Contents

Table of Figures

Table of Tables

12. Noise and Vibration

12.1 Outline of Project Noise Elements

The proposed project is a major infrastructure project that is expected to be carried out over the course of approximately 36 months. During this time the construction activities on and around the main dam wall will continue on a daily basis. The proposed works will be undertaken using a range of construction methods that involve the use and maintenance of heavy earth moving equipment and other industrial processes such as blasting and concrete batching.

The main project details are further described in **Section 3** of the EIS. **Figure 12-1** shows the location of proposed activities and work areas in relation to the dam.

■ **Figure 12-1 General location of activities and work areas**

12.2 Terms of Reference

The project ToR requires consideration of impacts with respect to noise and vibration from construction activities associated with the project\. This section of the report has addressed the Coordinator General's requirements with respect to noise considerations in **Section 3.12** of the ToR.

12.2.1 Potential for Noise Impacts

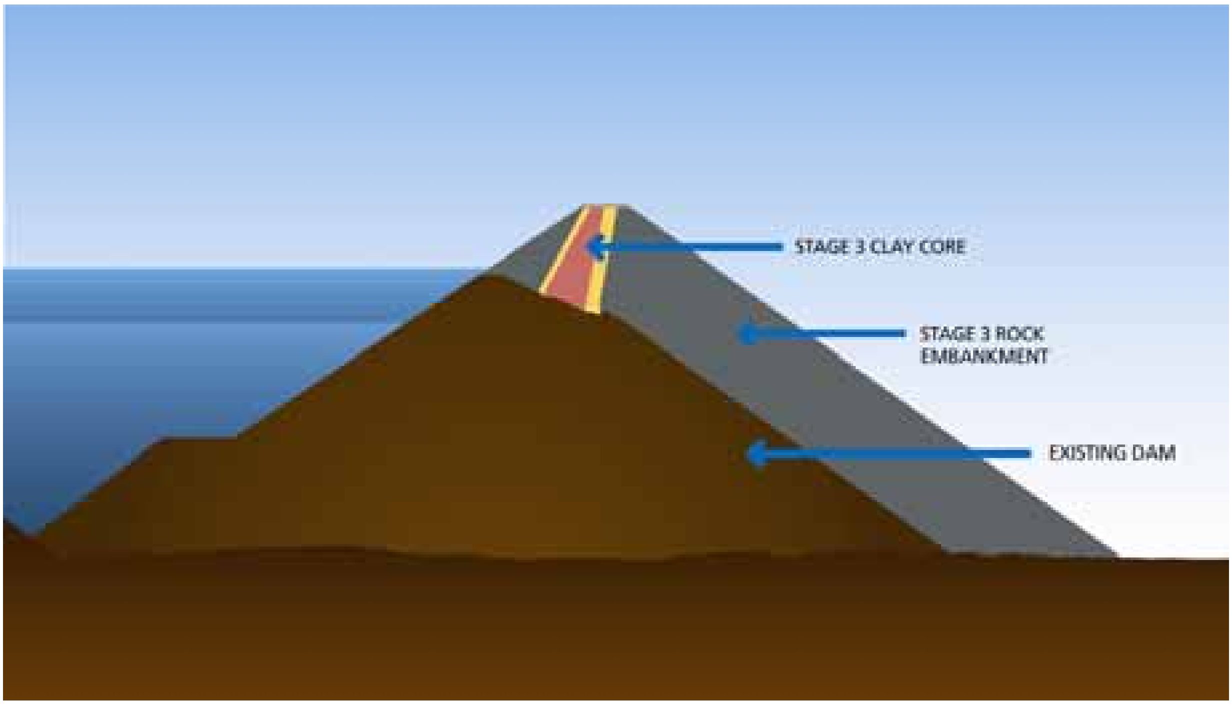
This section identifies the potential for noise emissions during the course of the construction works to impact on nearby residences or other noise sensitive receivers. Works such as earth moving and blasting and have the potential to generate intrusive noise levels at nearby receiver locations. The construction schedule and methodology for the proposed works is currently under development however a preliminary schedule has been used to assess the potential for noise impacts in relation to the project. The preliminary schedule provides a list of tasks to be undertaken for the project as well as indicative time frames for each of the activities.

The construction works will be carried out six days per week during the hours identified in **Section 12.4**. At this stage there are no night time construction works identified for the project. While construction activities will be restricted to day time hours, maintenance of the construction equipment may potentially occur during the night time. Any night time work has the potential to cause sleep disturbance impacts at nearby residences and therefore will require ameliorative measures to ensure that impacts are minimised. The current amelioration measures include ensuring that maintenance work only takes place within the maintenance shed during the night time hours. No audible noise impacts should result at the nearby receivers as the result of night time maintenance works.

12.2.2 Construction Methodology

Figure 12-2 below shows a cross section of a typical earth and rock dam construction and the various components that are used to provide stability and an impervious layer to retain the water. In order to raise the dam wall by 15 metres, the dam wall will be widened and the top of the dam wall will be removed in sections while the inner core is built up to the correct height and then recapped.

- **Figure 12-2 Cross section of a typical earth dam**



There are five basic components of construction works that will be assessed with respect to fugitive noise emissions. These activities consist of:

- quarrying rock for the dam wall: The quarry is located to the west of the dam wall and will be used to extract rock for the wall. The activities in this location will consist of blasting, which will occur on a daily basis, extraction of the rock via excavators and crushing and screening of the material;
- clay mining for the core: The clay-borrow area to the east of the dam wall will be used to extract clay for the core material. Scrapers and front end loaders will extract the clay that will then be taken to the conditioning area prior to be to being used in the dam core;

- fortification and raising of the existing dam wall: The dam wall and saddle dam require extra material to be deposited as part of the wall raising process. The extra rock material will be deposited in layers up to the height of the existing core. After this, conditioned clay is added to the core and the dam building progresses at a slower rate as the vertical sections of core, filter and dam wall are added individually. These works will require scrapers, excavators and dozers to position the raw materials;
- hauling of materials to the dam wall: Material will be deposited on the dam wall at the rate of about 4000 m^3 per day until the new level for the clay core is reached. Once the core level has been reached material deposition rates reduce to about 1500 m^3 per day. Haul truck will access all areas of the site and will be used to transport rock from the quarry as well as clay from the borrow pit, the conditioning pad and the wall; and
- ancillary activities such as concrete batching and equipment maintenance.

Table 12-1 presents a summary of the type and quantity of equipment associated with various construction activities, along with the number and type of equipment used in the assessment for each modelling. The modelling scenarios referred to in the table below are described in **Section 12.6**.

Table 12-1 Summary of construction activities

Construction Activity	Equipment List	Number	Modelling Scenario [3]
Strip Site & Prepare Down Stream Foundations	633 Scraper	1	1
	30t Excavator	1	1
Establish Haul Roads & Quarry	40t & 100t Excavator	1	1
	50t Truck	1	1
	D9 Dozer	1	1
	16G Grader	1	1
	Vibrating Roller	1	1
	Water Cart	1	1
Clear & Site Preparation	633 Scraper	1	1
	D7 Dozer	1	1
	30t Excavator	1	1
Construct Down Stream Access	30t &100t Excavator	1	1
	50t Truck	1	1
	D8 & D9 Dozer	1	1
	16G Grader	1	1
	Vibrating Roller	1	1
	980 Front End Loader	1	1
	Water Cart	1	1
Drilling & Grouting	Drill Rig	1	2
	Grout Mixer & Pump	1	2
Quarrying	D9 Dozer	1	2,3
	100t, 150t & 300t Excavator	3	2,3
	Cat 777 Haul Truck	5	2,3
	Cat 773 Haul Truck	5	2
	50t Truck	5	2,3
Crusher	996 Front End Loader	1	2,3
Concrete Batching Plant	996 Front End Loader	1	2,3
	Agitator Trucks	3	2,3
Clay Borrow	633 Scraper	1	2,3
	50t Truck	5	2,3

Construction Activity	Equipment List	Number	Modelling Scenario[3]
	16G Grader	1	2,3
Place Rock Fill – Main and Saddle Dam	633 Scraper	3	2,3
	Dozer D11	2	2,3
	30 t Excavator	3	2,3
	980 Front End Loader	2	2,3
Clay Core, Filters & Rock	Cat 777 Haul Truck	5	2,3
	633 Scraper	2	2,3
	Dozer D11	1	2,3
	980 Front End Loader	2	2,3

[#]Refer **Section 12.5** for description of activities.

12.3 Pre Construction Environment

12.3.1 Identification of Receivers

Aerial photographs were used to identify the nearest residences to the construction activities. As there is an element of judgement required to determine which buildings are residences using this method, a ground truthing exercise was undertaken to confirm the location of buildings closest to the dam.

12.3.2 Current Noise and Vibration Levels

Background noise measurements

Land use surrounding the Dam is predominantly rural residential set in the Gold Coast hinterland, which is characterised by hills and valleys. **Figure 12-3** shows the type of topography that is common in and around the Hinze Dam as viewed from the dam wall in the direction of the receivers. The existing noise environment in the vicinity of the Dam is quiet during both the day time and night time as there are no observed impacts from industrial or road traffic noise sources in the area. Typical noise in the area north of the dam wall was observed as sounds from birds and occasional domestic activities such as lawn mowing.

- **Figure 12-3 Topographic setting at the Hinze Dam looking north and east**

In order to quantify the existing noise environment and set appropriate noise level goals with respect to the amenity of the local residents, noise monitoring was undertaken at various locations around the dam. In general, to identify the trends in background noise levels, one week of ambient noise monitoring must be undertaken. Legislation in

Section 12.4 states that ambient noise levels are to be measured outside a dwelling over a 24 hour period. In the Ecoaccess Guideline, the Queensland Environmental Protection Agency (EPA) further categorises one 24-hour monitoring period into the following three assessment periods:

- daytime-the eleven hour period between 0700 and 1800 hours;
- evening-the four hour period between 1800 and 2200 hours; and
- night-time-the nine hour period between 2200 and 0700 hours.

The noise environment at residential locations near the Hinze Dam wall and construction areas was measured using both attended and unattended monitoring methods. The measurements were undertaken in general accordance with the EPA Noise Measurement Manual (2000).

When measuring noise levels, the use of statistical descriptors is necessary to understand and describe how variations in the noise environment occur over any given period. A list of common descriptors used in this noise assessment as well as their meaning is given below.

- L_{A10} – the noise level exceeded for ten percent of the fifteen minute interval, this is commonly referred to as the average-maximum level;
- L_{A90} – the noise level exceeded for 90 percent of the fifteen minute interval. This is commonly referred to as the background noise level and represents the quietest 90 seconds in a fifteen minute period; and
- L_{Aeq} – the noise level having the same energy as the time varying noise level over the fifteen minute interval.
- L_{Amax} maximum noise level measured at a given location over the fifteen minute interval.

Monitoring locations

The locations for noise monitoring were selected based on a number of factors. These factors included the likely exposure to noise emissions from the construction works, the proximity to the dam wall, freedom from extraneous noise sources and the availability and willingness of the owners to have the noise monitors located on their properties. **Table 12-2** lists the locations of the noise surveys while **Figure 12-4** shows the noise monitoring locations in relation to the proposed construction sites and the local area.

Table 12-2 Noise monitoring locations

ID	Address	Description
H1	Mottee Court	Residential dwelling approx. 560 m north of the dam wall
H2	Toula Court	Residential dwelling approx. 840 m north of the dam wall
H3	Duncan Road	Residential dwelling approx. 450 m north east of new saddle dam

Figure 12-4 Monitoring locations

Attended noise monitoring

Attended monitoring was undertaken on 27 February 2007 during a day time period at the three locations to the north of the dam site. These locations were at or near the locations where unattended noise monitors were positioned.

Attended monitoring was undertaken over fifteen minute intervals using a Rion NA27 Type 1 Sound Level Meter. The calibration of the meter was checked before and after the monitoring period and difference in calibration levels was noted to be less than 0.3 dB(A). Meteorological conditions during the attended measurements were described as calm to light winds with clear skies and moderate temperatures. Results of attended monitoring and a description of the audible noise sources at the time of the survey are presented in **Table 12-3**.

Table 12-3 Attended monitoring results

Location	Monitoring Time (24hr)	Sound Pressure Levels (dB(A))					Comments
		L_{Aeq}	L_{A1}	L_{A10}	L_{A90}	L_{Amin}	
H1	13:27	45	52	48	41	32	Noise influences during the monitoring included birds and insects Machinery noise from mobile equipment (eg dozer)
H2	12:55	42	49	44	37	35	Noise influences during the monitoring included birds and insects background noise from mobile equipment (eg dozer)
H3	12:07	40	46	42	36	35	Noise influences during the monitoring included wind and leaves, birds and machinery noise Children playing and some

Location	Monitoring Time (24hr)	Sound Pressure Levels (dB(A))					Comments
		L_{Aeq}	L_{A1}	L_{A10}	L_{A90}	L_{Amin}	
							machinery noise from mobile equipment (eg dozer), Intermittent high pitch noise from possibly a drill or circular saw

Discussion of the attended monitoring results

During the measurements the background (L_{A90}) and minimum (L_{Amin}) noise levels were consistent between locations H2 and H3. Birds were the dominant noise during the attended monitoring period. There were noise influences from some machinery operating in the area. Although the machinery noise was audible, it was not the dominant noise source. The attended noise modelling results are consistent with a quiet noise environment.

Unattended monitoring

Unattended noise monitoring was undertaken at locations identified in **Table 12-2** and **Figure 12-4** above for a nominal period of seven days between 20 and 27 February 2007 at Mottee Court and 13 and 21 March 2007 at Toula Court and Duncan Road. The unattended monitoring was undertaken with automatic noise loggers that measure environmental noise and store the results in memory. The loggers used were B&K type 2238 and had been NATA tested by the manufacturer within the last twelve months. The loggers were set to record a range of noise indices at fifteen minute intervals. This data was used to determine the median values for the L_{Aeq}, L_{A90}, L_{A10} and L_{A1} descriptors for the day, evening and night time period. The calibration of the noise loggers was checked before and after the monitoring period and the drift was noted to be less than 0.5 dB(A).

The Rating Background Level (RBL) used in **Table 12-4** is the overall, single-figure, background level representing each of the day, evening or night assessment periods over the whole monitoring period. This is the level used for assessment purposes when referring to background noise. A summary of the measured noise data is shown in daily graphs provided in **Appendix F.12.1**.

- **Table 12-4 Results of unattended noise monitoring**

Location	Monitoring Dates	Rating Background Level (RBL)			L_{Aeq} over the assessment period			
		Day	Evening	Night	Day	Evening	Night	$L_{Aeq\ 24\ Hr}$
H1	20/02/07 to 27/02/07	34 dB(A)	36 dB(A)	32 dB(A)	45 dB(A)	43 dB(A)	39 dB(A)	43 dB(A)
H2	13/03/07 to 21/03/07	33 dB(A)	29 dB(A)	24 dB(A)	47 dB(A)	40 dB(A)	41 dB(A)	44 dB(A)
H3	13/03/07 to 21/03/07	31 dB(A)	28dB(A)	25 dB(A)	43 dB(A)	39 dB(A)	44 dB(A)	44 dB(A)

Background vibration measurements

There were no identifiable sources of ground borne vibration in the residential areas to the north of the dam wall. It is assumed that background vibration levels in these areas is very low and therefore not able to be measured by standard monitoring equipment.

12.4 Assessment Guidelines

The noise goals by which the project should be assessed must be relevant for the particular activity being undertaken and in accordance with the appropriate legislation and guidelines. The EPA is the referral authority and will be assessing the potential for noise emissions from the works to impact on residential dwellings in the vicinity of the dam. This section of the EIS presents the relevant Queensland legislation for noise control and discusses the project acoustic objectives.

12.4.1 Environmental Protection Act 1994

The *Environmental Protection Act 1994* (Qld) *(EP Act)* states in Section 3 of the Act that:

The object of the Act is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends ("ecologically sustainable development").

12.4.2 Environmental Protection (Noise) Policy 1997

The *Environmental Protection (Noise) Policy 1997 (EPP (Noise))*, provides guidance in achieving the object of the EP Act by identifying in Section 10 of the policy the environmental values to be enhanced or protected as follows:

> *The environmental values to be enhanced or protected under this (EPP Noise 1997) policy are the qualities of the acoustic environment that are conducive to:*
>
> *(a) the wellbeing of the community or a part of the community, including its social and economic amenity; or*
>
> *(b) the wellbeing of an individual, including the individual's opportunity to have sleep, relaxation and conversation without unreasonable interference from intrusive noise.*

Section 11 of the policy (EPP (Noise)) also provides a numerical value used to determine an acoustic quality objective as follows:

> *(1) The "acoustic quality objective" is the objective of achieving an ambient level of 55 dB(A) or less for most of Queensland's population living in residential areas.*
>
> *(2) It is intended that the acoustic quality objective be achieved as part of progressively achieving the object of this policy over the long term.*
>
> *(3) It is not intended that, in achieving the acoustic quality objective, any part of the existing acoustic environment be allowed to significantly deteriorate.*
>
> *(4) For subsection (1), the ambient level in a residential area is measured over 24 hours as the long-term Leq outside a dwelling in the area.*

From **Table 12-4** the $L_{Aeq\ 24hr}$ noise levels at the residential locations to the north of the dam were measured as being approximately 44 dB(A). In comparison the acoustic quality objective goal is an L_{Aeq} 55 dB(A). This difference in noise levels between the existing and objective levels equates to an environment that is approximately twice as loud, but is still expected to provide residents with an acceptable level of acoustic amenity. In the case of the project however, the noise level will change over a short timeframe and will have a very different noise characteristic to the existing environment. A change of this type can have a more dramatic effect on noise sensitive receivers than gradual changes or where other noise sources already exist and therefore must be managed to reduce the potential for impacts, where possible.

12.4.3 Environmental Protection Regulation 1998

The *EP Act* and the *EPP (Noise)* provide a general guide to the control of noise emissions from activities. Further to this the *Environmental Protection Regulation 1998 (amended 2006)* also categorises noise offences in Division 4, Subdivision 1 under Offences, 6W Building work as follows:

> A builder or building contractor must not carry out building work on a building site in a way that makes or causes audible noise to be made from the building work:
>
> (a) on a Sunday or public holiday, at any time; or
>
> (b) on a Saturday or business day, before 6.30a.m. or after 6.30p.m.

However non-adherence to these times is not an offence where the activity being undertaken is an Environmentally Relevant Activity (ERA) or where a development approval has been granted for the activity.

For an activity such as construction, even if the works take place over extended periods, the Queensland EPA does not provide specific guidelines for the assessment of noise impacts. The only guidelines are the generalised noise emission levels taken from Section 11 part 1 of the *EPP (Noise)* for the acoustic quality objective of $L_{Aeq\ 24Hr}$ 55 dB(A) ambient level in residential areas.

12.4.4 Project Acoustic Objectives

For construction projects carried out in Queensland there is not a legislated noise limit. As this is a significant project and will have industrial noise sources, it is recognised that specific noise goals need to be set. Therefore to ensure the acoustic amenity of the local community, project specific noise goals will be used to control emissions as reasonably and feasibly as possible

Where short term, high level noise impacts such as construction noise may potentially exist for extended periods, there is a need to manage noise emission levels as best as can practically be achieved. The Alliance recognises that management of noise from the construction works is a critical component of the project and will require ongoing consideration and community engagement for the duration of the works. Given that the project will be carried out over a three year period, the Alliance is proposing to adopt a voluntary project specific noise goal for nearby residential locations, which will serve as a target for noise emissions in order to protect the acoustic amenity of the local community.

The project specific noise goals will be a target to assist with the control of noise emissions from the works and with the implementation of reasonable and feasible noise mitigation measures. This means that construction activities will be undertaken in such a manner as to target noise goals wherever possible. Where practical measures limit achievement of noise goals, the Construction Communication Program (see **Appendix D**) and the Construction Noise and Vibration EMP (see **Section 19**) will manage these situations.

The project construction noise level goal will be used to track the progress of noise emissions from the works and provide a guide to alert Alliance Environmental Officers to potential noise impacts. In identifying a measurable project noise level goal the fulfilment of noise management commitments can be benchmarked by the Alliance. The project noise level goal can also be used as a guide when applying noise control measures and identifying when an acceptable level has been reached.

12.4.5 Project Specific Noise Goals

Airborne noise

The project noise goal for airborne noise should be relevant to the acoustic quality objective identified in the EPP (Noise) but calculated to reflect the 12 hour construction day. The modified noise level objective for the project, having the same basis as an $L_{Aeq\ 24Hr}$ 55 dB(A) acoustic quality objective, will be $L_{Aeq\ 12Hr}$ 58 dB(A).

This objective aims to provide an acceptable acoustic environment for residential locations that may potentially be affected by noise emissions from the project. The project specific noise goals will be met when the $L_{Aeq\ 12Hr}$ 58 dB(A) noise emission objective is met for a 12 hour period.

Some practicalities limit to be strict adherence to the acoustic goals and where emissions resulting in community concern are identified, an environmental management response will be initiated to investigate the matter and respond to the relevant stakeholders (refer **Section 19** for EMP). Where high noise levels are forecast to occur because of the nature of an activity or process, residents will be notified in advance of upcoming works.

No night time construction is proposed for the project however the Alliance may seek obtaining of approval for special works that require night time activities that may occur during the course of the project. It is expected that any construction works to be undertaken past the normal hours of operations will be the subject of a separate approval from the EPA. Where time or safety restrictions prevent adequate notice of the works to be provided to the EPA and they are only short term, a community consultation process will be undertaken as a minimum to advise the residents of the nature, extent and expected duration of the works.

To protect the amenity of the nearby residents, no night time noise emissions should be audible from any part of the works past 10:00 pm under normal operational conditions. There may be other activities such as maintenance that are expected as a routine part of the works as long as they remain inaudible at residential locations. To limit these impacts and maintain inaudibility at the nearest residences, these activities will only occur within the maintenance building. Therefore the maintenance building is to be of adequate design and construction to sufficiently attenuate noise from activities during the night time period.

Blasting

The ToR requires consideration of the blasting noise and vibration limits provided in section 61 of the *Environmental Protection Regulation (1998)* and the EPA Ecoaccess Guideline *Noise and vibration from blasting* (March 2006). The Ecoaccess guideline provides the most stringent assessment goals for blasting noise and vibration and has therefore been adopted as the project limits. The following sections are an extract from the EPA Blasting Guideline:

Noise Levels

Blasting activities must be carried out in such a manner that if blasting noise should propagate to a noise sensitive place, then:

a) the airblast overpressure must be not more than 115 dB(linear) peak for nine out of any ten consecutive blasts initiated, regardless of the interval between blasts; and
b) the airblast overpressure must not exceed 120 dB(linear) peak for any blast.

Vibration Levels

Blasting operations must be carried out in such a manner that if ground vibration should propagate to a noise sensitive place:

a) the ground-borne vibration must not exceed a peak particle velocity of 5 mm per second for nine out of any ten consecutive blasts initiated, regardless of the interval between blasts; and
b) the ground-borne vibration must not exceed a peak particle velocity of 10 mm per second for any blast.

Working Hours

Hours for construction works will be generally in line with the EP Regulations for building works as follows:

- Monday to Saturday 6.30 am – 6.30 pm
- Sunday, Public Holidays and all other times No audible work

Works will be undertaken five days per week, generally Monday to Friday, however every fourth week works will be conducted Tuesday to Saturday.

The project aims to limit blasting to one blast per day, carried out at a similar time each day during afternoon hours, in order to minimise impacts on residents.

Work other than construction activities such as equipment maintenance may take place outside these hours where the activities are inaudible at all noise sensitive receivers.

Summary

The project specific noise and vibration assessment levels are summarised in **Table 12-5**.

- **Table 12-5 Derivation of Project Specific Noise Criterion**

Project Aspect	Day	Evening	Night-time
Construction Noise	58 dB(A) $L_{Aeq\ 12\ Hr}$	Not Audible	Not Audible
Blasting			
Noise	115 dB Lin Pk #	Not Audible	Not Audible
Vibration	5mm/s PPV # 10mm/s PPV (Max)	N/A	N/A

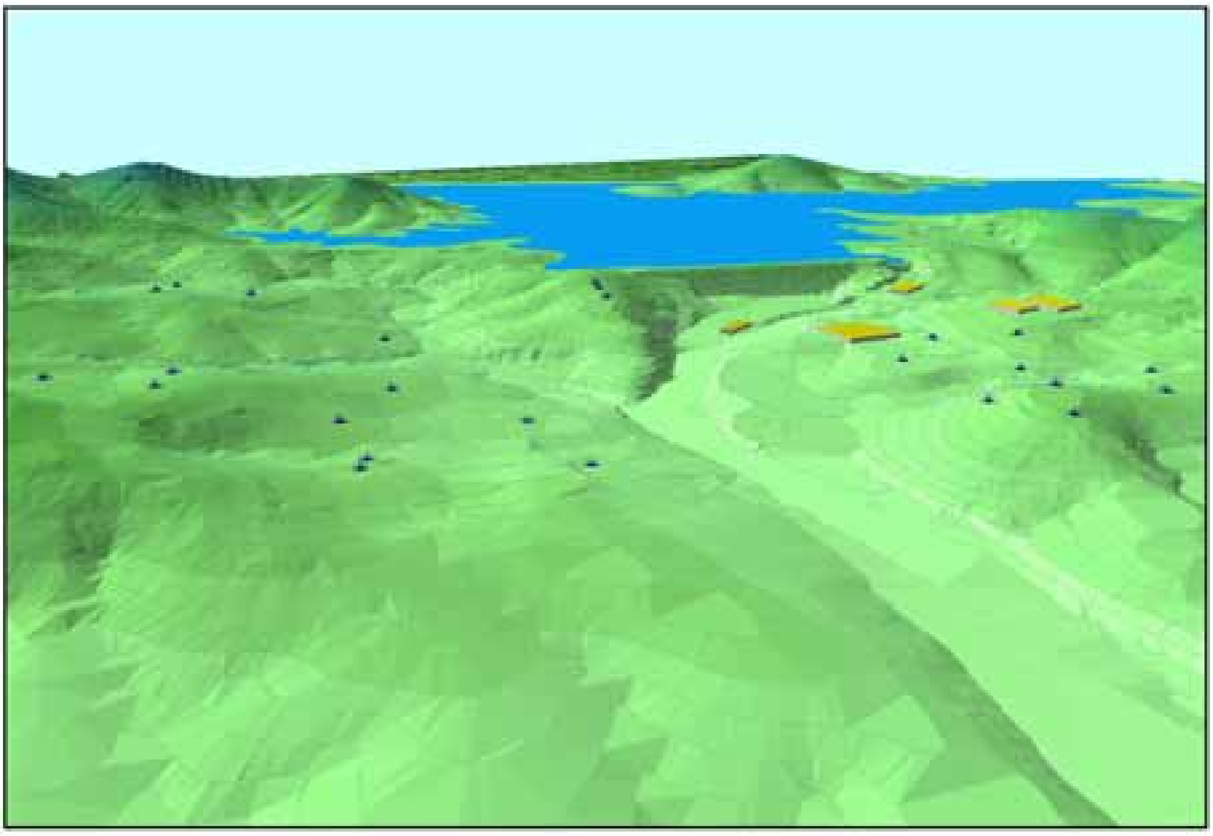
9 out of every 10 consecutive blasts

12.5 Assessment Details

12.5.1 Assessment Methodology air borne noise

The assessment of noise impacts is primarily concerned with day time noise emissions from general construction activities. To determine the potential for construction noise to cause an unacceptable noise impact at noise sensitive receiver locations, several assessment scenarios have been modelled using SoundPLAN noise modelling software. The results of predictions from the modelling exercise are then compared to the $L_{Aeq\ 12\ Hr}$ 58 dB(A) noise goal and also to the existing background noise levels. Where predicted noise levels are higher than the project goal noise, mitigation measures will be proposed to reduce potential amenity impacts on nearby receivers. **Figure 12-5** presents a screen shot from the noise model showing how terrain and barriers are incorporated into the assessment.

- **Figure 12-5 Noise Assessment Modelling Terrain**



Assessment scenarios

Two possible alternatives are available for assessing the noise emissions from the dam. The first being construction noise associated with raising the wall and is likely to represent a significant change in the local noise environment around the dam and the second is operational noise once the works are complete. An assessment of construction noise has been undertaken to determine the potential for noise impacts at residential locations. Operational noise has not been assessed as there will be no substantive change to the equipment type or location associated with the upgrade and normal running of the dam.

To ensure a balanced assessment is provided for the noise emissions that could be generated by the construction activities, three different construction scenarios have been assessed over the course of the project. These scenarios include aspects of the project operations from the clay borrow area to the quarrying and wall construction. Each scenario assesses a different stage of the construction process to represent the changing form of the Dam. A description of these scenarios is as follows:

- Scenario 1 site preparation and initial construction: - During the first two to three months of the project, site preparation activities to establish site facilities and access roads will be undertaken prior to the construction works for the dam;
- Scenario 2 construction of the dam wall at 12 months: - The construction activities for the dam wall are expected to take approximately 16 months in total and are expected to be continuous during daytime hours for this duration. These activities will include quarrying, concrete batching, haul truck movements, clay mining and positioning the raw materials. This stage of the works is expected to be the most intensive in terms of equipment utilisation and movement of raw material quantities around the site; and
- Scenario 3 core construction 24 months: - After the main dam wall reaches the height of the current dam, the rate of progress of the works will ease as the more complicated construction of the core and transition filter is undertaken in conjunction with the dam wall. During this time fewer materials will be required and as a result the quarrying and crushing activities and haul truck movements will decrease proportionally.

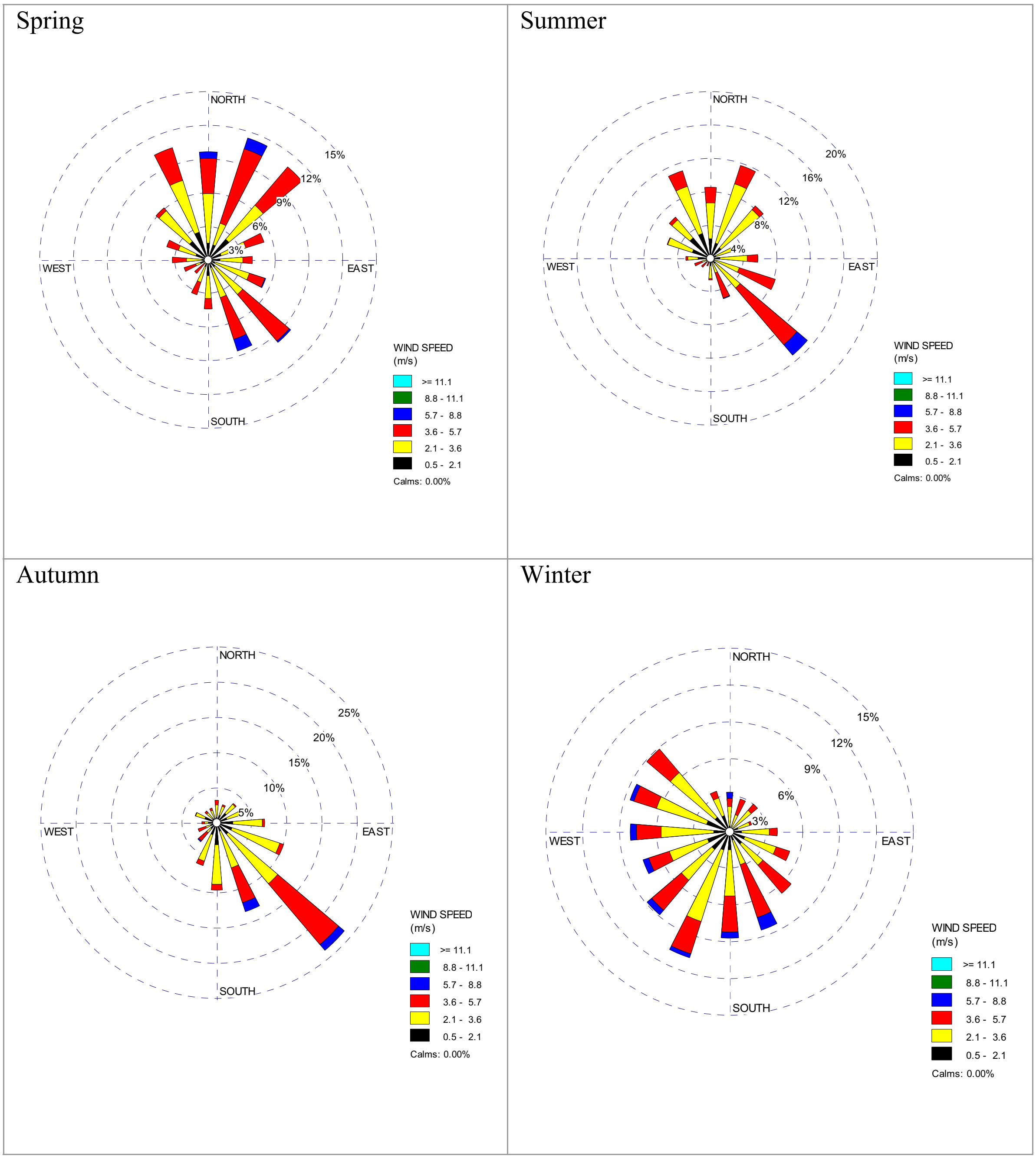
Meteorological Conditions

Noise levels at a sensitive receiver can become quieter or louder under certain meteorological conditions. In particular the weather conditions that can cause noise to be reinforced are due to wind direction or atmospheric stability known as temperature inversions. Light winds in the direction of the receiver will cause an increase in noise levels from a source by concentrating propagation in that direction. Similarly, stable conditions with very light winds during the night time can cause a temperature inversion, which reflects noise back towards the ground from the upper atmosphere.

The prediction of noise levels at sensitive receiver locations has considered the effects of weather by including an assessment of winds in the area. The effects of a temperature inversion have not been included in the assessment as this phenomenon only occurs during the night time and even then is generally only apparent under very specific atmospheric conditions. There is currently no night time construction work planned for the project.

Meteorological information generated for the project using The Air Pollution Model (TAPM) (CSIRO 2003) has been used in the assessing the likelihood of adverse winds in the area. The EPA Ecoaccess guideline specifies adverse winds to be those that blow in the direction of the source to the receiver at a maximum of 3m/s and occur for 30% of the time. Daytime wind roses showing wind direction by season are presented in **Figure 12-6**.

- **Figure 12-6 Seasonal daytime wind roses – 6am – 6pm inclusive**



The above graphs indicate the direction that wind is blowing from and are oriented with respect to the dam. These graphs show that winds tend to blow away from residences located to the north and east of the dam during the summer, spring and autumn seasons. The graphs for winter months indicate that the winds blowing from the south and west would tend towards the residential areas to the north and east during this time. Based on the occurrence of winds from the south-west in winter, an assessment of adverse winds has been incorporated into the modelling results. **Table 12-6** presents a breakdown of the wind data by speed category and direction during the winter time.

Table 12-6 Frequency of wind by direction (blowing from) – winter months

Wind Speed	**Wind Direction**								
	N	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**	**Total (%)**
<0.5 (calm)									0.59
0.5 - 1.9	1.86	0.86	0.68	1.49	2.81	2.72	2.99	3.44	16.84
2.0 - 3.9	3.49	2.08	2.85	4.03	17.16	14.8	8.87	7.79	61.07
4.0 - 5.9	0.72	0.41	0.41	2.81	4.21	7.42	2.22	1.49	19.69
6.0 - 7.9	0.23	0	0	0.09	0.41	0.59	0.5	0	1.81
Totals (%)	6.29	3.35	3.94	8.42	24.58	25.53	14.58	12.72	100

12.6 Modelling results

The results of the noise modelling for each scenario are presented as point calculations on the aerial photography (see **Figure 12-7**). The predicted values are based on an average hourly L_{Aeq} noise level in the vicinity of the sensitive receiver. In each scenario the noise levels predicted for the location nearest to the dam (circled) are not representative of a residential receiver as this property has been acquired by the Alliance.

Scenario 1

This scenario is representative of the types of activities and equipment quantities onsite during the initial site preparation including road maintenance and clearing vegetation in the quarry and clay borrow areas.

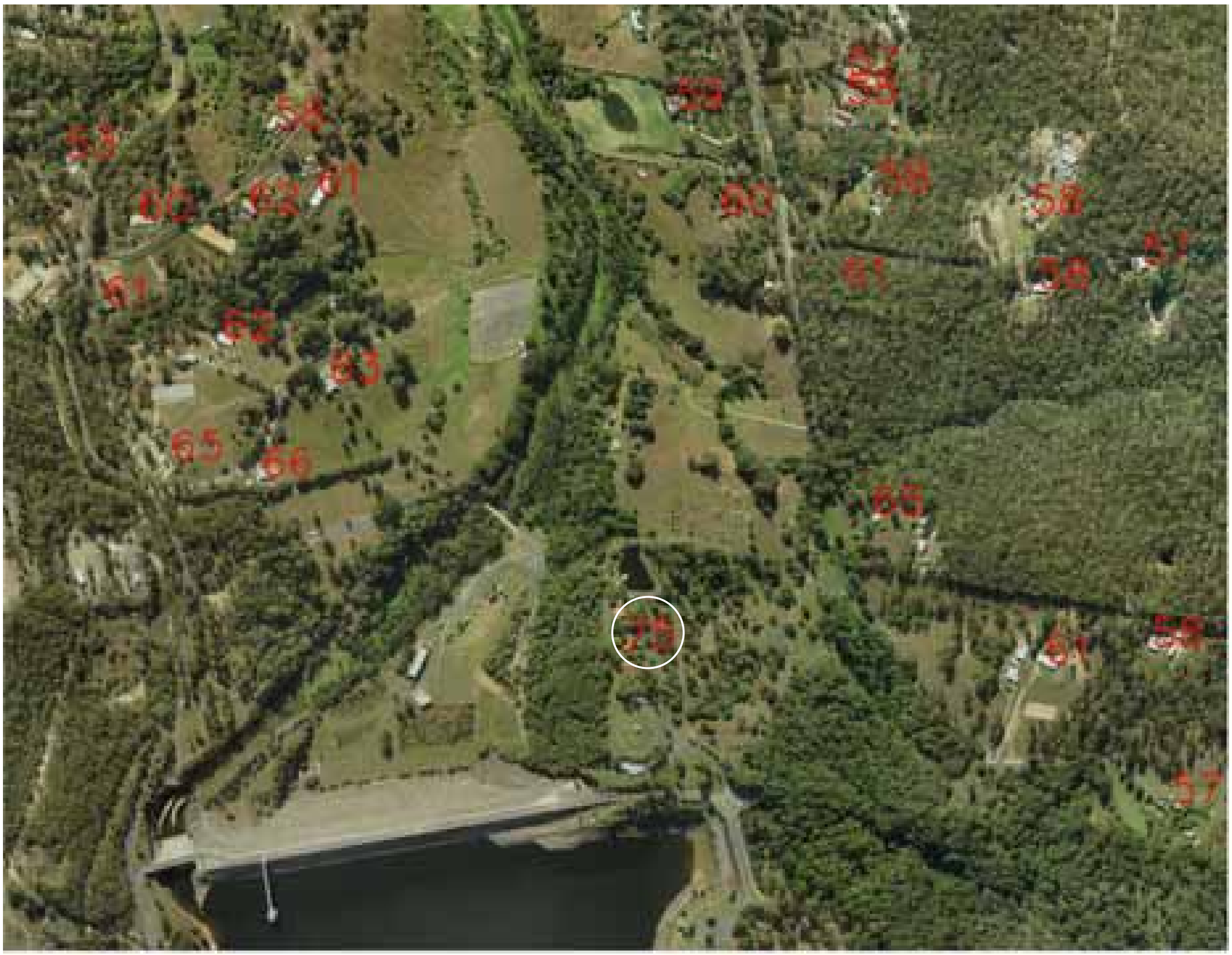
Figure 12-7 Initial results from noise modelling scenario 1

The values indicated on the aerial photo are estimates of the average hourly L_{Aeq} noise level as the result of the combined activities at receiver locations. These predictions equate to a level approximately 5 dB(A) below the noise goal of $L_{Aeq12Hr}$ 58 dB(A) at the closest residences.

Scenario 2

Scenario 2 noise predictions are presented below in **Figure 12-8** and are representative of the noise levels from quarrying activities, rock filling at the dam wall and clay extraction at the clay borrow area. The results indicated in red are average hourly L_{Aeq} values over the 12 hour construction day.

- **Figure 12-8 Initial results from noise modelling scenario 2**



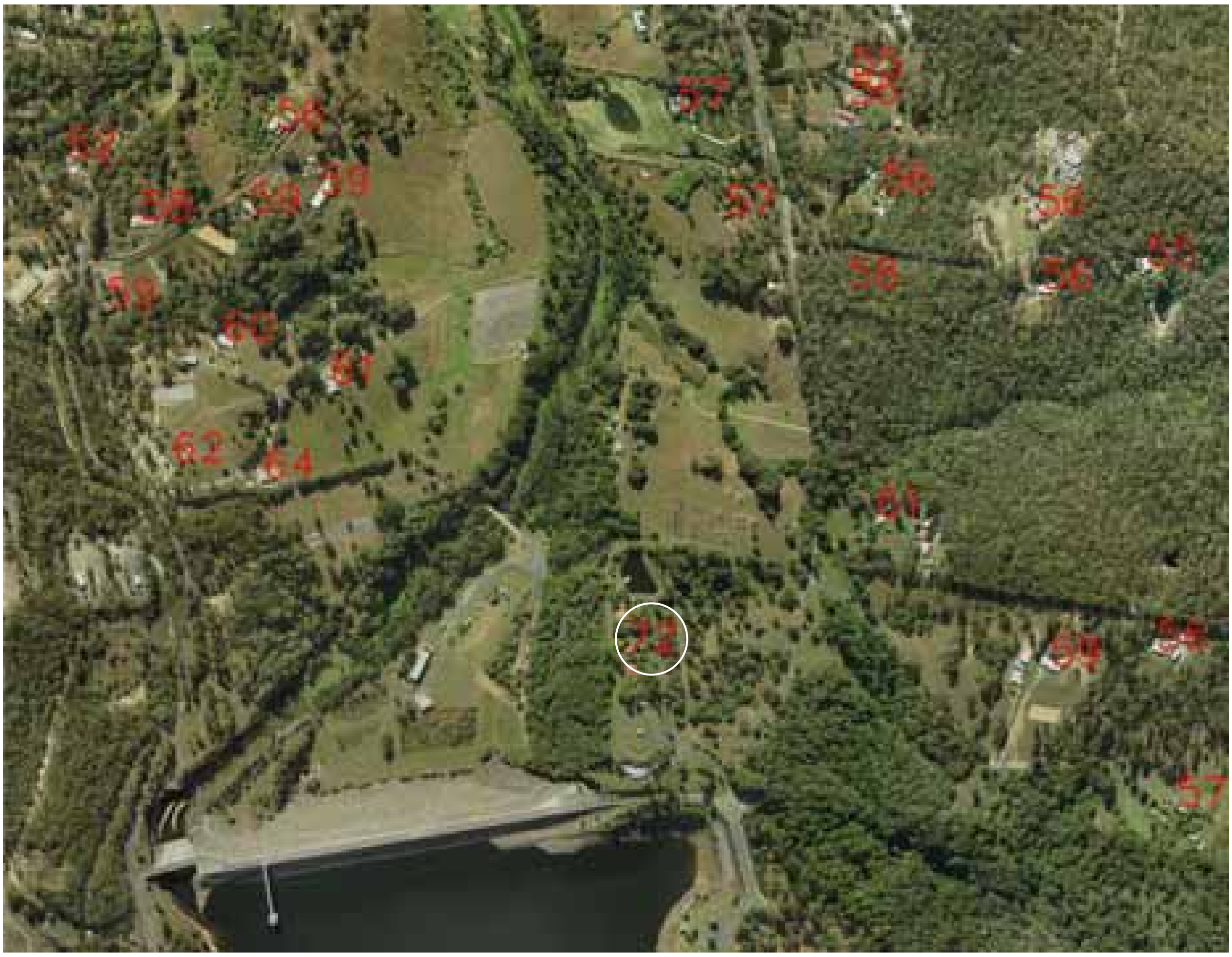
Based on the above predictions for the construction component of the works, an estimate of the $L_{Aeq\ 12Hr}$ noise levels at the nearest receivers would be approximately 66 dB(A). This represents a level above the nominal external noise goals in the order of about 8 dB(A).

When inside a dwelling, noise levels are expected to be below the predicted external noise levels due to the attenuation offered by the building. Where the external level is 66 dB(A) noise levels inside could range between about 46 dB(A) or lower, with all windows and doors closed to approximately 56 dB(A) with windows partially opened. These levels are expected to be acceptable but are only possible when indoors.

Scenario 3

This scenario is representative of the works that may occur during the later stages of the project. These works include reduced truck movements, operations at the quarry and clay borrow pit as well as the main dam wall. Scenario 3 noise predictions are presented below in **Figure 12-9**.

- **Figure 12-9 Initial results from noise modelling scenario 3**



The predicted noise levels from these works are similar to scenario 2 but show a slight reduction due to a scaling back of many activities during the slower core construction process. Construction noise levels above the $L_{Aeq12Hr}$ noise goals would be expected during this stage of the works but may be only 4-6 dB(A) above the noise goals when the noise levels are averaged for the 12 hour period.

12.6.1 Discussion of air borne noise predictions and management

The modelling results for the scenarios presented above are based on a reasonable expectation of the construction activities which are likely. The modelling for each scenario includes the quantity and position of equipment on site for the various activities however these scenarios are static representations of an infinite number of scenarios that may occur over the duration of the works. These results are therefore only indicative of the level of impact that could be expected at the residential locations at a given time and have been used to identify where noise levels above the project goals may occur and to assist with determining possible noise management solutions.

The predictions show that there is a strong possibility that construction noise levels greater than the goal of $L_{Aeq\ 12\ hr}$ 58 dB(A) may occur at some locations and has the potential to cause impacts on the external noise environment at some residents. While the preliminary results indicate an increase in noise levels above the noise goals at some of the nearby locations, there is a need to verify these predictions with compliance monitoring during the construction activities.

If noise monitoring of the works also indicates that levels from construction are significantly higher than the goals, further reasonable and feasible mitigation measures will be adopted to minimise or eliminate these impacts.

A feasible mitigation of noise impacts includes reducing noise by addressing the mechanisms of noise transmission either at the source, within the path of noise transmission, or at the receiver. Ameliorative measures will be implemented based on a hierarchy of control firstly by elimination then substitution and finally modification of the noise source and where these methods cannot adequately reduce noise levels, secondary measures could be employed by blocking the path of the sound transmission between the receiver and the source. When all of the above methods of reducing noise impacts are exhausted and impacts at the receiver remain unacceptable, noise controls at the receiver can be considered.

The notion of reasonable and feasible mitigation is itself designed to be a cost benefit approach to reducing noise impacts. With noise impacts, the law of diminishing returns becomes applicable and after initial strategies have been employed to reduce levels, the cost of further reductions often increases dramatically for minimal noise level reductions.

Noise management and mitigation measures for the project are addressed in **Section 12.10** and are also identified in detail in the Noise and Vibration Environmental Management Plan (see **Section 19**). Identification of noise impacts and subsequent remedial actions are to be based on consultation with relevant members of the community. **Section 12.11** identifies the compliance noise monitoring requirements for the project.

12.7 Assessment methodology blasting

The project proposes to use blasting methods in the quarry to provide bulk rock and other materials for the construction of the dam. Blasting at the quarry will occur approximately 900 metres from the nearest residences which will minimise the potential for airborne acoustic impacts as well as groundborne vibrations affect the amenity of sensitive receiver locations. This report provides an initial assessment to quantify these impacts based on the preliminary information available at this time. A more comprehensive assessment of blasting impacts will be undertaken prior to the commencement of works.

12.7.1 Overview

Two types of impacts are potentially generated by blasting activities. These impacts are either airborne in the form of both audible and infra noise or ground borne vibration. Human hearing falls somewhere in the frequency range of about 20 Hz to 20 kHz however, for blasting noise emissions there is a component of the acoustic spectra that falls outside of this range. For impacts such as blasting acoustic energy may be present in the range between 0 Hz to 8 kHz. While the audible component of a blast may be easily identified the sub audible component, the infra noise, can only be “felt”.

The infra noise commonly referred to as overpressure or airblast is an impulsive pressure wave that occurs from the release of high pressure gasses to the atmosphere from the blast and/or the pressure front generated by the movement of air at the face of the free rock surface. These impacts are felt or seen as an effect such as a rattling window. Airblast is measured as a peak linear sound pressure level with the impact assessment levels detailed in **Section 12.7.2**.

Groundborne vibration from blasting is caused by the energy from the blast radiating from the source via the rock mass or soil. Due to reflections, attenuation and scattering, vibration levels reduce with increasing distance from the source. Vibration is generally measured as a peak particle velocity (mm/s).

Estimates of airblast levels and ground borne vibration are affected by variables such as the blasting parameters and geology of rock as well as the intervening geology between the source and the receiver. In the absence of field data such as blasting trials, the Australian Standard AS 2187.2 recommends using simple charge weight scaling laws, which incorporate the charge weight per delay and the distance from the blasting site to the sensitive receptor. The following sections provide an assessment of airblast and groundborne vibration for the project.

12.7.2 Assessment of airblast levels

The project will use blasting parameters that will be fully determined after the quarry site survey and any blasting trials are completed. Typical values for these parameters have been provided by the Alliance as a guide to the expected level of airblast as the result of quarrying operations. A simple estimate of airblast overpressure levels is given using the following cube root scaling formula from AS2187.2 for the estimated Maximum Instantaneous Charge (MIC) of 15kg of explosive.

$$P = K_a \left(\frac{R}{Q^{1/3}} \right)^a$$

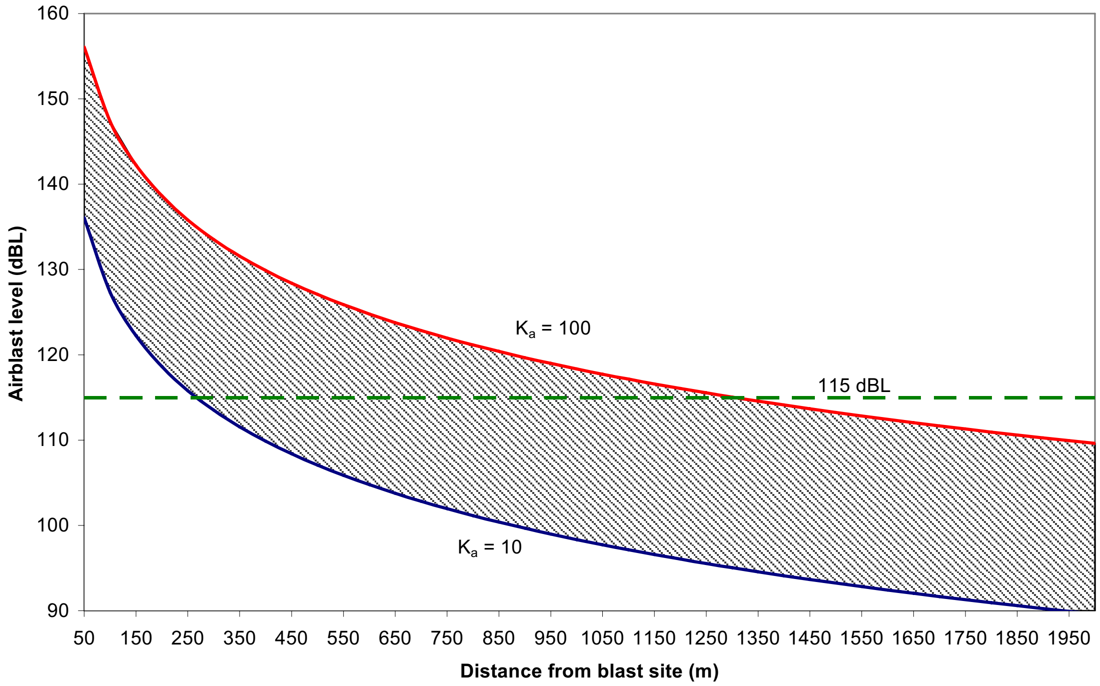
Where

P = pressure (kPa)
Q = explosive charge mass per delay (kg)
R = distance from charge (m)
K_a = site constant.
a = site exponent

The pressure calculated from the above formula can be converted into an acoustic energy equivalent to predict the expected level of impact at any given distance from the blast source. The constants used in the above formula are specific to each site and therefore require a detailed knowledge of the blasting methods however, the upper and lower ranges can be closely predicted. The site constant **K_a**, refers to the level of constraint of the charge and is a value of between 10 and 100 for confined blasthole charges. The other constant **a,** for blast hole charges of -1.45 corresponds to an attenuation of 8.6dB per doubling of distance from the blast source.

It should be noted that the orientation of the quarry is essentially facing away from the residential areas to the north and east and therefore a slight reduction of the theoretical overpressure levels could be expected. The number of blasts is to be restricted to one per day and no blasting will be carried out at night. It is recommended that blasting occurs at a similar time each day to minimise any disruptions to normal routines and to allow the local community to plan activities around this event. An appropriate timing for this activity will be early afternoon at say 3:30 pm, when children are leaving school or travelling home and other members of the community are likely to be active. A graph of theoretical airblast levels with distance is shown in **Figure 12-10** indicating the theoretical upper and lower airblast values versus distance form the source.

- **Figure 12-10 Estimated airblast level Hinze Dam quarry**



The above graph indicates that at the nearest residential locations (approximately 800m from the quarry) are likely to be at the lower end of the range of airblast impacts. Factors such as the orientation of the blast face and prevailing winds are also expected to contribute to a reduction in potential impacts at the nearest receivers.

Safeguards for these activities include monitoring at residential locations during trial blasts to determine the potential for adverse impacts as well as a ban on the use of surface (unconfined) charges or det cord. **Section 12.10** provides more general blasting mitigation measures as recommended by AS2187.2 however the blasting contractor will provide a detailed management plan for these impacts prior to commencement of work in the quarry.

12.7.3 Assessment of ground vibration

Many site-specific factors affect the generation and transmission of ground vibration. The most accurate method of predicting vibration levels at sensitive receivers therefore is from actual site measurements. In the absence of site specific data, Figure J7.3.1 in Appendix J of AS2187.2 provides the following graph reproduced in **Figure 12-11** below, which can be used to estimate the level of vibration at a sensitive receiver based on charge size and distance from the blast source.

- **Figure 12-11 Estimated vibration level Hinze Dam quarry**

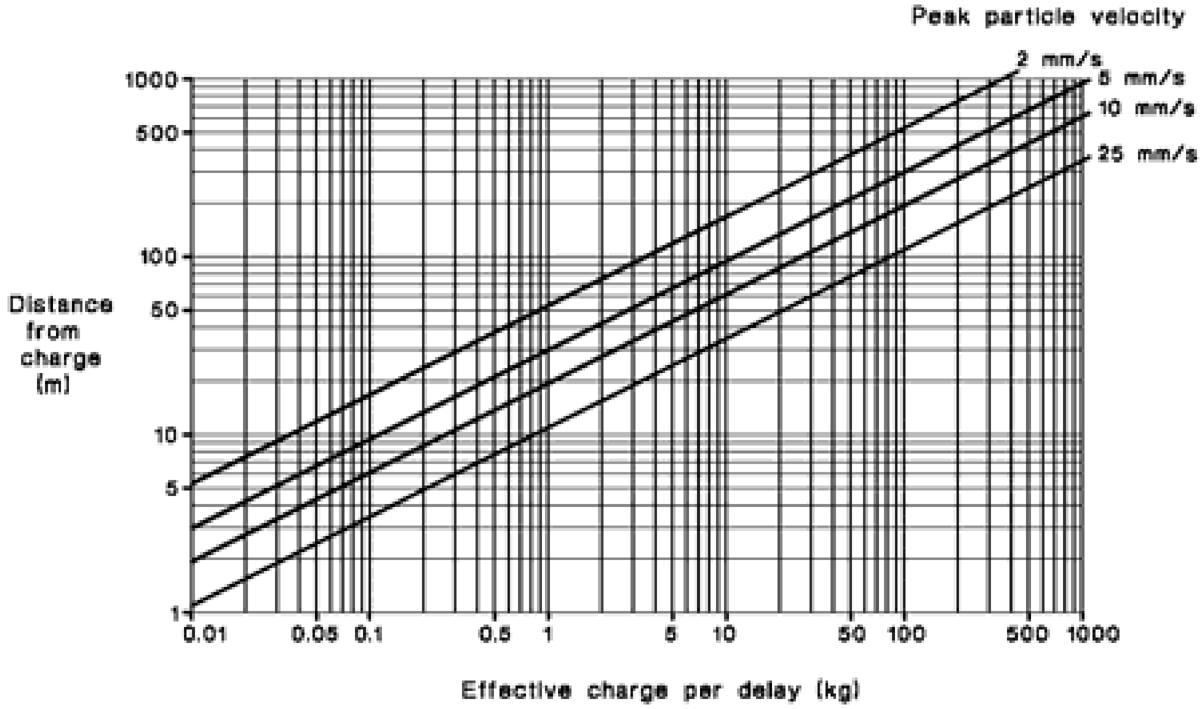


FIGURE J7.3.1 FREE-FACE—AVERAGE FIELD CONDITIONS

From the above graph, the expected level of vibration at the nearest sensitive receivers is expected to be less than 0.3mm/s when using a MIC of 15kg. This level of vibration is below the level of perceptible vibration and therefore the risk of vibration levels affecting the community is considered negligible. From the above assessment of airblast it has been shown that there is the potential for this impact to occur to some degree at a sensitive receiver location. The two different types of impacts should not be confused even though the effects may be similar. As with airblast, monitoring will be undertaken for vibration during trial blasting to determine the extent of any impacts from this activity. General recommendations for mitigation of ground borne vibration reproduced from the Australian Standard are presented in **Section 12.10** and more detailed measures will be included in the management plan for blasting.

12.8 Road Traffic Noise Assessment

As part of the proposal for the raising of the dam wall, a section of Springbrook Road will also need to be raised to avoid a 1 in 100 year flood level. The raising of this section of road has the potential to change the noise environment at nearby residential locations and therefore must be assessed against the DMR road traffic noise level goals.

12.8.1 Background noise environment

Noise levels near Springbrook road in the vicinity of proposed section to be upgraded were measured over a ten day period from 21 March 2007 to 31 March 2007. **Table 12-7** provides a summary of measured traffic noise data measured under free field conditions near a residential dwelling along Springbrook Road.

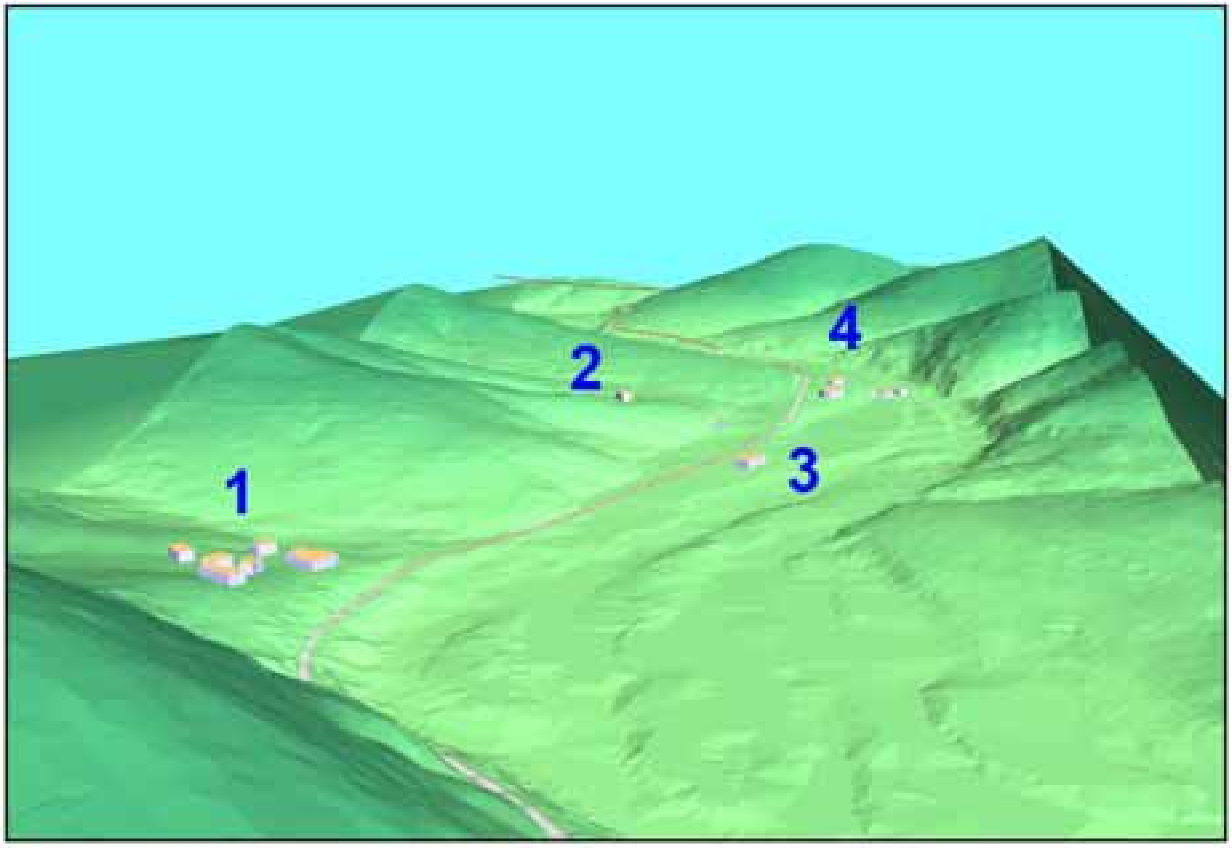
Table 12-7 Summary of measured daily noise levels Springbrook Road

Date	LA10 (18hour)	LAeq (24hour)
Wed 21-Mar-07	51.6	50.5
Thurs 22-Mar-07	50.0	49.9
Fri 23-Mar-07	49.7	48.7
Sat 24-Mar-07	51.3	49.1
Sun 25-Mar-07	50.7	49.0
Mon 26-Mar-07	50.2	51.1
Tues 27-Mar-07	48.5	47.9
Wed 28-Mar-07	50.4	50.0
Thurs 29-Mar-07	49.1	48.5
Fri 30-Mar-07	49.6	47.9
Sat 31-Mar-07	50.2	50.3
Sun 1-Apr-07	52.6	51.6
Median	50.2	49.5

Validation and prediction

The measured noise levels were used to validate a noise model of the existing traffic conditions on Springbrook Road with the difference between measured and predicted levels being approximately 1dB(A) (includes Calibration Factor of 0.7dB(A)). These works will not change the alignment of the existing road and are not expected to result in a change to the quantity or mix of traffic currently using Springbrook road. As there are no substantive changes to the operational parameters, the same traffic numbers have been applied to the modelled section of the road upgrade. **Figure 12-12** is a screen shot of the validation noise model for the existing road showing local terrain and residential dwellings along the section of proposed road upgrade.

▪ **Figure 12-12 Screen shot of noise model for existing conditions, Springbrook Road**



Results of noise predictions

The existing and predicted noise levels were compared to the DMR *Road Traffic Noise Management: Code of Practice*, Part B3, Priority 3, for the upgrading of existing roads. This section of the Code identifies the conditions for the further consideration of noise attenuation following the upgrade of an existing road. The Code states that when the $L_{A10\ 18\ hr}$ predicted for the 10 year period following the upgrade is 68 dB(A) or greater and there is an increase of 3 dB(A) above pre construction noise levels, attenuation measures may be employed to reduce the level to 68 dB(A) or less.

Table 12-8 presents the predicted $L_{A10\ 18\ hr}$ noise levels at the four residential locations for the section of road that is to be upgraded. It should be noted that at either end of the upgrade where the road transitions from the old to the new, residential dwellings will not experience any noticeable affects as the result of the works.

▪ **Table 12-8 Predicted $L_{A10\ 18\ hr}$ noise levels Springbrook Road**

Receiver	Predicted L_{A10} (18hour) Existing	Predicted L_{A10} (18hour) Future
1	52	53
2	47	48
3	54	55
4	55	56

For the section of Springbrook Road where the road height is proposed to be increased, existing $L_{A10\ 18\ hr}$ noise levels are currently in the order of at least 13 dB(A) below the assessment goal. Predicted noise levels after the upgrade have been estimated to be within 1 dB(A) of the existing noise levels after traffic growth over the 10 year period is included.

Modelling of existing traffic and future road upgrades indicates that road noise levels are low and will remain low due to the minor change in the vertical height of the proposed road upgrade and the very low traffic numbers using the road both before and after the upgrade.

12.9 Effects of Noise on Wildlife

There is little information available on the effects of noise on animals however the information available suggests that long term exposure to noise may have an effect on the behaviour and possibly even the habitat of some wildlife. In Australia there are no noise studies are presently available that deal with noise impacts on native species for long term exposure. Studies of potential impacts from military noise (USACERL Technical Report 96/21 1996) may however provide some information with respect to blast type noise impacts.

The USACERL report suggests that military and civilian blast noise had no unusual effects beyond those encountered as the result of other human-generated noise although, hearing damage was not included in the terms of reference for this study. For the project however, the existing conditions do not lend themselves to a pre-exposure to anthropogenic noise sources as the area around Hinze Dam is well forested. In addition impulse type noises such as an explosion is only relatively short in duration and do remain at a high level for the majority of the day as with construction noise.

The major potential for impact of long term noise exposure however, is not related to hearing but more importantly to feeding and mating of some species. The potential for wildlife to sustain an impact to feeding and mating patterns is due to the need to locate food and partners through hearing, which can, in high noise environments such as a construction site, be impaired. Where construction is over a long term this has the potential to have an impact on animal behaviour and numbers, or may force the involuntary relocation from idealised habits to less desirable locations.

While this area of acoustics is not full understood, especially in relation to Australian native wildlife, safety measures may be required under certain circumstances. Due to the scale of the construction activities proposed for the Hinze Dam, there is little ability to mitigate the impacts of noise on the local wildlife. However, where a rare or threatened species is identified in the vicinity of the project, precautionary measures may include:

- a pre construction survey of native habitat to identify the extent of the habitat and approximate colony size;
- periodic monitoring of the colony; and
- a post construction survey to identify any impacts and possible remedial measures where required.

To further understand any implications on the local fauna, reference should be made to **Section 9** and **Section 10**.

12.10 Mitigation Measures

Noise mitigation measures will be required to reduce potential impacts from the noisiest and most easily identified of the construction equipment adopting the approach outlined in **Section 12.6**.

Table 12-9 and **Table 12-10** list specific as well as general methods of reducing noise emissions from the site however the Noise and Vibration Environmental Management Plan (refer **Section 19**) outlines more detailed management measures for the project.

Table 12-9 General construction noise and vibration mitigation and management

Timing	Action Required
Pre construction	Acoustic enclosures will be constructed around fixed plant or over individual pieces of equipment during the site establishment works. These areas include: ▪ Crusher and screen (requires acoustic design); ▪ Concrete batch plant; ▪ Maintenance area/shed (requires acoustic design).
Pre and during construction	Other General Planning considerations: ▪ Maximise the offset distance between noisy plant items and nearby noise sensitive receivers, where possible, using the effects from the following to reduce noise; ▪ Purpose built barriers; ▪ Materials stockpiles; and ▪ Site sheds and material and/or equipment handling areas;
During construction	Orient equipment with directional noise characteristics away from noise sensitive areas.
During construction	Carry out loading and unloading as far away from noise sensitive areas as possible.
During construction	Avoid the coincidence of noisy plant working at the same time close together and adjacent to sensitive receivers.
Pre and during construction	Reduce impact of construction traffic noise by considering: ▪ site road maintenance; ▪ noise walls at closest locations on haul roads; and ▪ traffic management including limitations on vehicle speeds both on and off site.
Pre construction	Ensure that traffic flow through the site is one direction to prevent delays and to avoid the use of reversing alarms as much as possible.
Pre construction	Use ‘smart’, reversing alarms (levels vary with changing background noise levels) on plant and equipment such as bulldozers, cranes, graders, excavators, trucks, etc where practicable.
Pre and during construction	Consult with the local community as an important part of the noise management of the site.
Pre construction	Mitigate noise through the appropriate selection of plant. The unit with the lowest noise rating which meets the requirement of the job will be used.
Pre and during construction	Appropriate selection of construction processes / methodologies, which minimise the generation of construction noise.
Pre and during construction	Fit particularly noisy equipment with noise suppression measures, where practicable.
During construction	Employ respite periods for particularly noisy activities where possible.
Pre and during construction	Train staff to ensure awareness of noise targets and potential community noise issues with the project.
Pre and during construction	Where possible metal surfaces will be lined with rubber impact protection where there is potential for contact.
Pre and during construction	Use quieter hydraulic hammers or the lowest possible energy level to complete any given task.
Pre and during construction	Conduct regular and effective maintenance of both stationary and mobile plant and equipment;
Pre and during construction	No equipment associated with the work will be left standing with its engine running for extended periods.
Pre and during construction	Ensure that vehicles required within compounds do not “queue” outside the worksite close to residential areas. This particularly applies in the morning where sleep disturbance issues may arise.
Pre and during construction	Entry and departure of heavy vehicles to and from the site are restricted to the standard daytime construction times.
Pre and during construction	All construction activities to be restricted to daytime operational hours.
Pre and during construction	Rock breaking, rock hammering, sheet piling and any other activities which result in impulsive or tonal noise generation are only to be conducted during normal operational hours.

■ **Table 12-10 Blasting noise and vibration mitigation and management**

Impact Type	Action Required
Ground vibration	(a) Reducing maximum instantaneous charge (effective charge mass per delay) for example by reducing blasthole diameter or deck loading (b) Using a combination of appropriate delays. (c) Allowing for excessive humps or toe in the blast design. (d) Optimizing blast design (changing burden and spacing) by altering drilling patterns, delaying layout or alter blasthole inclination from the vertical. (e) Exercising strict control over the location, spacing and orientation of all blastholes and using the minimum practicable sub-drilling that gives satisfactory toe conditions. (f) Establishing times of blasting to suit the situation.
Airblast reduction	(a) Optimising blast design (changing burden and spacing) by altering drilling patterns and adjusting maximum instantaneous charge (effective charge mass per delay). (b) Using a combination of appropriate delays. (c) Using survey methods, as appropriate, to ensure burden is adequate. (d) Keeping face heights to a practical minimum. (e) Ensuring stemming type and length is adequate. (f) Eliminating exposed detonating cord. Investigate alternative initiation methods. (g) Eliminating secondary blasting (instead of popping, use rock breaker). (h) Making extra efforts to eliminate the need for two shots (e.g., better control of drill patterns). (i) Considering delaying or cancelling the blast by not loading if the weather forecast is unfavourable. (j) Allowing for the effects of temperature inversion and wind speed and direction on the propagation of airblast to surrounding areas. (k) Orientating faces where possible so that they do not face directly towards residences. (l) Varying the direction of initiation. (m) Exercising strict control over the burden, spacing and orientation of all blastholes. (n) Taking particular care where the face is already broken or where it is strongly jointed, sheared, or faulted. (o) Considering deck loading where appropriate to avoid broken ground or cavities in the face (e.g., from back break).

Source: AS 2187.2

12.11 Compliance Monitoring

12.11.1 Monitoring program and methodology

Monitoring must be undertaken for both specific construction equipment and overall construction noise levels on the project. Noise monitoring and measurements will be performed according to relevant standards and policies including but not limited to the EPA *Noise Management Manual (2000)* and the Australian Standard *AS1055.*

12.11.2 Equipment monitoring

The noise emissions from mobile machinery and construction equipment may vary over the course of its life due to normal aging or maintenance issues. To ensure that noise levels from the project are maintained at appropriate levels, equipment noise levels will be monitored:

- when key items of equipment are first brought onto site to establish baseline noise levels (measured at a distance of seven metres for compliance with Australian Standards and relevant Australian design rules); and
- as required as part of the investigation of noise complaints.

Where equipment noise levels are found to exceed the baseline levels, maintenance will be carried out on the equipment so as to reduce noise emissions to the baseline level. Prior to commencement on site, a noise test will be completed for items of plant which includes a check of reverse / travel alarm noise levels (L_{Amax}) at seven metres as well as operational noise levels. Any subsequent periodic monitoring will then be recorded in an Environmental Monitoring Log as part of the EMP.

12.11.3 Environmental noise monitoring

Long term environmental noise monitoring using unattended noise monitoring equipment as described in **Section 12.3.2**. This monitoring will be carried on a permanent basis out at two locations along with the collection of weather data and dust levels. The permanent sites will provide a high quality source of data of construction noise levels at representative sensitive receiver locations.

In addition to these permanent sites, noise monitoring will be carried out at alternative locations every three months, or as part of investigations in response to a valid complaint received in relation to the works. The objective of the measurements is to measure the $L_{Aeq,24\ Hr}$ noise levels, to determine the extent of any exceedance of the project noise goal. Where an exceedance occurs and the cause can be identified, remedial action will be implemented to ameliorate the impact or avoid a reoccurrence.

12.11.4 Environmental Noise Monitoring Locations

Environmental noise compliance monitoring will be conducted on a 24 hour basis at two locations representative of the closest residential areas to the construction activities. Other sensitive receiver locations will be used on an ad hoc basis to monitor specific work activities or in response to a noise complaint.

12.11.5 Vibration Monitoring

Activities likely to cause vibration impacts at residential dwellings are likely to be limited to rock blasting at the quarry site. Other activities such as piling, rock breaking or vibratory roller use can also cause a vibration impact however there are no works of this nature likely to take place near sensitive receivers. To confirm that construction works do not cause adverse impacts on sensitive receivers a pre-construction dilapidation survey will be carried out at potentially affected properties. Monitoring during initial blasting trials will be undertaken at key locations to ensure that any impacts are within or below acceptable limits.

12.12 Summary and conclusions

The project is proposing to carry out major earth works and construction activities to raise the height of the existing dam wall by approximately 12 metres. The existing noise environment in the vicinity of the dam is typically that of a quiet rural residential community located in the Gold Coast Hinterland. In the area close to the dam wall the change in the character and level of the noise environment due to construction activities is expected to be significant and therefore noise impacts must be managed wherever practical.

While there are no specific noise guidelines for the construction activities a noise level goal of $L_{Aeq\ 12\ Hr}$ 58 dB(A), consistent with the EPP (Noise) acoustic quality objective, has been developed for the project. An assessment of the airborne noise emissions from typical construction activities has been made to determine the potential for impacts on the amenity of adjacent noise sensitive receivers and assist in the development of appropriate mitigation strategies. The noise level predictions indicate that at nearest sensitive receivers, construction noise levels are likely to be higher than the project noise goals during the most intensive portion of the works. To minimise or eliminate the emissions that contribute to the noise environment as a result of the project, a table of mitigation and management measures has been developed and incorporated into the EMP.

Monitoring of noise levels from the project is proposed to assist with the management of construction noise impacts at sensitive receiver locations. These measured levels will be compared to the project noise goals and reasonable and feasible remedial actions will be implemented, as required. As part of the Construction Communication Program a system of complaint reporting, investigation and response will be initiated allowing the local community the opportunity to provide feedback on noise and other environmental issues.