. Then the dominant noise source overall was distant road traffic noise. Noise from birds was also significant throughout the survey. Noise from quarry activities was slightly audible at this monitoring location on occasion, when traffic noise was absent and during brief periods when noise from birds reduced temporarily.
N05	09/09/2014 16:47	53.9	52.4	Dominant noise source at this area initially was a quarry truck on the weighbridge. Subsequently the noise environment was dominated by quarry operations in stockpiling area. Birds chirping nearby were audible but not significant.
N06	23/09/2014 12:09	45.0	30.4	Dominant noise source generally was a combination of breeze in trees and birds chirping in the area. Occasionally, dog barking was audible at this monitoring location. In addition, road traffic noise was also faintly audible.
N07	16/03/2015 15:17	55.6	39.9	The overall noise environment was dominated by traffic noise on Brandy Hill Drive. Occasionally, domestic activities were audible at the monitoring location. Noise from birds was also audible throughout the survey

5 CRITERIA

5.1 NSW EPA INDUSTRIAL NOISE POLICY

The NSW Environmental Protection Authority (NSW EPA) Industrial Noise Policy (INP) sets limits on the noise that may be generated by facilities ranging from industrial premises/sites to processing plants and includes quarries such as the Brandy Hill Quarry operations. These limits are dependent upon the existing noise levels at the site and noise sensitive receptors located in the surrounding area and are implemented to ensure changes to the existing noise environment are minimised and deal with the intrusiveness of the noise and the amenity of the environment. The most stringent of the limits is taken as the limiting criterion for the noise source.

The intrusiveness noise criterion requires that the $L_{Aeq,15minutes}$ for the noise source, measured at the most sensitive receiver under worst-case conditions, should not exceed the Rated Background Level (RBL) by more than 5dB, represented as follows:

- $L_{Aeq,15minutes}$ < RBL+ 5dB

Noise levels associated with the proposed Quarry expansion plan and potential impacts on nearby noise sensitive receptors (located in the surrounding area) will be required to comply with the Project Specific Noise Levels detailed in ***Table 7***, which have been determined on the basis of the results of the baseline noise surveys.

Table 7: Project Specific Noise Levels at Noise Sensitive Receptors dB(A)- Residential

Location	Period	L_{Aeq}	RBL	Recommended Acceptable L_{Aeq} [1]	Intrusiveness Criteria Level	Project Specific Noise Level
N01 (rural residential)	Day	58	48	50	53	50
	Evening	60	52	45	57	45
	Night	59	47	40	52	40
N02 (suburban residential)	Day	53	42	55	47	47
	Evening	49	42	45	47	45
	Night	47	36	40	41	40
N03 (suburban residential)	Day	53	37	55	42	42
	Evening	52	36	45	41	41
	Night	49	33	40	38	38
N04 (rural residential)	Day	63	56	50	61	50
	Evening	56	53	45	58	45
	Night	65	56	40	61	40
N06 (rural residential)	Day	45	32	50	37	37
	Evening	56	30	45	35	35
	Night	37	30	40	35	35

5.2 NSW EPA ROAD NOISE POLICY

5.2.1 NOISE ASSESSMENT CRITERIA – RESIDENTIAL LAND USES

The requirements of the NSW Road Noise Policy are also applicable to this assessment. ***Table 8*** summarises the road category to establish the noise assessment criteria based on the type of road and the land use developments.

Potential Brandy Hill Quarry related traffic noise impacts have been assessed on Brandy Hill Drive only, as the vast majority of Hanson (Brandy Hill) truck movements associated both with the existing quarry operations and proposed expansion of the quarry utilise Brandy Hill Drive.

[1] Recommended Acceptable L_{Aeq} noise level for residence in Rural and Suburban area from Table 2.1 in EPA Industrial Noise Policy.

Brandy Hill Drive provides connection between arterial roads (Clarence Town Road/Seaham Road) and local roads and is classified as a sub-arterial road. ***Table 8*** (refer to Table 3 of the RNP) below presents the road noise criteria for a sub-arterial road.

Table 8: Road Traffic Noise Assessment Criteria for Residential Land Uses

Road Category	Type of project / land use	Assessment Criteria/ Target Noise Level, dB(A)	
		Day (7am-10pm) 15-hr	Night (10pm-7am) 9-hr
Sub-arterial road	3. Existing residences affected by additional traffic on existing sub-arterial roads generated by land use developments.	L_{Aeq}, (15-hour) 60 (external)	L_{Aeq}, (9-hour) 55 (external)

Note: These criteria are for assessment against façade- corrected noise levels when measured in front of a building façade. Hence, a correction factor of 2.5 dB is added to the predicted noise levels

5.2.2 RELATIVE INCREASE CRITERIA

As outlined in Section 2.4 of the Road Noise Policy, in addition to the assessment criteria outlined in ***Table 8***, any increase in the total traffic noise level at a location due to a proposed project or traffic-generating development must be considered. Residences experiencing increases in total traffic noise level above the relative increase criteria in ***Table 9*** should be considered for mitigation (refer to Table 6 of the RNP).

Table 9: Relative increase criteria for residential land uses

Road Category	Type of project/development	Total traffic noise level increase dB(A)	
		Day (7am to 10pm) 15-hr	Night (10pm to 7am) 9-hr
Sub-arterial roads	Land use development with the potential to generate additional traffic on existing road	Existing traffic LAeq,15hour + 12dB (external)	Existing traffic LAeq,9hour + 12dB (external)

As stated in Section 3.4 of the RNP, where existing traffic noise levels are raised above the noise assessment criteria, the primary objective is to reduce these through feasible and reasonable measures to meet the assessment criteria. A secondary objective is to protect against the excessive decreases in amenity as the results of a project by applying the relative increase criteria.

In assessing feasible and reasonable mitigation measures, an increase of up to 2dB represents a minor impact that is considered barely perceptible to the average person.

5.2.3 PRACTICE NOTE 3 (SLEEP DISTURBANCE IMPACT)

A substantial portion of the DECC NSW Road Noise Policy (RNP) discusses a review of international research on the subject of sleep disturbance associated with noise. The guidance outlined with regard to road traffic noise and potential impacts on sleep disturbance expands on previous guidance set out in the RTA Environmental Noise Management Manual (ENMM) and earlier guidance set out in the Environmental Protection Authority Environmental Criteria for Road Traffic Noise (ECRTN).

The most recent guidance set out in the RNP states that "*there appears to be insufficient evidence to set new indicators for potential sleep disturbance due to road traffic noise*". The RNP refers to the RTA Practice Note 3 protocol as the method for assessing and reporting on maximum noise levels that may cause sleep disturbance. The guidelines indicate that:

- Maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions, and
- One or two noise events per night with maximum internal noise levels of 65-70 dB(A) are not likely to significantly affect health and well-being.

5.3 NSW DECCW INTERIM CONSTRUCTION NOISE GUIDELINE

The NSW Interim Construction Noise Guideline was developed by the NSW – Department of Environment & Climate Change (DECCW) and contains detailed procedures for the assessment and management of construction noise impacts.

The Guideline presents two ways of assessing construction noise impacts (Initial development of the quarry expansion) – the quantitative method, which is generally suited to longer-term construction works, and the qualitative method, which is generally suited to short-term works (usually not more than 3 weeks) such as infrastructure maintenance.

It is expected that the length of the construction works associated with the quarry expansion will be more than 3 weeks and therefore, a quantitative method has been used for this assessment.

Table 10 sets out the management levels for noise at residences and sensitive land uses, respectively. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level.

Noise management levels associated with the initial development of the proposed expansion area of the quarry are presented in ***Table 11***

It is Vipac's understanding that the initial development (construction) of the proposed expansion area of the Quarry will only occur during standard construction hours.

Table 10: Noise at residence using Quantitative Assessment

Recommended Hours	Time of Day	Management level [1] $L_{Aeq(15min)}$
Recommended standard hours	Monday to Friday - 7 am to 6pm Saturday - 8am to 1 pm No Work on Sundays or Public holidays	Noise affected RBL [2] + 10dB
		Highly noise affected [3] 75dB
Outside recommended standard hours		Noise affected RBL [2] + 5dB

Table 11: Project Specific Noise Levels at Noise Sensitive Receptors dB(A)- Residential

Location	Period	L_{Aeq}	RBL	Noise Management Levels
N01 (rural residential) R10	Day	58	48	58
	Evening	60	52	57
	Night	59	47	52
N02* (suburban residential)	Day	53	42	52
	Evening	49	42	47
	Night	47	36	41
N03* (suburban residential (R011 to R018))	Day	53	37	47
	Evening	52	36	41
	Night	49	33	38
N04 (rural residential) (R04 to R08)	Day	63	56	66
	Evening	56	53	58
	Night	65	56	61
N06 (rural residential) (R01 to R03, R09)	Day	45	32	42
	Evening	56	30	35
	Night	37	30	35

* In accordance with Section 2.2 of the INP, the monitoring locations N02 and N03 have been classified as suburban residential locations on the basis of their proximity to Brandy Hill Drive and Clarence Town Road respectively and the increased contribution of traffic noise on these locations. This contrasts with the other monitoring locations classified as rural residential locations which were influenced to a greater extent by natural noise sources and experienced very little direct traffic noise exposure.

1 Noise levels apply at the boundary that is most exposed to construction noise and at a height of 1.5 m above ground level. If the property boundary is more than 30m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence. Noise levels may be higher at upper floors of the noise-affected residence.

2 RBL is the Rating Background Level as defined in the EPA Industrial Noise Policy.

3 $L_{Aeq\ 15\text{-}minute} \geq 75$ dB is highly likely to generate strong community reactions and should be avoided.

6 MODELLING

Noise prediction modelling was undertaken using the SoundPLAN computational noise prediction software package. The use of the SoundPLAN noise prediction modelling software and referenced modelling methodology is accepted for use in the state of NSW by the Environmental Protection Authority (EPA) for environmental noise modelling purposes. SoundPLAN is a proprietary noise prediction modelling package that has been used for numerous quarrying, mining and industrial noise impact assessments conducted both by Vipac and other Consultancy Practices.

6.1 GEOGRAPHICAL DATA

Table 12 below lists the drawings/information received and used in the noise model.

Table 12: List of Drawings

Description	Date	Provided by
Brandy Hill PDP_May 2014_Stage 1	16.10.2014	Hanson Heidelberg Cement Group
Brandy Hill PDP_May 2014_Stage 2	16.10.2014	Hanson Heidelberg Cement Group
Brandy Hill PDP_May 2014_Stage 3	16.10.2014	Hanson Heidelberg Cement Group
Brandy Hill PDP_May 2014_Stage 4	16.10.2014	Hanson Heidelberg Cement Group
Brandy Hill PDP_May 2014_Stage 5	16.10.2014	Hanson Heidelberg Cement Group
Ground elevation of the study area	15.09.2014	Land & Property Information, NSW

6.2 NOISE SOURCES

A noise emissions survey of the Quarry Infrastructure (mechanical plant & equipment) was conducted during typical operations on 17th& 23rd September 2014 at the existing Brandy Hill Quarry. Subsequently, the sound pressure measurements taken of all major infrastructure components were analysed and calculated sound power levels derived for the machinery (noise source contributor) associated with the current quarry operations. It is proposed that the existing quarry plant will also be used for the proposed expansion area of the quarry.

Vipac understands that Hanson Heidelberg Cement proposed to receive concrete wash out plant from the concrete batch plants in order to produce blended recycled aggregates and road base. In order to determine the noise emission from the concrete wash out plant, Vipac conducted a noise emission survey on the 26th September 2014 at a Hymix concrete plant, which is also owned by the Hanson Group. The concrete plant monitored at the Hymix site is stated to be similar to the plant that will be installed at Brandy Hill Quarry in conjunction with the proposed expansion of the quarry.

Table 13 details the sound power levels of the current mechanical plant and equipment associated with the existing operations and activities at the Quarry site.

Table 13: Quarry Operations - Sound Power Levels (L_w)-dB

Plant & Equipment	L_{WA}	Frequency- Linear										
		16	31.5	63	125	250	500	1k	2k	4k	8k	16k
Crusher 3 + 4	114	118	109	108	107	108	111	109	108	103	98	87
Primary Crusher	115	115	114	118	114	114	113	110	108	102	95	86
Secondary Crusher	120	121	112	115	114	115	115	115	115	110	100	87
Screen 5	107	119	108	108	103	104	102	100	100	99	96	89
Screen 3	122	124	107	111	111	110	113	117	117	113	102	89
Dump Truck CAT 773B Tipping into Crusher	113	109	108	118	112	109	109	107	107	100	92	83
Dump Truck CAT 773B	112	104	102	107	109	104	104	104	109	95	84	76
Excavator - PC600	99	99	94	104	107	99	98	93	87	84	78	69
Loader WA 500	101	99	96	111	106	101	100	95	91	84	79	72
Watercart	103	96	89	106	97	98	101	99	96	89	82	75
Excavator	96	92	91	99	100	96	93	91	87	82	73	65
Pugmill	111	105	106	110	102	108	109	107	103	99	91	85
Volvo L250G	101	94	91	99	106	96	97	97	94	84	76	66
Truck Idling[1]	90	81	92	92	93	89	91	90	91	93	91	84
Truck being loaded[1]	107	103	91	104	101	101	103	100	101	97	91	82
Truck revving[1]	105	93	95	95	95	99	102	99	98	94	88	79

6.3 WEATHER CONDITIONS

Two noise prediction modelling scenarios were run using the SounPLAN program using CONCAWE algorithms in order to approximate the expected neutral and worst-case weather scenarios. It should be noted that sound will propagate further through the atmosphere under certain weather conditions. The 'worst-case' weather conditions chosen are those that are highly conducive to sound propagation.

The weather parameters used in the CONCAWE calculations to approximate expected neutral and worst-case weather situations at the quarry site are outlined in ***Table 14*** below. As operations occur during daytime hours, this situation has been considered in the noise predictions. The weather parameters used in the noise predictions have been determined based on the annual data from the Bureau of Meteorology (BoM) Weather Station at Paterson NSW (061250)

Table 14: Sound Plan Weather Parameters

Parameter	Day		Evening/Night	
	Neutral	Worst-Case	Neutral	Worst-Case
Pasquill Stability Category	B	D	D	F
Wind Speed (m/s)	0	3	0	3
Humidity (%)	53	53	73	73
Temperature (deg Celsius)	18	18	6	6
Met Category	3	5	4	6

[1] Measurement was taken at Hymix concrete plant

6.4 NOISE MODELLING SCENARIOS

Vipac understands that the proposed quarry extension has been divided into 5 stages. ***Table 15*** sets out the activities associated with the noise sources during day and evening/night periods for stages 1 to 5. The difference between each stage in terms of noise emissions will primarily be associated with varying heights associated with the plant items operating in the quarry pit for each stage and the changing location for fixed plant between stages 1-3 and stages 4-5.

Table 15: Quarry activities during the day, evening and night period

Day Period	Evening/ Night Period
• Dump trucks on haul road • Excavators working in the pit • Water truck watering the quarry roads • Loader working in the pit • Loader working in the processing plant area • Primary crusher operations • Crusher 3 and 4 operations • Screens operations • Concrete wash out plant operations • Pug mill operating intermittently • Road haulage trucks entering/leaving the site via the quarry access road	• Loader working in the processing plant area • Crusher 3 and 4 operations • Screens operations • Pug mill operating intermittently • Road haulage trucks entering/leaving the site via the quarry access road

6.5 NOISE IMPACT FROM GENERATED TRAFFIC

The Calculation of Road Traffic Noise (CoRTN) method of traffic noise prediction was used, which is a method approved by the EPA. The traffic data presented in the report entitled Traffic Impact Assessment "Quarry Expansion Project, 979 Clarence Town Road, Seaham" (by Intersect Traffic dated October 2014) was used to calculate the traffic noise generation.

Vipac has been advised by Hanson Group that majority of the Brandy Hill Quarry truck movements associated with the existing quarry operations and proposed future expanded quarry operations will utilise Brandy Hill Drive and therefore only this road is considered for potential road traffic noise impacts associated with the quarry. ***Table 16*** presents the existing traffic volumes obtained from the traffic counter during the auto-count traffic surveys undertaken in March 2015 (by Intersect Traffic), which was used to predict the generated traffic noise impact on sensitive receivers. The traffic data presented in ***Table 16*** was obtained from the traffic counts conducted for one week in March 2015 in conjunction with weighbridge counts to determine the project's current noise traffic contribution. It is noteworthy that the two week traffic counts for the Traffic Impact Assessment were undertaken in September 2014 over a two week period. There will be variation in the different data sets.

The potential traffic generated from the proposed extension quarry has not been confirmed at this stage and Vipac has assessed the potential quarry traffic noise impact for the proposed Brandy Hill Quarry expansion by determining the allowable maximum number of truck movements that can be accommodated on Brandy Hill Drive before the overall road traffic noise levels exceed the applicable noise criteria at the noise sensitive receivers located along Brandy Hill Drive.

Table 16: Traffic Volumes- Brandy Hill Drive

Traffic Details	Base Traffic	Existing Hanson truck movements
Average Daily Traffic -Weekdays	1845	240
Average of Daily Heavy Vehicles -Weekdays	458	
15-hour traffic flows	1630	213
Number of heavy vehicles – 15 hours	400	
9 hour traffic flows	215	27
Number of heavy vehicles – 9 hours	59	
Speed Limit (km/h)	80	80

7 RESULTS

7.1 OPERATIONAL PHASE OF PROPOSED QUARRY EXTENSION

7.1.1 MODELLED QUARRY NOISE – EXISTING OPERATIONAL PHASE

Table 17 provides the predicted noise impact at the calibration point (N05) during typical quarry operations. The operations of the quarry at the time of the measurements included the excavators, loaders, haul trucks, primary crusher, secondary crushers and screens. The noise prediction was also based on the meteorological conditions at the time of the attended measurements.

Table 17: Existing Quarry Operations - Predicted Noise Impact

Location	Quarry Contribution L_{Aeq}(dB)	
	Predicted Noise Levels	Measured Noise Levels
N05	52	54

The results of the noise prediction model show general agreement between the predicted levels and measured noise levels. Calibration of the operational quarry noise prediction model was undertaken by comparing the predicted noise levels with the measured noise levels at the monitoring point N05 based on the proximity of the monitoring point N05 to Hanson quarry pit. It is acknowledged that the noise monitoring point N05 was representative of a reference position on-site at Brandy Hill Quarry and noise monitoring was also conducted at additional monitoring points, representative of noise sensitive receptors surrounding Brandy Hill Quarry. However, the additional monitoring locations (N01, N02, N03, N04 and N06) were situated further from Brandy Hill Quarry and were influenced by other extraneous noise sources such as traffic noise, insects, birds, agricultural and domestic activities near the properties, and were not dominated by noise emissions from Brandy Hill Quarry. The influence of the other extraneous noise sources at the noise sensitive monitoring locations was noted during the attended noise surveys. Noise impact from Brandy Hill Quarry operations was not apparent at these monitoring locations (N01, N02, N03, N04 and N06). Therefore, only monitoring point N05 was used to calibrate the noise model for the quarry operational phase noise predictions.

7.1.2 MODELLED QUARRY NOISE – PROPOSED EXPANSION OPERATIONAL PHASE

Noise prediction modelling has been carried out to identify the potential impact associated with the proposed quarry expansion on the existing noise environment at the nearest noise sensitive receptors located in proximity to the site. The predicted noise levels representative of the operational phase of the expanded quarry for both neutral weather conditions and worst-case weather conditions for each stage during the day and evening/night period are presented in ***Table 18*** and ***Table 19***.

Table 18: Operational Phase - Predicted Noise Impact (Day Period) – dB(A)

Receiver ID	Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		Noise Criteria Day
	Neutral	Worst	Neutral	Worst	Neutral	Worst	Neutral	Worst	Neutral	Worst	
R001	0	0	0	0	0	0	0	0	0	0	37
R002	2	12	2	12	2	12	1	11	1	11	37
R003	0	5	0	5	0	5	0	4	0	0	37
R004	0	2	0	1	0	2	0	0	0	0	50
R005	0	0	0	0	0	0	0	0	0	0	50
R006	0	2	0	1	0	2	0	0	0	0	50
R007	11	20	11	20	12	20	14	24	14	24	50
R008	10	19	10	18	10	19	7	16	6	16	50
R009	4	14	4	13	4	14	2	12	0	9	50
R010	12	20	11	20	12	20	12	22	11	21	50
R011	20	29	19	29	20	29	20	30	20	30	42
R012	23	32	22	32	23	32	23	33	23	33	42
R013	29	38	29	38	29	38	32	41	31	40	42
R014	28	37	28	37	28	37	32	40	32	40	42
R015	26	35	26	35	26	35	29	37	28	37	42
R016	26	35	26	35	27	35	28	37	28	36	42
R017	24	33	24	33	24	33	25	35	25	35	42
R018	20	30	20	30	20	30	20	29	20	29	42

Table 19: Operational Phase - Predicted Noise Impact (Evening/Night Period) – dB(A)

Receiver ID	Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		Noise Criteria Evening/ Night
	Neutral	Worst	Neutral	Worst	Neutral	Worst	Neutral	Worst	Neutral	Worst	
R001	0	0	0	0	0	0	0	0	0	0	35 / 35
R002	0	2	0	2	0	2	3	9	2	8	35 / 35
R003	0	5	0	5	0	5	0	4	0	0	35 / 35
R004	0	0	0	0	0	0	0	0	0	0	45 / 40
R005	0	0	0	0	0	0	0	0	0	0	45 / 40
R006	0	0	0	0	0	0	0	0	0	0	45 / 40
R007	10	15	10	15	9	15	14	19	14	19	45 / 40
R008	7	13	7	13	7	12	6	12	6	11	45 / 40
R009	6	12	6	12	6	12	6	11	0	5	35 / 35
R010	11	16	11	16	10	16	15	21	13	19	45 / 40
R011	20	26	20	26	20	25	22	28	21	26	41 / 38
R012	23	29	23	29	23	28	25	30	24	29	41 / 38
R013	31	36	31	36	31	36	34	38	32	36	41 / 38
R014	28	33	28	33	27	32	34	38	34	38	41 / 38
R015	26	31	26	31	25	30	32	36	31	36	41 / 38
R016	26	31	26	31	25	30	31	35	31	35	41 / 38
R017	23	28	23	28	23	28	25	30	25	30	41 / 38
R018	19	24	19	24	18	23	22	28	22	27	41 / 38

Noise prediction modelling has been undertaken for each of the five operational stages taking into consideration both the neutral and worst-case conditions during the day, evening and night periods.

The predicted noise impact associated with the proposed quarry expansion on the noise sensitive receivers ranged between 1 to 41dB(A). The predicted noise levels associated with each stage of the proposed Brandy Hill Quarry expansion during both the daytime and evening/night periods is within the applicable Project Specific Noise Level criteria during the daytime, evening and night periods, as outlined in ***Table 18*** and ***Table 19*** respectively.

7.2 TRAFFIC NOISE IMPACT

7.2.1 TRAFFIC NOISE MODEL CALIBRATION

The model was calibrated with the noise data from the baseline noise monitoring surveys. The predicted $L_{10, (15hrs)}$ and $L_{10, (9hrs)}$ was compared with the $L_{10, (15hrs)}$ and $L_{10, (9hrs)}$ calculated from logging data, and a calibration constant was determined. ***Table 20*** provides the results of the measured and predicted $L_{10, (15hrs)}$ and $L_{10, (9hrs)}$ values used to calculate the calibration constants.

Table 20: Model Calibration – dB(A)

Period	Noise Parameter	N02	N07
Day Time	Predicted $L_{A10\ (15hr)}$	51.6	59.5
	Logging (measured) $L_{A10\ (15hr)}$	54.0	60.4
	Difference	+2.4	+0.9
Night Time	Predicted $L_{A10\ (9hr)}$	42.9	50.9
	Logging (measured) $L_{A10\ (9hr)}$	49.2	54.4
	Difference	+6.3	+3.5

The model calibration during the day time is generally acceptable and is representative of the dominance of traffic noise on Brandy Hill Drive, in the area during the daytime. However there was a significant difference between the predicted and the logging measurement levels during the night-time, which is most likely representative of the dominance of other noise sources in the area during the night-time (e.g. noise from insects) and the comparatively lower traffic noise levels from Brandy Hill Drive during the night-time. This is also evident in the results of the road traffic auto-counts for Brandy Hill Drive, with an approximate average of 215 vehicles on the road during the night. With lower volumes of traffic on Brandy Hill Drive during the night the ambient noise levels are most likely influenced by other noise sources such as insects, which contributed to elevated noise levels during the night-time as logged during the baseline surveys.

Calibration of the road traffic noise prediction model was undertaken by comparing the predicted noise levels with the measured noise levels at the monitoring point N07 based on the proximity of the monitoring point N07 to Brandy Hill Drive and the proximity of the monitoring point to the sensitive receptor R19, which is the nearest sensitive receiver to Brandy Hill Drive. It is acknowledged that the noise monitoring location N02 was situated at a noise sensitive receptor located off Brandy Hill Drive. However, the receptor at N02 is situated further from the road (approximately125m) than the property R19 (approximately 30m) represented by the monitoring location N07.

Calibration of the noise model was also based on the measured noise levels at N07, given the fact that, of the noise monitoring locations taken into consideration for the purpose of this assessment, the noise levels recorded at N07 were not affected by operational quarry noise emissions from the quarry site or road traffic noise emissions on Clarence Town Road. Quarry traffic accessing Brandy Hill Quarry travels on Brandy Hill Drive and does not generally travel on Clarence Town Road. It was therefore considered that calibration of the model with the measured noise levels recorded at the monitoring location N07 was the most accurate approach.

7.2.2 NOISE PARAMETER CONVERSION

To determine the other required noise parameters, logging data was used to calculate differences between the noise parameters. Correction factors are presented in ***Table 21***.

Table 21: Parameters Calibration – dB(A)

Location ID	Noise Parameter	Measured (L_{Aeq})	Measured (L_{A10})	Difference from Measured Results	Predicted (L_{A10})	Difference from Predicted Results
N02	$L_{Aeq\ (15hr)}$ $L_{Aeq\ (9hr}$	51.1 45.9	54.0 49.2	-2.9 -3.3	51.6 42.9	+2.4 +3.5
N07	$L_{Aeq\ (15hr)}$ $L_{Aeq\ (9hr)}$	56.7 51.3	60.4 54.4	-3.7 -3.1	59.5 50.9	+0.9 +3.5

The total noise source adjustment in the model to predict noise parameters, which include the model calibration and the noise parameter conversion, are shown in ***Table 22*** below. The model calibration value for the night-time period is not added to the overall model adjustment, as the measured noise levels during the night-time were influenced by extraneous noise sources (other than traffic noise, such as insects) and therefore it is assumed that the model calibration during the night-time period is calibrated.

As outlined above, the night-time noise levels were influenced to a greater extent by noise sources such as birds and insects throughout the night, as opposed to traffic noise, which was the dominant noise source in the vicinity of the monitoring locations N02 and N07 during the daytime. It is not possible to model the noise emissions from the natural noise sources such as birdsong and insect noise, due to the variability and randomness of these natural noise sources. The model adjustment/correction factors presented in ***Table 22*** below are calibrated based on the variations recorded during the noise logging surveys in combination with the variations in the predicted road traffic noise levels, in order to more accurately refine the noise prediction results.

Table 22: Summary of Model Adjustments – dB(A)

Location ID	Noise Parameter	Model Cal	Parameter Cal	Total
N02	$L_{Aeq\ (15hr)}$ $L_{Aeq\ (9hr)}$	+2.4 +2.4[1]	-2.9 -3.3	-0.5 -0.9
N07	$L_{Aeq\ (15hr)}$ $L_{Aeq\ (9hr)}$	+0.9 +0.9[1]	-3.7 -3.1	-2.8 -2.2

[1] Day period model calibration is used for the night time model calibration as the measured noise levels were influenced by other sources.

7.2.3 TRAFFIC NOISE IMPACT ASSESSMENT

Only one noise sensitive reception point has been modelled to assess the road traffic noise impact from Brandy Hill Quarry traffic travelling on Brandy Hill Drive. This receiver is considered the nearest receiver to the road, and is situated at a set-back distance of approximately 31 metres from Brandy Hill Drive (R19, 25 Brandy Hill Drive), as shown in ***Figure 4***.

Details of the traffic volumes in the noise predictions are outlined in ***Section 6.5***. The existing traffic volumes on Brandy Hill Drive, Clarence Town Road and the Brandy Hill Quarry Access Road were determined by Intersect Traffic using auto-tube traffic counters. This determined the volumes of all traffic travelling on the road network in the vicinity of the quarry in addition to a separate determination of the volume of Brandy Hill Quarry generated traffic movements on the road network in the area. The associated existing traffic noise levels in the area were determined during the baseline noise logging surveys as the noise loggers were in place during the same time period that the road traffic auto-tube counters were in place. It should be noted however, that the auto-tube counters were positioned at sections of the roads that were not in the immediate vicinity of the noise loggers, in order to eliminate the potential influence of the tyre and tube-count cable interaction on noise levels, which would not be representative of typical conditions.

The result of the noise predictions associated with the existing traffic volumes and the future traffic generated by the proposed quarry are presented in ***Table 23***. The noise levels presented in ***Table 23*** include the façade correction factor of 2.5dB.

The results show that the predicted existing traffic noise levels at the receivers located off Brandy Hill Drive are raised above the noise criteria during the day period. As stated in Section 3.4 of the Road Noise Policy and outlined in ***Section 5.2.2*** above, where the existing traffic noise levels have already exceeded the noise criteria, an increase in total traffic noise level should be limited to 2dB above the corresponding existing noise level at any residential property. In this context, an increase of up to 2dB represents a minor impact that is considered barely perceptible to the average person.

It is reiterated that the day period noise assessment has been assessed based on the criterion whereby the difference between the existing traffic noise level and future traffic noise level should not exceed 2dB, with regard to the applicable daytime noise criteria. For the night-time period noise assessment, the existing noise level is within the noise criteria and therefore the night-time assessment has been assessed based on the applicable noise criterion of $L_{Aeq,9hour}$ 55dB, during the night-time period.

Table 23: Existing and Future Traffic Noise Levels dB(A)

Daytime / Night-time	Day Period ($L_{Aeq,15hr}$)				
	Existing Noise Levels (Base Traffic Flow)	Traffic Generated		Applicable Noise Criteria	Difference
		Allowable Truck Movements	Future Noise Levels dB(A)		
Day period (7am to 10pm)	62.4	584	64.4	64.4	2.0
Night Period (10pm to 7am)	53.7	78	55.7	55.7	2.0

As shown in ***Table 23***, the noise prediction modelling results indicate that it would be acceptable for a total of 584 truck movements inclusive of the existing truck movements of 214 to occur during the daytime on Brandy Hill Drive, without exceeding the applicable noise criteria at the nearest noise sensitive receptor to the road, located along Brandy Hill Drive. The predicted noise level at the residential property associated with a total of 584 trucks passing during the daytime (which is equivalent to an average of approximately 39 [or more precisely 38.9] truck movements per hour) is 64.4dB(A), which is within 2.0dB of the existing noise levels at the nearest property to the road, located along Brandy Hill Drive.

During the night-time period, it is predicted that the maximum allowable number of truck movements would be 78 trucks movements inclusive of the existing truck movements of 28, which is equivalent to an average of 9 (or more precisely 8.7) truck movements per hour, without exceeding the applicable night-time noise criterion

The predicted increase in traffic noise levels from the traffic generated by the proposed expansion of Brandy Hill Quarry is expected to comply with the relative increase criteria requirements of the Road Noise Policy, whereby increases in road traffic noise levels should not exceed the existing road traffic noise levels by more than 12dB.

Overall, the predicted noise generated by Brandy Hill Quarry Operations and Quarry Traffic on Brandy Hill Drive would comply with the daytime and night-time noise criteria provided that the total number of truck movements on Brandy Hill Drive is kept within the acceptable limit of 584 truck movements during the daytime and 78 truck movements during the night-time periods respectively.

7.2.4 SLEEP DISTURBANCE

Table 24 presents the predicted external noise level at the nearest receiver along Brandy Hill Drive (R19), which is situated at a setback distance of approximately 31 metres from the road.

Table 24: Predicted Noise levels, external dB(A)

Existing Noise Level		Future Noise Levels	
$L_{Aeq,9hr}$	$L_{Amax,9hr}$	$L_{Aeq,9hr}$	$L_{Amax,9hr}$
54	72	56	74

Typically building façades exposed to the road are generally closed structures (including doors and windows) which provide a degree of attenuation (in the order of 20dB) to the inside amenity of the building. The corresponding internal noise levels predicted for the property are presented in ***Table 25***, taking into account the expected level of noise reduction for external to internal areas of the property.

Table 25: Predicted Noise levels, Internal dB(A)

Existing Noise Level		Future Noise Levels	
$L_{Aeq,9hr}$	$L_{Amax,9hr}$	$L_{Aeq,9hr}$	$L_{Amax,9hr}$
32	52	36	54

The internal noise levels are predicted to be below the maximum internal noise levels, which is unlikely to cause awakening reaction to the occupants.

7.3 INITIAL DEVELOPMENT (CONSTRUCTION) OF THE PROPOSED EXPANSION AREA OF THE QUARRY

The activities associated with the initial development of the expanded area of the quarry will comprise of excavators removing overburden material and loading the overburden into dump trucks for transportation.

Noise modelling has been undertaken to assess the potential noise impacts associated with the initial development phase of the proposed expanded area of the quarry for all stages. The results of the noise predictions associated with each stage are presented in ***Table 26***.

Table 26: Initial Development (Construction) of Proposed Quarry Expansion – Predicted Noise Impact

Receiver ID	Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		Noise Management Levels (Standard Construction Hours)
	Neutral	Worst	Neutral	Worst	Neutral	Worst	Neutral	Worst	Neutral	Worst	
R001	0	0	0	0	0	0	0	0	0	0	42
R002	0	0	0	1	0	2	0	4	0	0	42
R003	0	0	0	0	0	0	0	0	0	0	42
R004	0	0	0	0	0	0	0	0	0	0	61
R005	0	0	0	0	0	0	0	0	0	0	61
R006	0	0	0	0	0	0	0	0	0	0	61
R007	0	7	3	10	3	10	3	10	4	12	61
R008	0	0	1	9	1	8	0	7	0	5	61
R009	0	0	0	2	0	1	0	0	0	0	61
R010	9	17	2	10	3	10	0	7	4	12	58
R011	9	18	10	19	10	19	9	18	6	15	47
R012	13	21	13	22	12	21	11	20	9	18	47
R013	22	29	17	25	16	25	16	25	15	24	47
R014	22	28	18	26	18	26	18	26	17	25	47
R015	18	25	16	25	16	25	17	25	15	24	47
R016	16	23	17	25	17	25	17	25	12	20	47
R017	8	16	14	23	14	23	15	23	10	19	47
R018	5	14	10	20	11	20	11	20	4	12	47

The predicted results associated with the initial development phase of the proposed expanded area of the quarry indicate that the noise levels are within the applicable Noise Management Level criteria at all of the noise sensitive locations. Therefore, there is no mitigation measures required in association with the construction stages for any of the expansion phases of the quarry.

Regardless, in accordance with standard practice at operational quarries and mines throughout NSW, it is recommended that a Noise Compliance Management Strategy should be implemented for Brandy Hill Quarry. This should comprise of a noise monitoring programme whereby Brandy Hill Quarry operational phase noise emissions are assessed at the nearest noise sensitive receptors by way of an attended environmental noise monitoring survey at a frequency to be determined in consultation with NSW EPA.

8 CONCLUSION

A noise impact assessment has been undertaken to determine the potential noise impact associated with the proposed expansion of the existing Brandy Hill Quarry, on noise sensitive receptors in the surrounding area.

Noise prediction modelling has been undertaken for each of the proposed five operational stages associated with the proposed expansion of the quarry, taking into consideration both the neutral and worst-case conditions during the day, evening and night periods. The predicted noise impact associated with the proposed expansion on the noise sensitive receivers ranged between 1 to 41dB(A), which is within the applicable Project Specific Noise Level criteria during the daytime, evening and night period. The results of the noise impact assessment for the construction phases of the proposed quarry expansion also indicate that the predicted noise levels will comply with the applicable noise criteria.

The predicted noise generated by the Brandy Hill Quarry Operations and Quarry Traffic on Brandy Hill Drive would comply with the daytime and night-time noise criteria provided the total number of truck movements on Brandy Hill Drive is kept within the acceptable limit of 584 truck movements during the daytime and 78 truck movements during the night-time periods respectively. The potential sleep disturbance impact from the overall level of road traffic generated noise, including potential traffic movements associated with the proposed Brandy Hill Quarry Expansion would be within the applicable criteria at the nearest noise sensitive receiver, assuming that the total volume of traffic movements as outlined above is not exceeded.

Predicted noise levels associated with all other activities on-site at the proposed Quarry Expansion comply with the applicable noise criteria during the day, evening and night periods. It is therefore Vipac's professional opinion that the proposed Brandy Hill Quarry Expansion is acceptable from an acoustic point of view.

While it is acknowledged that there are no specific mitigation measures required in conjunction with the proposed expansion phases of the Quarry, it is none-the-less recommended that a Noise Compliance Management Strategy should be implemented for the Quarry, which should include provision for a noise monitoring programme to monitor operational phase noise emissions from Brandy Hill Quarry, in accordance with the requirements of NSW EPA.

Appendix A NOISE LOGGING RESULTS

Figure 5: Monitoring Location N01

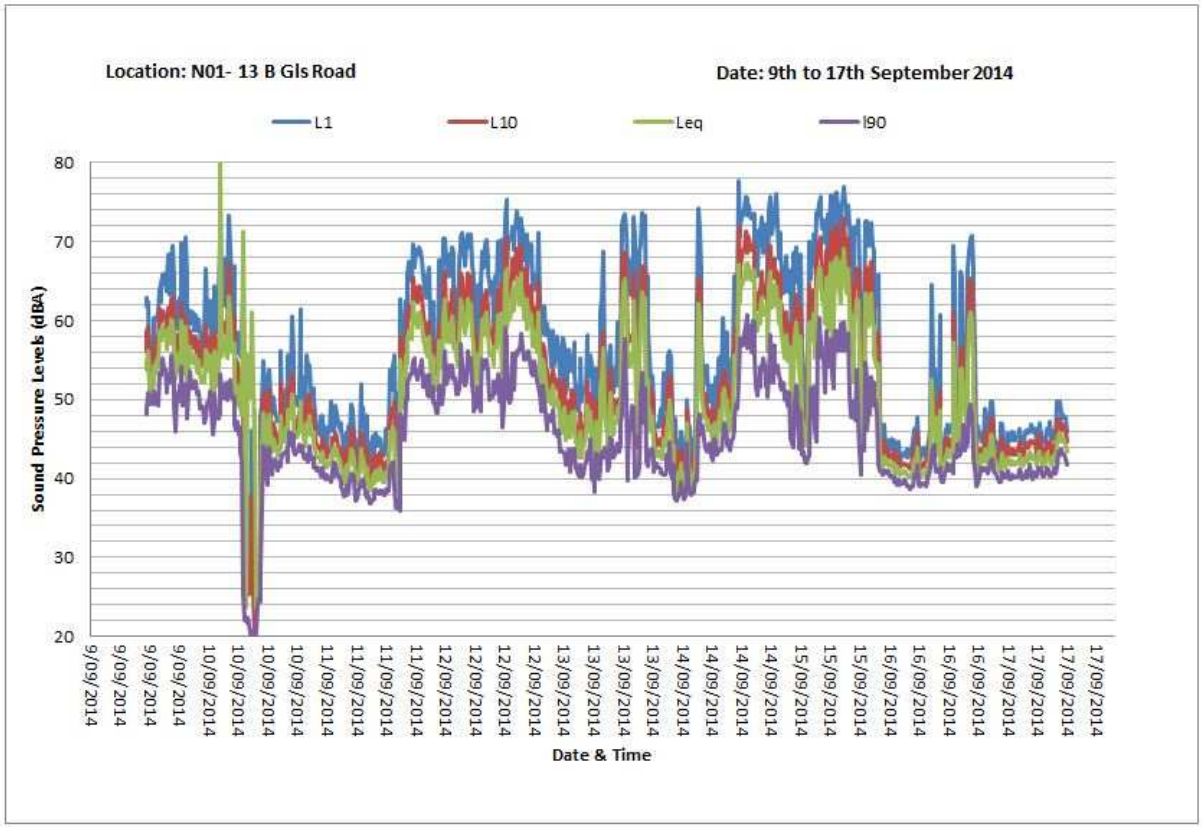

Figure 6: Noise Logging Results- N01

Figure 7: Monitoring Location N02

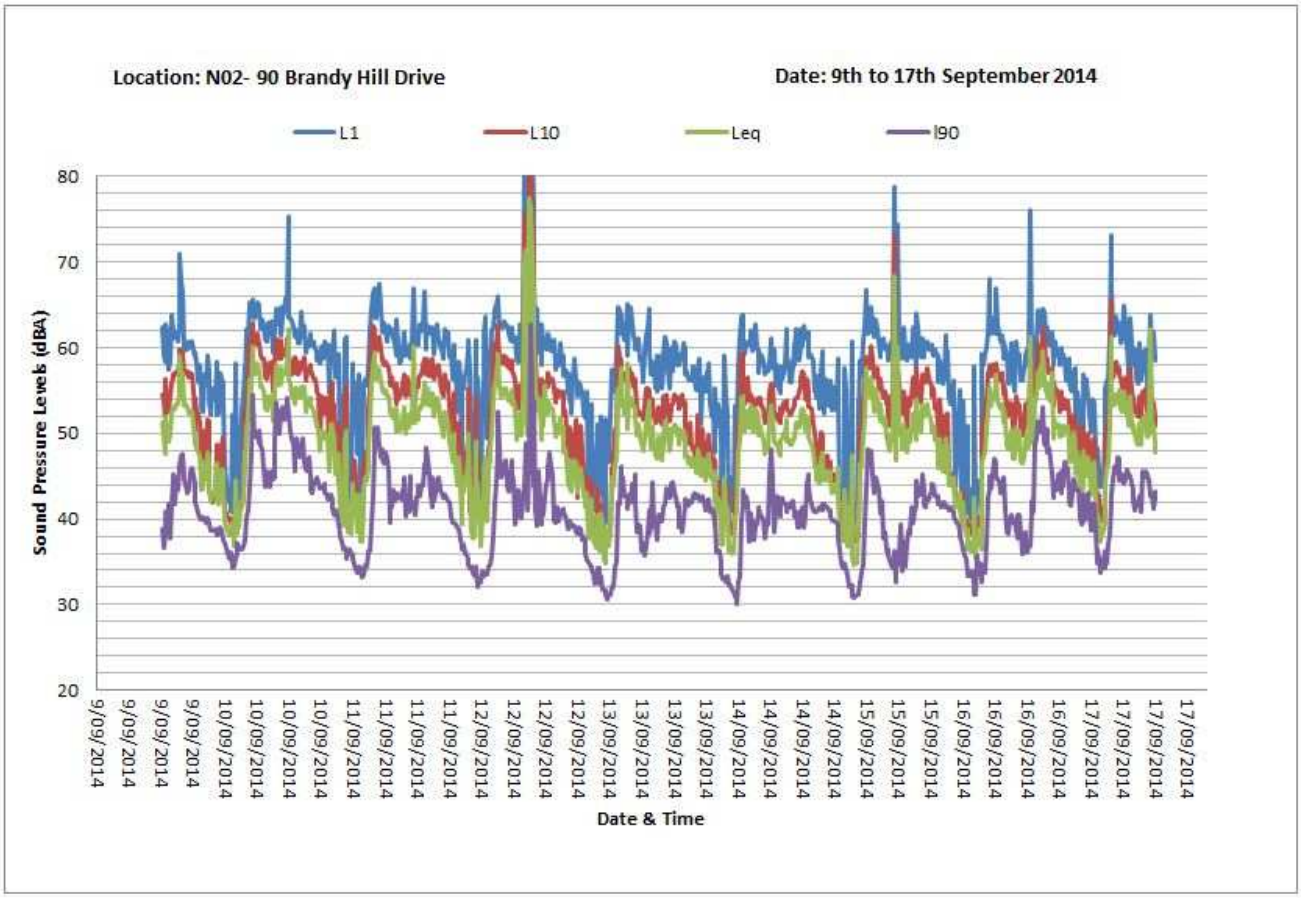

Figure 8: Noise Logging Results- N02

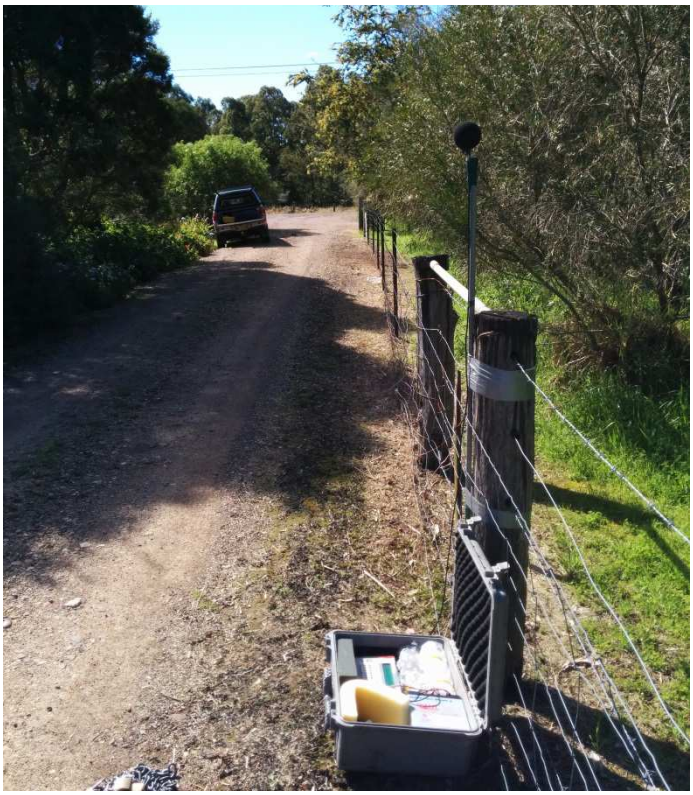

Figure 9: Monitoring Location N03

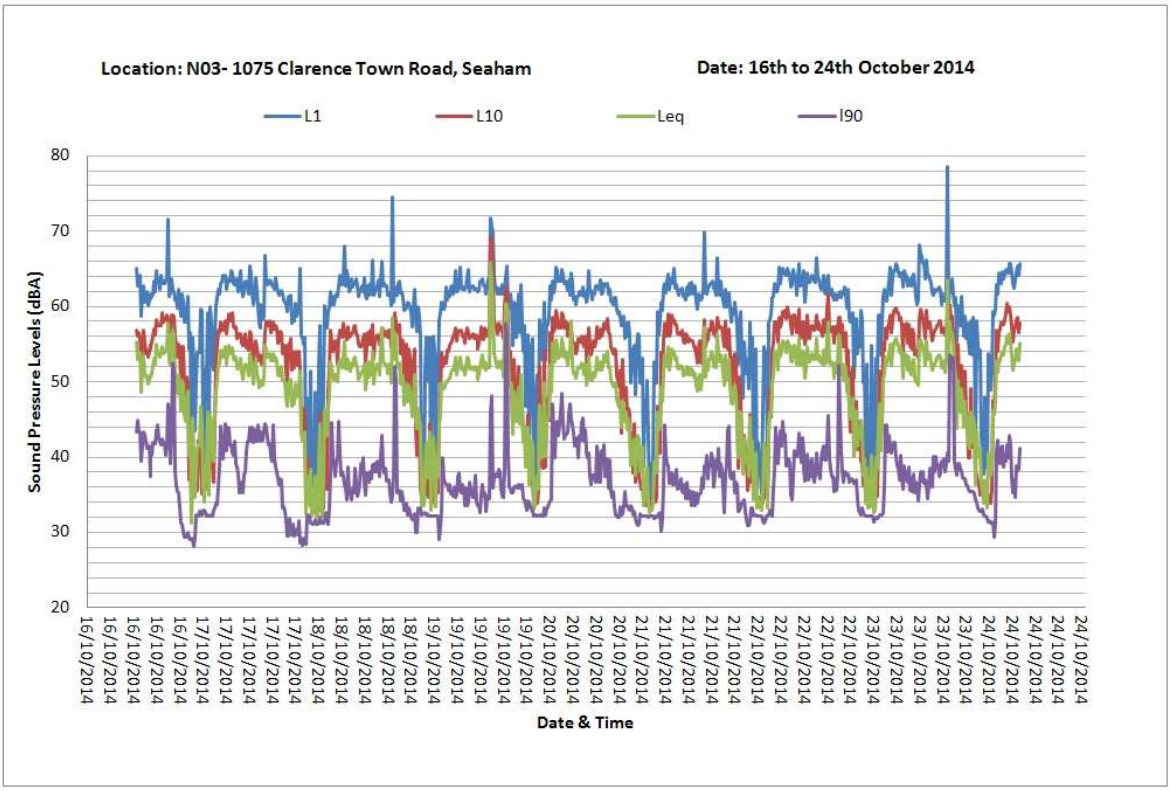

Figure 10: Noise Logging Results- N03

Figure 11: Monitoring Location N04

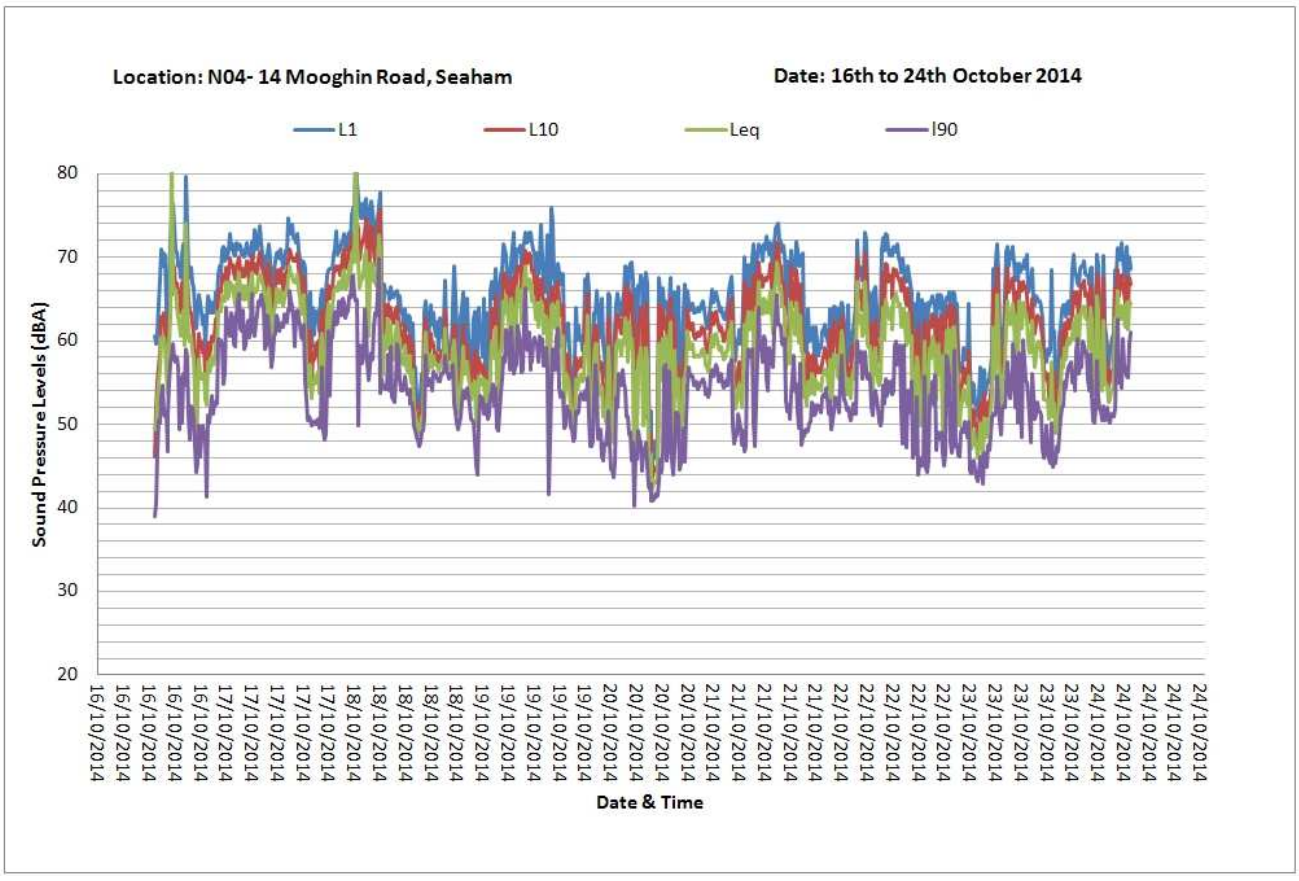

Figure 12: Noise Logging Results- N04

Figure 13: Monitoring Location N05

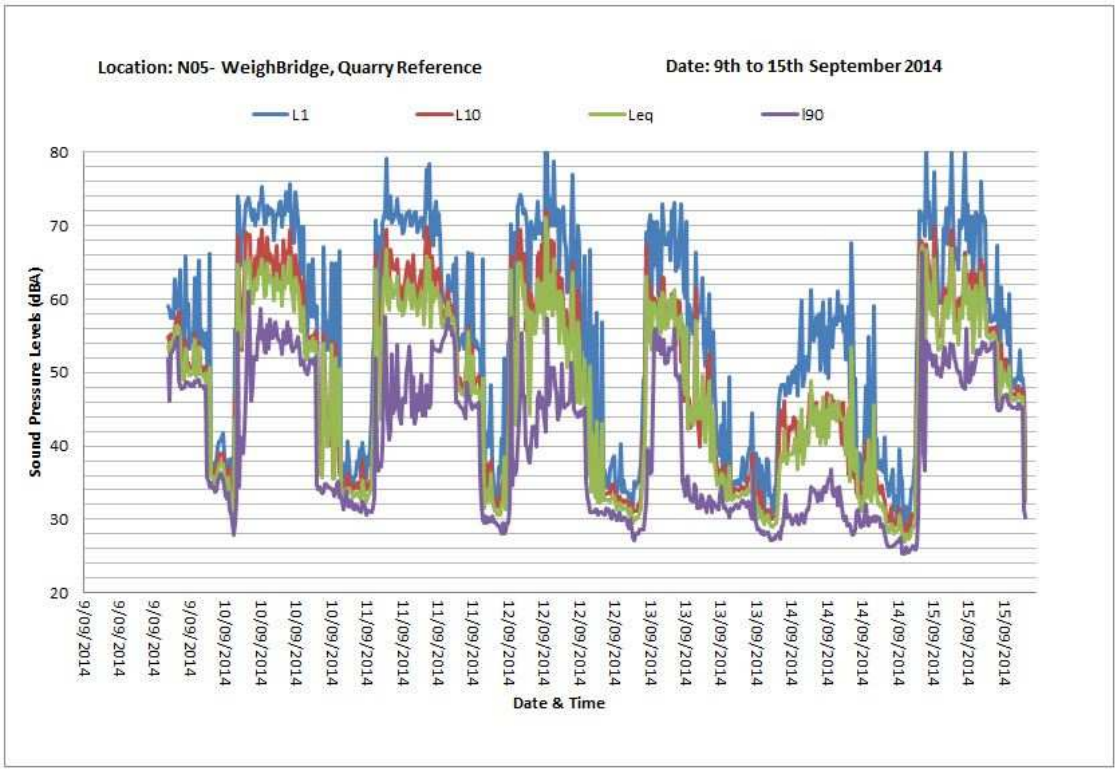

Figure 14: Noise Logging Results- N05

Location: N07 - 2 Merindah Close (near 25 Brandy Hill Drive)

Figure 15: Access to Monitoring Location N06

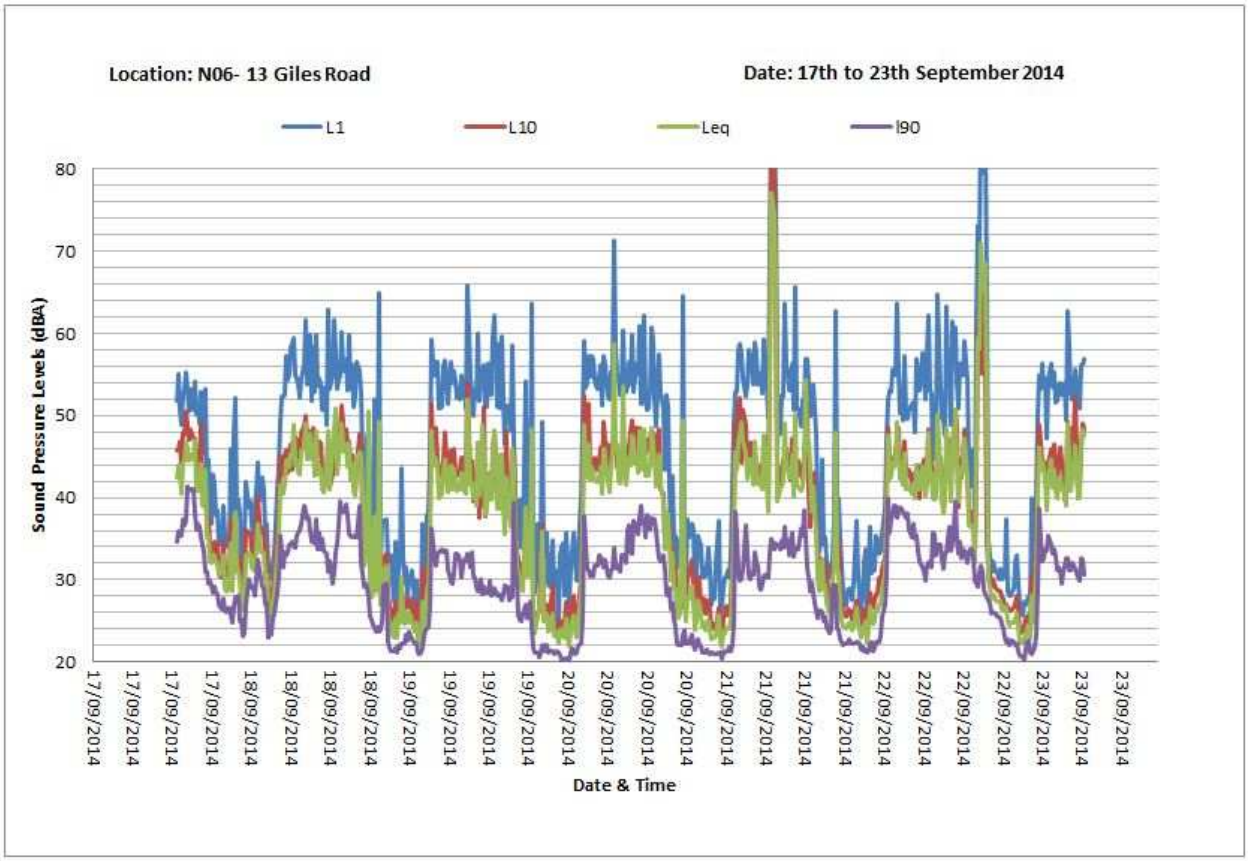

Figure 16: Noise Logging Results- N06

Figure 17: Monitoring Location N07

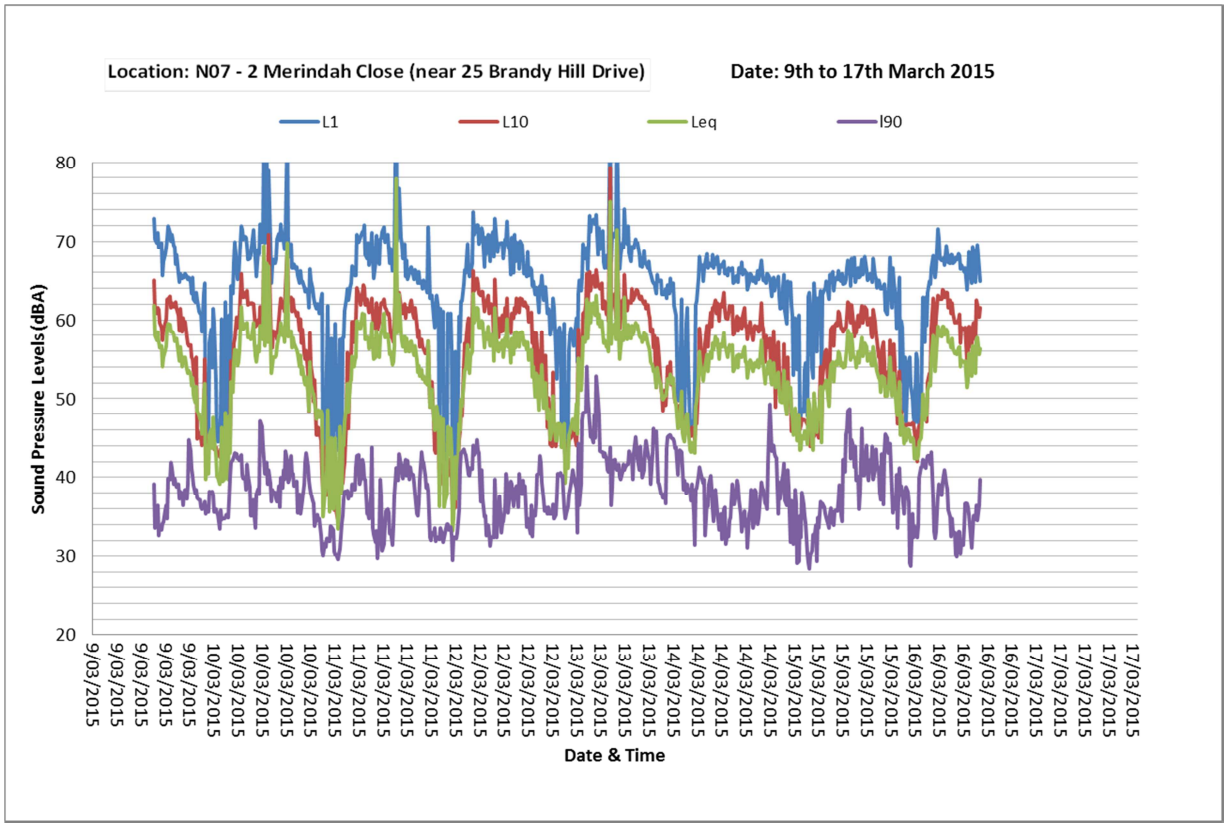

Figure 18: Noise Logging Results- N07

Appendix 9B

Response to Adequacy Comments

Brandy Hill Expansion Project

Environmental Impact Statement

Vipac Engineers & Scientists Ltd.

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Hanson Heidelberg Cement Group

Level 5, 75 Georges Street

Parramatta, New South Wales, 2150, Australia

30 May 2016

Ref: 29N-14-0060-GCO-473121-0

Attention: Pip Cox

Hanson - Brandy Hill Quarry- Adequacy Review (May 2016)

Dear Pip,

Vipac have undertaken a review of the 3rd Round of Adequacy Review Comments received regarding the Brandy Hill Quarry Expansion – Noise & Vibration Impact Assessment report

Our responses with regard to additional Adequacy Review Comments are provided in the table below.

Yours sincerely,

Vipac Engineers & Scientists Ltd

Darragh Kingston

Manager Hunter Valley/Newcastle

Team Leader Acoustics

Inadequacy Comment (May 2016)	Responses
The reported RBL values in Table 5 for at least N1, N2, N4 and N5 appear incorrect.	Vipac reviewed the RBL values for the N1, N2, N4 and N5. The RBL was found to be correct. There are no changes required regarding the RBL value for N1, N2, N4 and N5. It is acknowledged that the patterns of the RBLs determined during the evening and night-time periods at these locations are unusual in the context that such levels would typically be notably lower than the levels determined during the daytime period. However, the levels have been determined on the basis of the results that were obtained from the noise logging surveys undertaken in 2014. Details regarding the setting/location of the noise monitoring locations and the contributors to the noise environment at each location have been provided in Section 4.1 of the Noise & Vibration Impact Assessment. Vipac accepts that the Department has been provided with background noise monitoring data for the quarry dating back to 2011 which shows RBLs in the low 30's dB(A) range. Vipac cannot comment further in this regard, unless additional baseline noise surveys were to be conducted.
The graphs of N1, N2, N4 and N5 in Appendix A also appear incorrect. It does not seem possible to get the statistical levels that are being presented. It may be that the L_{eq} is being incorrectly labelled as the L_{90}, but there could be a number of other explanations.	Vipac have reviewed the graphs of N1, N2, N4 and N5. The L_{90} and the L_{eq} noise levels labelled in the graphs shown in Appendix A are correct. The L_{90} noise levels, which represent the background noise levels, are shown to have a lower noise level compared to the L_{eq} noise levels for all of the monitoring locations. Vipac have undertaken an additional review of the logged data across the day, evening and night-time periods at each of the noise sensitive monitoring locations N1, N2 and N4. The monitoring location N5 was used as a reference location near the weighbridge at the quarry, as opposed to a baseline monitoring location representative of a noise sensitive receptor. It is noted from the trends in the noise levels that the ambient and background noise levels monitored at the monitoring point N2 are characteristic of the patterns that are observed from locations that are influenced by a combination of environmental and traffic noise sources with similar cycles on a daily basis of the diurnal range in noise levels over each 24-hour period. The trends in the noise levels monitored at the monitoring points N1 and N4 are somewhat more erratic and the patterns are less cyclical over the duration of the noise logging surveys. In addition, it is noted that the range between the statistical noise descriptors is narrower, whereby the variations in the noise levels with time for L_{Aeq} and L_{90} are much closer, than the trends noted for example from the noise logging data recorded at the monitoring point N2. This is indicative of less variation between underlying background noise levels that are periodically interrupted and dominated for example by intermittent passing traffic as would have been evident at the monitoring point N2. The close correlation between the fluctuating ambient and background noise levels as noted from the noise logging trends at the

	monitoring points N1 and N4 is somewhat suggestive of natural environmental noise sources, such as fluctuation in insect or bird noise that is generally dominant at the noise monitoring location. However, Vipac cannot definitively comment on the noise sources that led to the fluctuation in the noise levels across the duration of the unattended noise logging surveys. As outlined above, it is acknowledged that the patterns of the RBLs determined during the evening and night-time periods at a number of the noise monitoring locations are unusual, with regard to the level of noise recorded during the evening and night-time period in comparison to the overall daytime noise level trends.
Data for N2 presented in Table 5 is different to that in Table 21	The noise data presented in Table 5 and Table 21 are different because the noise levels presented in both tables relate to two different noise descriptors. For example, the daytime period of relevance to the noise levels listed in Table 5 refers to the noise levels during the (INP) daytime period which extends from 07:00 – 18:00, (11-hour day period), the evening period extends from 18:00 – 22:00 (4-hour evening period) and night-time extends from 22:00 – 07:00 (9-hour night-time period) This is in accordance with the NSW INP Guidelines, which are used when classifying the baseline noise monitoring results into the respective day, evening and night-time periods, with regard to determining the applicable RBL and Project Specific Noise Levels. In contrast, the noise data presented in Table 21 relates to the noise descriptors and the applicable daytime and night-time periods used to assess road traffic noise levels. This is in accordance with the NSW RNP Guidelines, which are used for traffic noise assessment. The daytime period applicable in this regard extends from 07:00 – 22:00 (15-hour day period) and the night-time period extends from 22:00 – 07:00 (9-hour night period). An evening period is not assessed separately as a discreet period with regard to the guidance set out in the NSW RNP.

The attended monitoring data recorded in Table 6 should have been a flag that the unattended data was incorrect. For example, Vipac states that the day RBL for N1 is 48dB(A) (which is close to the lowest L_{90} value that would have been recorded), yet their attended daytime L_{90} reading is only 30.8 dB(A). This should have rung alarm bells	Vipac noted the difference between the L_{90} for the attended and unattended measurements. However, Vipac was unable to comment definitively on the cause of the difference between the ambient and background noise levels recorded during the noise logging surveys and during the attended survey. All monitoring equipment was within calibration and was field calibrated during the surveys. A potential factor may have been the physical presence of the Vipac Engineer during the attended surveys which may have affected the noise sources that were prevalent during similar periods of the unattended logging surveys. The presence of the operator during the attended measurement may have disturbed the presence or the influence of wildlife or insects in the surrounding area. In addition, the unattended noise measurements was taken over much longer periods of time, i.e. 11-hours of daytime noise levels, 4-hours of evening noise levels and 9-hours of night-time noise levels, in contrast to the 15-minute daytime periods associated with the attended noise surveys. It should be noted that the RBL data is presented based on the overall dataset recorded by the noise loggers across the day, evening and night-time periods after excluding any periods associated with adverse weather due to high winds or rainfall as determined from the BOM data. However, as an example in order to demonstrate the significant variance of the ambient and background noise levels that prevailed at the noise monitoring locations over the duration of the noise logging surveys the following data is presented as a snapshot of the noise levels recorded each morning at the monitoring positon N01 during the 15-minute period 11:30 – 11:45 (noting that the attended survey conducted at N01 was carried out at 11:25 on the 9th September 2014, which demonstrates the significant variance between the L_{Aeq}, L_{A90}, L_{Amax} and L_{Amin} levels on the different days over the duration of the noise logging surveys.

Date	Time	L_{Aeq}	L_{90}	L_{Amax}	L_{Amin}
09/09/15	11:30 – 11:45	53.7	48.1	77.9	44.4
10/09/15	11:30 – 11:45	32.1	24.4	69.0	23.8
11/09/15	11:30 – 11:45	39.4	37.4	47.1	35.7
12/09/15	11:30 – 11:45	58.5	53.5	73.6	49.8
13/09/15	11:30 – 11:45	51.6	42.0	72.7	38.5
14/09/15	11:30 – 11:45	46.9	45.0	55.0	42.3
15/09/15	11:30 – 11:45	63.6	54.6	80.8	50.3
16/09/15	11:30 – 11:45	41.0	39.6	59.9	38.2
17/09/15	11:30 – 11:45	42.1	40.7	52.5	39.4

Poor assessment of sleep disturbance.	Based on the predicted noise levels, the maximum noise level $L_{Amax,9hours}$ is predicted to be 74dB(A) externally, and this will be equivalent to 54dB(A) internally taking into account a 20dB noise reduction loss through the façade of a property. Given that the internal noise level results comply with the adopted criteria of 50-55 $L_{Amax,}$ it was considered that additional examination was not necessary as it was effectively screened out. Vipac reviewed the unattended noise logging results, and it is noted that there were only one to two events per night when the maximum noise level exceeded the 55 dB(A) L_{Amax} criteria. In accordance with Practice Note 3, one or two noise events per night with maximum internal noise levels of 65-70 dB(A) are not likely to significantly affect health and well-being. Notwithstanding the above, the measured maximum noise level exceeding the criteria ranged between 76 to 84dB(A) externally (56 to 64 dB(A) internally), which is within the 65-70dB(A) criteria. In other words, it has been predicted that there will not be any event per night that is likely to exceed the 65-70 dB(A) criteria.

Appendix 9B

Clarification of Information

Brandy Hill Expansion Project

Environmental Impact Statement

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Hanson Heidelberg Cement Group

Level 5, 75 Georges Street

Parramatta, New South Wales, 2150, Australia

27 Jan 2016

Ref: 29N-14-0060-GCO-472977-0

Attention: Pip Cox

Re: Brandy Hill Noise Impact Assessment – Clarification of Information

Dear Pip,

Please find outlined herein clarification of the Noise Impact Assessment, prepared in support of the Environmental Impact Statement (EIS) for Brandy Hill Quarry at 979 Clarence Town Road, NSW

The Noise & Vibration Impact Assessment report was finalised in April 2015 and subsequently Department of Planning (DoP) issued a request for clarification of information relating to a request for clarification of information regarding the Noise Impact Assessment.

The DoP issued the following query regarding the Traffic Noise Impact Assessment.

> *The traffic noise impact assessment is inadequate because it is not clear how increases in background traffic noise have been taken into account, particularly in the context of the proposed 30 year life of the proposed development.*

In response to the query outlined above, a noise prediction for 30 years life span for traffic noise impact is not a standard practice as there are many variable factors such as development growth and road network upgrades that can lead to inaccuracies in the noise predictions and can lead to unreliable prediction results.

In accordance with the Road Noise Policy (RNP), an assessment criteria timeframe for a project is typically ten years and this typically applies to new road projects and road redevelopment projects.

We assessed the traffic noise on the basis of the existing traffic from tube count in conjunction with weighbridge count, the site specific noise levels and the predictions that assessed what the maximum volume of traffic that could be accommodated on the roads was, without exceeding the acceptable noise limits/criteria.

As stated in the traffic impact assessment report, 1% traffic growth per annum is adopted in Brandy Hill Drive and with this small percentage of background traffic growth, the traffic noise impact in the next ten years (as per the Road Noise Policy) would not be considered significant.

Notwithstanding the above, a Noise Compliance Management Strategy should be implemented for the Quarry, which should include provision for a noise monitoring programme to monitor the traffic noise at the nearest noise sensitive receivers to Brandy Hill Drive, in accordance with the requirements of NSW EPA.

Trusting that this is to your satisfaction.

If you should have any questions, please do not hesitate to contact us

Yours sincerely,

Vipac Engineers & Scientists Ltd

Lynne Tan

Project Engineer