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Tweed Shire Council

Report on Eviron Road Quarry and Landfill Concept Plan

Noise and Vibration Assessment

May 2011

Revision 0

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Contents

Table Index

Figure Index

Appendices

Glossary

Noise Glossary	
dB	Decibel, which is 10 times the logarithm (base 10) of the ratio of a given sound pressure to a reference pressure; used as a unit of sound.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels.
L_N	Statistical sound measurement recorded on the linear scale.
L_{AN}	Statistical sound measurement recorded on the "A" weighted scale.
$L_{A10\ (Time)}$	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
$L_{A10\ (1\ hour)}$	The L_{10} level measured over a 1-hour period.
$L_{Aeq\ (Time)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
$L_{Aeq\ (15\ hr)}$	The L_{Aeq} noise level for the period 7 am to 10 pm.
$L_{Aeq\ (9\ hr)}$	The L_{Aeq} noise level for the period 10 pm to 7 am.
$L_{Aeq\ (1\ hr)}$	The L_{Aeq} noise level for a one-hour period. In the context of the NSW DEC environmental criteria for road traffic noise, it represents the highest tenth percentile hourly A-weighted L_{eq} during the period 7 am to 10 pm, or 10 pm to 7 am, (whichever is relevant). If this cannot be defined accurately, use the highest A-weighted L_{eq} noise level.
$L_{A90\ (Time)}$	The A-weighted sound pressure level that is exceeded for 90 per cent of the time over which a given sound is measured. This is considered to represent the background noise e.g. $L_{A90\ (15\ min)}$.
Rating Background Level (RBL)	The overall single-figure background level representing each assessment period (day / evening / night) over the whole monitoring period (as opposed to over each 24 hour period used for the assessment background level). This is the level used for assessment purposes. It is defined as the median value of: ◗ All the day assessment background levels over the monitoring period for the day. ◗ All the evening assessment background levels over the monitoring period for the evening. ◗ All the night assessment background levels over the monitoring period for the night.

Vibration Glossary	
Vibration	The variation of the magnitude of a quantity which is descriptive of the motion or position of a mechanical system, when the magnitude is alternately greater and smaller than some average value or reference. Vibration can be measured in terms of its displacement, velocity or acceleration. The common units for velocity are millimetres per second (mm/s).
Ground borne Vibration	Ground borne vibration is vibration transmitted from source to receiver via the medium of the ground.
Ground borne Noise	Ground borne noise describes noise transmitted as vibration through the ground and into structures, radiated as low frequency rumbling noise.
Peak Particle Velocity	Current practice for assessments of the risk of structural damage to buildings use measurements of Peak Particle Velocity (PPV) ground vibration (v_p), which is the maximum vector sum of three orthogonal time-synchronized velocity components. When not directly measured by an instrument, PPV may be determined by: $v_p = \sqrt{(v_x^2 + v_y^2 + v_z^2)}$ Where v_x, v_y, v_z are the instantaneous components of particle velocity of the x, y, z primary axes, respectively.
RMS	Root mean square.

1. Introduction

GHD was engaged by Tweed Shire Council (TSC) to assess the potential for noise and vibration impacts from the proposed Eviron Road Quarry and Landfill development, Eviron, NSW.

1.1 Context

Council has developed an overall Concept Plan for the site which comprises a staged project to develop a waste disposal facility within the existing void created by Quirks Quarry, develop two further extractive industries to be used as waste disposal facilities after exhaustion of the quarry resource, and install necessary operational infrastructure such as a haul road and other minor associated facilities. The site and study area can be seen in Figure 1-1.

This proposed method of landfilling in quarry voids is consistent with the method of landfill creation in the Tweed Shire to date. Material won from quarrying is used for road building and other Council civil projects, and overburden stockpiled for road construction, clay liners (where appropriate) and site rehabilitation purposes.

Chronologically, the overall Concept Plan will involve:

- Stage 1 (Project Application):
  - Establishment of a new haul road from Stotts Creek RRC to Quirks Quarry, and development of a landfill within the Quarry void.
  - Progressive rehabilitation of Quirks Quarry landfill.
  - Development of a new quarry in West Valley.
- Future stages may include:
  - Development of a landfill within the void formed from quarrying West Valley.
  - Progressive rehabilitation of the West Valley landfill.
  - Development of a new quarry within North Valley.
  - Development of a landfill within the void formed from quarrying North Valley.
  - Progressive rehabilitation of the North Valley landfill.

The landfills and quarry will operate in sequence and there will be no overlap between landfilling in the Quirks Quarry, West Valley and North Valley, this will also be the case for the quarry operations.

Based on the concept design work and studies undertaken to date the following operational periods have been adopted for the purposes of assessing the potential environmental impacts:

- Quirks Quarry Landfill: 10 years (2012 – 2021).
- West Valley Quarry: 10.5 years (2012-2021).
- West Valley Landfill: 12 years (2022-2033).
- North Valley Quarry: 3.5 years (2022-2026).
- North Valley Landfill: >10 years (2034 -2045).

Figure 1-1 Study Area and Site Boundary

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1.2 Scope of Work

The scope of work undertaken by GHD for the assessment of noise and vibration emissions from the proposed development is outlined in the points below. These points are described in greater detail in the subsequent sections of this report.

- Initial desk top review to identify key environmental noise and vibration catchment areas and sensitive receivers from aerial photography and a site visit.
- Unattended noise monitoring for a period of one week at each of two noise receiver locations identified as being indicative of the local ambient noise environment.
- Attended noise measurements at each of the unattended noise logging locations to supplement the unattended measurements and to determine the existing ambient noise levels from Quirks Quarry and Stott's Creek Landfill at the identified sensitive receivers.
- Noise data was assessed and filtered to remove invalid data due to extraneous noise or adverse weather conditions.
- Establish project specific noise and vibration goals for the operation of the proposed quarries and landfills.
- Identify and characterise the likely principal noise and vibration sources.
- Noise modeling using Computer Aided Noise Abatement (Cadna-A) software to predict emitted operational noise levels at the nearest identified noise receivers for individual quarry and landfill sites and combined operations with consideration to the project development planning.
- Assessment of blasting noise and vibration impact.
- Recommend noise and vibration (including blasting) mitigation measures.

The abovementioned scope of work has been conducted with consideration to the following NSW Office and Environment and Heritage (OEH) guidelines:

- Industrial Noise Policy (INP).
- Assessing Vibration: a technical guideline.
- Environmental Criteria for Road Traffic Noise (ECRTN)
- Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (ANZECC).

2. Project Description

2.1 Quarry Activities – West Valley and North Valley

2.1.1 Level of Production

It is assumed that the maximum rate or level of production will total approximately 200,000 tonnes per year at each quarry. However this will be further determined by the amount of material available for extraction and what is outlined in the approvals process as appropriate for the site.

2.1.2 Hours of Operation

The hours of operation for each quarry will be the same as those currently at Quirks Quarry, as outlined in Table 2-1.

Table 2-1 Quarry Operating Hours

Operation	Operating Days	Start Time	Finish Time
Quarrying	Monday to Friday	7 00	1700
	Saturday	7 00	1200
Blasting	Monday to Friday	9 00	1500
	Saturday	9 00	1200
Hauling	Monday to Friday	7 00	1700
	Saturday	7 00	1200

2.1.3 Description of Operations

The operations in extracting rock from the proposed quarries typically involve the following tasks:

- Pre strip activities and topsoil stockpiling activities.
- Blast-hole Drilling and Blasting (if required).
- Extraction:
  - Primary screening.
  - Primary crushing.
  - Secondary Screening and crushing where required.
- Stockpiling.
- Product Loading and Hauling.

Material extraction will typically be undertaken using a bulldozer or excavator. Blasting would be undertaken on a periodic basis depending upon demand for the resource and when manual extraction becomes too difficult or dangerous. Drilling would be required as part of blasting operations.

Material will then be loaded into a series of mobile crushers and screens for on-site processing or loaded directly into haul trucks and taken off site. Processed products will be segregated and stockpiled ready for use and/or delivery. Based on current operations at Quirks Quarry, all material will be processed on-site unless requested otherwise.

The expected products available would be:

- 70-30 mm, 40 mm, 20 mm, 10 mm, 7 mm Drainage Aggregates.
- Cracker Dust.
- “C” Grading Type 2.1 and “B” Grading Type 2.3 Road base.
- Overburden/Fill.
- Screened topsoil (Rescreened from imported spoil).
- Screened Sand (Rescreened from imported spoil).

The exact products to be available from the West Valley and North Valley Quarries have not been determined at this stage, however these products are currently available from the Quirks Quarry site and due to their close proximity should reflect that available at West Valley and North Valley quarries.

Typical quarry operations are shown in Figure 2-1, depicting Quirks Quarry in 2008.

Figure 2-1 Quirks Quarry Operations – 2008

2.2 Landfill Activities – Quirks Landfill, West Valley Landfill and North Valley Landfill

2.2.1 Hours of Operation

The hours of operation at each landfill is expected to be identical to the existing Stotts Creek RRC and will be seven days per week between 7:00 am and 4:00 pm Monday to Friday and between 9:00 am and 4:00 pm Saturday and Sunday.

2.2.2 Facility Layout

Access to each landfill will be via a haul road constructed between the existing Stott's Creek facility and the Quirks Quarry Landfill. Small vehicular traffic (i.e. domestic and small commercial customers) will continue to utilise the transfer station facility at the Stotts Creek RRC.

The main features of the landfill site include the following:

- Active landfilling area (for council and contractor vehicles only).
- Sediment basin and stormwater drains.

2.2.3 Waste Acceptance Rates

The levels of waste that are likely to be accepted at each landfill throughout their lifespan are shown in Table 2-2. These figures have been utilised in the noise model.

Table 2-2 Landfills – Levels of Waste Acceptance

Landfill	Years of Operation	Waste (tonnes per annum)
Quirks	2012 – 2021	Up to 70,000 tpa
West Valley	2022 – 2033	From 58,000 to 100,000 tpa
North Valley	2034 – 2045	From 100,000 to 145,000 tpa

3. Existing Environment

3.1 Study Area

Existing land uses in the vicinity of the Eviron Quarry and Landfill site include:

- Stott's Creek RRC.
- Quirks Quarry.
- The Pacific Highway.
- Pasture and agricultural land.

The site is bordered to the north by generally flat areas of agriculture and sugar cane fields. The proposed quarries and landfills are located in areas of undulating topography.

A number of residential properties are located around the proposed site. Details of identified sensitive receivers are also shown below in Table 3-1. There is also a property on Hawkens Lane that has recently been purchased by Tweed Shire Council and is currently unoccupied. The future use for this property is not expected to be residential and it has therefore been excluded from the assessment.

An aerial photograph showing the location of the proposed project footprint, the existing landfill and quarry and nearby sensitive receivers is shown in Figure 3-1. It is noted that Lot 25 on DP 615931 (Receiver 3) was not considered a sensitive receiver as this property was acquired by Council in early 2011, however for completeness it is included in this version of the assessment report.

Table 3-1 Identified Sensitive Receivers

Sensitive Receivers	Address Details	Property Details
Receiver 1	751 Eviron Rd, Eviron	Lot 30 on DP 820048
Receiver 2	157 Hawkens Ln, Eviron	Lot 2 on DP 705781
Receiver 3	656 Eviron Rd, Eviron	Lot 25 on DP 615931
Receiver 4	657 Eviron Rd, Eviron	Lot 1 on DP 783802
Receiver 5	726 Eviron Rd, Environ	Lot 30 on DP 706846
Receiver 6	10 Donalyn Crt, Duranbah	Lot 501 on DP 1000612
Receiver 7	Eviron Rd, Duranbah	Lot 603 on DP 1001049

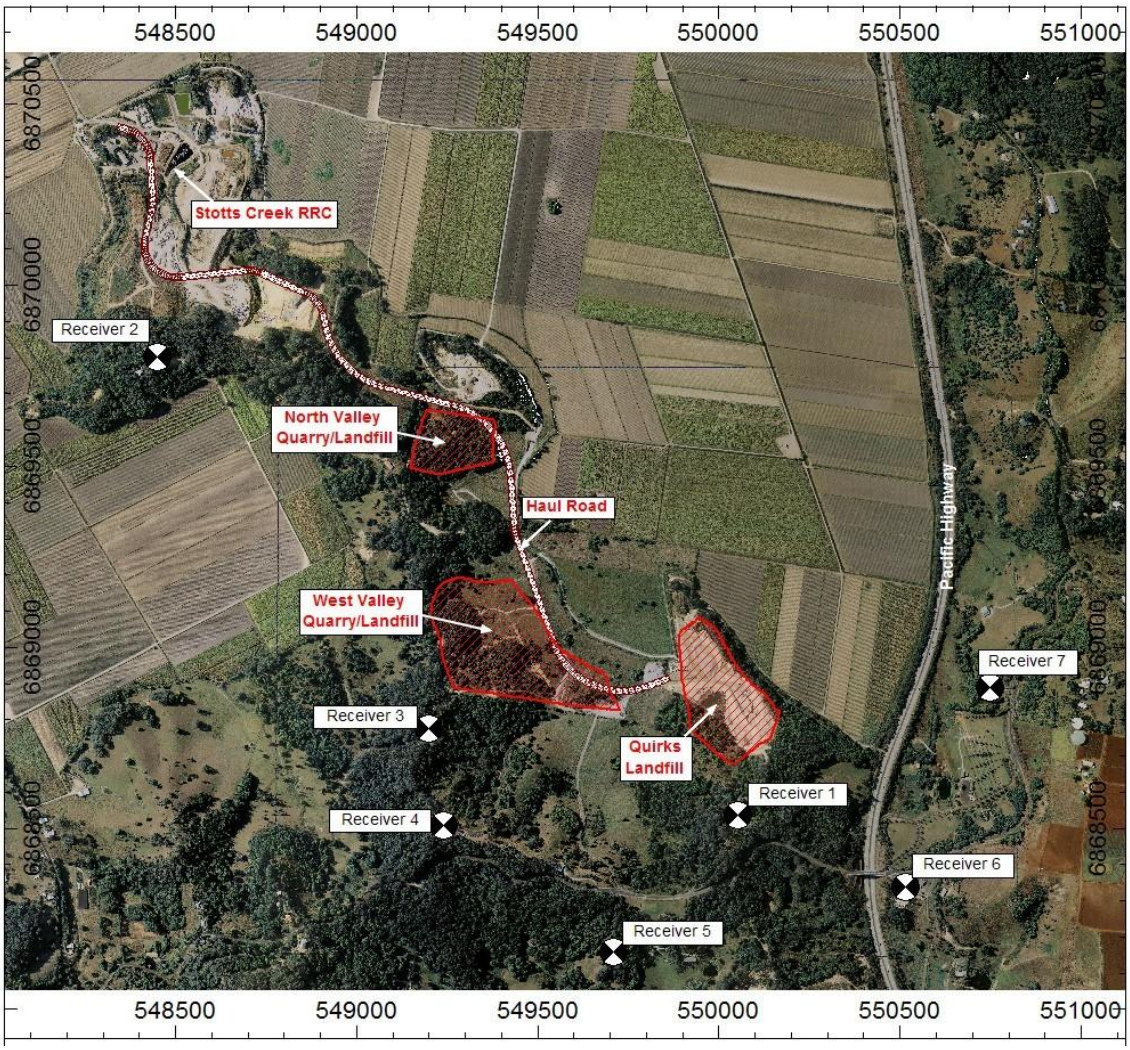


Figure 3-1 Study Area

3.2 Local Meteorology

Local meteorological conditions, such as wind and temperature inversions, may increase noise levels when favourable to noise propagation.

The INP states that wind effects on noise propagation need to be assessed when source-to-receiver wind speeds of 3 m/s or below occur for 30% of the time or more in any assessment period (day, evening or night) in any season. The assessment of temperature inversions is confined to the night noise assessment period (10 pm to 7 am), hence, inversion effects were not considered in this assessment because the quarries and landfills would not be operating during the night period.

The nearest Automatic Weather Station (AWS) is located at Coolangatta Airport (approximately 10 km to the north-west of the site), and is operated by the Bureau of Meteorology (BoM). Data from this weather station was obtained but due to the intervening topography and coastal location, this data alone was considered insufficient to be used to represent meteorological conditions at the site.

Therefore, GHD utilised a regional-scale prognostic meteorological model, The Air Pollution Model (TAPM V 4), to simulate the wind climate over the subject site with consideration to DECCW *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, August 2005. Weather data from the Coolangatta AWS was used as input to TAPM to assist in calibrating the model. TAPM was used to produce representative hourly surface and upper air meteorological data at the project site as part of the air quality assessment also conducted by GHD and the resulting data was used for input in the noise assessment. Further information on the use of TAPM can be found in the Air Quality Assessment report (GHD document number 90344, 2011).

Figure 3-2 displays the daytime (7 am to 6 pm) annual and seasonal wind roses for study area.

Analysis of wind data indicated that that source-to-receiver wind of 3 m/s or below does not occur for greater than 30% of the time in any period (day, evening, night) in any season. Therefore, with consideration to the requirements of the INP, wind was not included in the noise-prediction calculation.

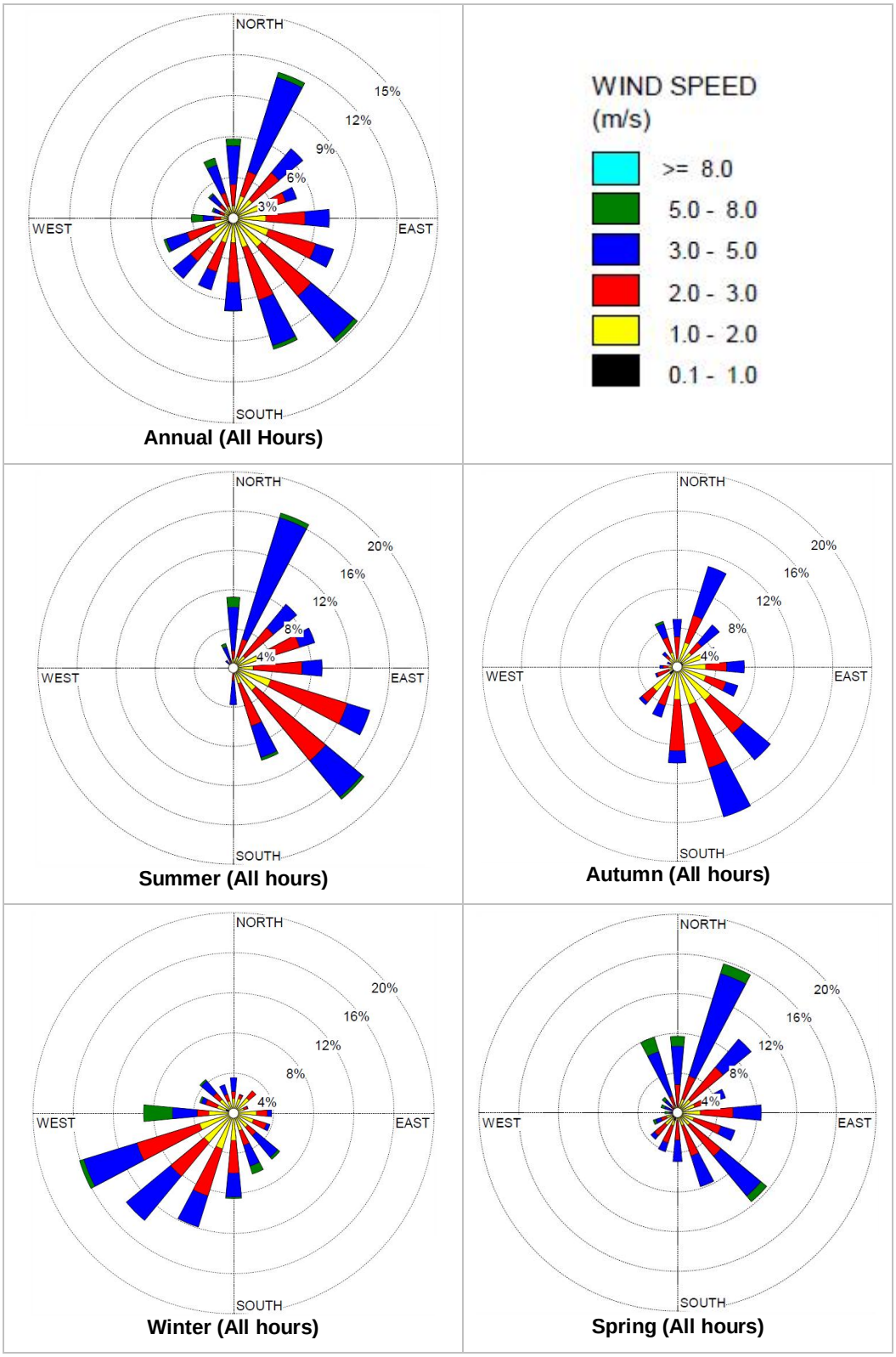


Figure 3-2 Daytime Seasonal Wind Roses

3.3 Existing Noise Environment

Attended and unattended noise monitoring was conducted by GHD in the area surrounding the proposed site. The purpose of noise monitoring was to determine the existing noise levels in the area, which will assist in setting operational noise goals for the project.

Long-term unattended noise monitoring was undertaken between 4 March 2011 and 21 March 2011. Monitoring was undertaken at two residential properties surrounding the project area. These locations were chosen as good locations to represent the ambient noise environment of the area and also to provide a secure location to noise monitoring equipment. Short-term attended noise monitoring was also undertaken at the same locations.

Concurrent weather data was obtained from the Bureau of Meteorology's AWS located at the Coolangatta Airport, which is situated approximately 10 km north-east of the subject site.

3.4 Unattended Noise Monitoring Results

Unattended noise monitoring was undertaken using two Rion NL-22 environmental noise loggers. These loggers are capable of measuring continuous sound pressure levels and are able to record L_{A90}, $L_{A10,}$ L_{Aeq} and L_{Amax} noise descriptors. The instruments were programmed to accumulate environmental noise data continuously over sampling periods of 15 minutes for the entire monitoring period.

Prior to deployment, the loggers were calibrated with a sound pressure level of 94 dB at 1kHz using a Bruel and Kjaer Type 4231 sound level Calibrator (serial number 2542101). At completion of the monitoring period, the loggers were retrieved and calibration was rechecked. The data collected by the loggers was downloaded and analysed, and any invalid data removed. Invalid data generally refers to periods of time where average wind speeds were greater than 5 m/s at ground level, when rainfall occurred, or for when anomalous noise levels occurred. Table 3-2 displays the detail of each noise logger.

Table 3-2 Unattended Noise Logger Details

Noise Logger	Logger 1	Logger 2
Monitoring Location	Residence Lot 19 Hawkens Lane	Receiver 3 656 Eviron Road
Logger Serial No.	852196	762857
Measurement Started	04/03/2011 09:00	04/03/2011 12:30
Measurement Ceased	13/03/2011 18:00	18/03/2011 18:00
Pre-measurement Calibration	93.8 dB(A)	94.0 dB(A)
Freq. Weighting	A	A
Time response	Fast	Fast

Table 3-3 and Table 3-4 present a summary of the long-term noise monitoring data. Statistical noise results are also presented in graphical format in Appendix A.

Table 3-3 Summary of Noise Monitoring Results – Logger 1 dB(A)

Logger	Background L_{A90} dB(A)			Ambient L_{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Friday-4-Mar-11	42	43	43	47	56	46
Saturday-5-Mar-11	43	-	43	50	-	48
Sunday-6-Mar-11	43	44	43	47	54	50
Monday-7-Mar-11	44	43	42	49	48	53
Tuesday-8-Mar-11	42	44	42	50	53	46
Wednesday-9-Mar-11	42	42	42	49	51	47
Thursday-10-Mar-11	42	43	42	49	53	45
Friday-11-Mar-11	42	43	41	49	51	45
Saturday-12-Mar-11	41	43	41	51	52	44
Sunday-13-Mar-11	42	-	-	47	-	-
RBL and L_{eq} Overall	**42**	**43**	**42**	**49**	**53**	**48**

Note: '-' refers to invalid data that has been excluded from the data set.

Table 3-4 Summary of Noise Monitoring Results – Logger 2 dB(A)

Logger	Background L_{A90} dB(A)			Ambient L_{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Friday-4-Mar-11	42	43	42	52	51	46
Saturday-5-Mar-11	43	-	41	52	-	49
Sunday-6-Mar-11	42	46	40	48	54	50
Monday-7-Mar-11	46	42	40	52	51	50
Tuesday-8-Mar-11	44	42	39	53	51	44
Wednesday-9-Mar-11	42	42	37	-	-	43
Thursday-10-Mar-11	43	43	38	53	51	44
Friday-11-Mar-11	43	45	36	52	57	44
Saturday-12-Mar-11	42	43	37	54	49	49
Sunday-13-Mar-11	41	42	38	57	53	44
Monday-14-Mar-11	42	43	36	53	-	46
Tuesday-15-Mar-11	43	42	35	51	51	43
Wednesday-16-Mar-11	42	41	36	54	54	45
Thursday-17-Mar-11	39	41	-	51	50	-
RBL and L_{eq} Overall	**42**	**42**	**38**	**53**	**53**	**47**

Note: '-' refers to invalid data that has been excluded from the data set.

3.4.1 Attended Noise Monitoring Results

Attended noise monitoring was conducted over 15-minute periods at each of the long term monitoring locations. Attended measurements were undertaken using a Bruel and Kjaer 2250 sound level meter (SLM) (serial number 2506887). This SLM is capable of measuring continuous sound pressure levels and is able to record L_{Amin}, L_{A90}, L_{A10}, L_{Amax} and L_{Aeq} noise descriptors. On-site calibration conducted immediately before and after the measurements showed negligible variation. Details of the existing noise environment were also recorded during these monitoring periods. The results of attended monitoring are shown in Table 3-5.

Table 3-5 15-Minute Attended Noise Monitoring Results

Monitoring Location and Description	Start time	L_{Aeq}, 15 minute	L_{A90}, 15 minute	Comments on Noise Environment
Logger 1 Lot 19 Hawkens Lane	09:30 04/03/11	43	41	◗ Temp 24 °C, calm wind, 8/8 cloud cover. ◗ Rural environment with local animals and nearby insects audible at times. ◗ Distant traffic noise on Pacific Highway was audible during measurements (approx. 40 – 43 dB(A)). ◗ Quirks Quarry not audible during measurements. ◗ Landfill operations were generally barely audible but were audible on occasions for short bursts i.e. less than one minute (approx. 43 – 48 dB(A)).
	13:30 22/03/11	52	40	◗ Temp 33 °C, wind NW <1 m/s, cloud 4/8. ◗ Quirks Quarry occasionally audible but generally not measureable above background (approx. 40 dB(A)). ◗ Local insect/bird noise approx. 45 – 55 dB(A). ◗ Distant traffic noise on Pacific Highway was audible during measurements (approx. 39 – 43 dB(A)).

Monitoring Location and Description	Start time	L_{Aeq}, 15 minute	L_{A90}, 15 minute	Comments on Noise Environment
Logger 2 Receiver 3 656 Eviron Road	12:15 04/03/11	53	44	◗ Temp 26 °C, calm wind, 8/8 cloud cover. ◗ Local animals and nearby insects were audible. ◗ Distant traffic noise on Pacific Highway was audible during measurements (approx. 41 – 43 dB(A)). ◗ Quirks Quarry trucks and loader reverse alarm audible but generally not measureable above background noise level (approx. 43 – 45 dB(A)). ◗ Landfill operations not audible.
	13:00 04/03/11	52	42	
	14:00 22/03/11	49	41	◗ Temp 34 °C, wind calm to NW <1 m/s, cloud 4/8. ◗ Distant traffic noise on Pacific Highway was audible during measurements (approx. 39 – 43 dB(A)). ◗ Quirks Quarry trucks and loader reverse alarm audible but generally not measureable above background noise level (approx. 40 – 45 dB(A)). ◗ Local insect/bird noise approx. 45 – 55 dB(A). ◗ Landfill operations not audible.

4. Noise and Vibration Assessment Criteria

4.1 Operational Noise Criteria

Operational noise criteria, applicable to site noise sources, were determined with consideration to the INP.

The INP provides guidance on the assessment of operational noise impacts. The guidelines include both Intrusive and Amenity criteria that are designed to protect receivers from noise significantly louder than the background level and to limit the total noise level from all sources near a receiver.

Intrusive noise limits set by the INP control the relative audibility of operational noise compared to the background level. The amenity criteria limit the total level of extraneous noise. Both sets of criteria are calculated and the more stringent of the two in each time period applies with consideration to the OEH Application Notes pertaining to Section 2.4 of the INP. Table 2.2 in the INP provides modifications to the amenity criteria for existing levels of industrial noise.

As mentioned in Section 3.3 of this report, attended observations noted that existing levels of industrial noise in the area are not a significant contributor to the existing ambient noise level in the vicinity of the development. Therefore adjustments are not necessary for the amenity noise criteria.

The amenity criteria are determined based on the overall acoustic characteristics of the receiver area and the existing level of noise excluding other noises that are uncharacteristic of the usual noise environment. Residential receiver areas are characterised into 'urban', 'suburban', 'rural' or other categories based on land uses, the existing level of noise from industry, commerce, and road traffic. The nearest residential receivers to this development were classified as rural.

The project specific noise levels for the proposed development at individual identified sensitive receivers are provided in Table 4-1. Given there are no night time activities proposed, only the daytime criterion would apply to the site operations.

Table 4-1 Project Specific Noise Levels

Criterion	Day 7 am to 6 pm	
	Logger 1	Logger 2
A: Rating Background Level	42 $L_{A90(day)}$	42 $L_{A90(day)}$
B: Intrusiveness Criteria (A + 5dB)	47 $L_{Aeq(15min)}$	47 $L_{Aeq(15min)}$
C: Rural Amenity Criteria (Table 2.1 INP)	50 $L_{Aeq(day)}$	50 $L_{Aeq(day)}$
D: Amenity Criteria: (INP Table 2.2 Adjusted)	-	-
Project Specific Noise Level (Page 21 INP)	**47 $L_{Aeq(15min)}$**	**47 $L_{Aeq(15min)}$**

Site observations indicated that the existing Quirks Quarry was audible, at times, during operations. However, noise levels from the above sources would typically be intermittent, resulting in no applicable noise penalty over the daytime period. This intermittency of noise is highly unlikely to effect the RBL's measured by the noise loggers, which is evident in Table 3-4 that shows no difference in daytime L_{A90} levels between Sunday (quarry not operating) and Weekdays (quarry operating normally). As the RBL's were unaffected and with the planned closure of the existing quarry, no Table 2.2 adjustments were made in determining noise goals with consideration to the NSW INP.

For the purpose of this assessment, the daytime noise criterion derived in Table 4-1 was applied to all the sensitive receivers identified as part of this assessment.

4.2 Road Traffic Noise Criteria

All changes in traffic flows on public roads must be assessed with consideration to the OEH's Environmental Criteria for Road Traffic Noise (ECRTN).

The proposed site has the potential to increase traffic on the Pacific Highway as well as Leddays Creek Road and Tweed Valley Way. These roads could be considered both local roads (Leddays Creek Road) and freeway/arterial roads (Tweed Valley Way and Pacific Highway). Therefore, the specific project falls under more than one of the ECRTN development types. Table 4-2 lists the "base" target road traffic noise criteria, as per Table 1 of the ECRTN.

Table 4-2 Road Traffic Noise Criteria

Type of Development	Criteria		
	Day (7am–10pm)	Night (10pm–7am)	Where Criteria are Already Exceeded
7. Land use developments with potential to create additional traffic on existing freeways/arterials.	$L_{Aeq(15hr)}$ 60 dB(A)	$L_{Aeq(9hr)}$ 55 dB(A)	Where feasible and reasonable, existing noise levels should be reduced to meet the noise criteria. Possible applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments.
13. Land use developments with potential to create additional traffic on local roads	$L_{Aeq(1hr)}$ 55 dB(A)	$L_{Aeq(1hr)}$ 50 dB(A)	Where feasible and reasonable, existing noise levels should be reduced to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments.

Additionally where the existing criteria have already been exceeded the ECRTN recommends that, *"…In all cases, traffic arising from the development should not lead to an increase in existing noise levels by more than 2 dB."*

4.3 Vibration Criteria

Guidance of limiting vibration values for general quarry activities is attained from reference to the following standards and guidelines:

- OEH *Assessing Vibration: A Technical Guideline.*
- British Standard BS 7385.2 - 1993 *Evaluation and Measurement for Vibration in Buildings, Part 2 - Guide to damage levels from ground borne vibration.*
- British Standard BS 6472 - 1992 *Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)*.

The BS 6472 human comfort peak vibration limits are shown in Table 4-3 for the frequency range of 1 Hz to 80 Hz, which is applicable to quarry activities. These values are limits that may cause loss of amenity to the occupant of a building.

Table 4-3 BS 6472 Human Comfort Vibration Limits from 1 Hz to 80 Hz (mm/s PPV[1])

Receiver type	Period[2]	Continuous Vibration		Intermittent and Impulsive Vibration	
		Preferred	Maximum	Preferred	Maximum
Residential	Day	0.28	0.56	8.6	17
	Night	0.2	0.4	2.8	5.6

[1] Based on sinusoidal vibration sources.

[2] Day is between 7 am and 10 pm and night is between 10 pm and 7 am.

4.4 Blasting Criteria

The ANZECC *Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* has been adopted for assessment of blasting noise and vibration impacts in this report. This guideline specifies recommended human comfort criteria for blasting activities.

The ANZECC recommended maximum level for airblast overpressure is 115 dB(L) peak. This level may be exceeded on up to 5% of the total number of blasts over a period of 12 months. However, the airblast overpressure must not exceed 120 dB(L) peak for any blast.

Ground-borne vibration level should not exceed 5 mm/sec Peak Particle Velocity (PPV). The recommended PPV level may be exceeded on up to 5% of the total number of blasts over a period of 12 months. However, the level should not exceed 10 mm/sec at any time.

ANZECC guideline recommends that blasting should only be permitted during the following hours:

- Monday to Saturday, 9am to 5pm.
- No blasting on Sundays or Public Holidays.

The frequency of blasting should not take place more than once per day. This requirement does not apply to minor blasts.

The abovementioned restrictions on times and frequency of blasting do not apply to premises where the effects of the blasting are not perceived at noise sensitive sites.

When a temperature inversion is known to exist, blasting should be avoided if practicable.

5. Assessment of Operational Noise Impacts

5.1 Noise Model Configuration

Acoustic modelling was undertaken using Computer Aided Noise Abatement (Cadna-A) to predict the noise levels generated from the proposed Quarry and Landfill activities forming part of the Stage 1 Project Application and future stages proposed in the Concept Plan.

Cadna-A is a computer program for the calculation, assessment and prognosis of noise propagation. Cadna-A calculates environmental noise propagation according to ISO 9613-2, *"Acoustics – Attenuation of sound during propagation outdoors*". Ground absorption, reflection, terrain and relevant shielding objects are taken into account in the calculations.

Modelling results are based on the information available and assumptions made at the time of the assessment.

5.1.1 Ground Contours

Detailed ground topography data was supplied for the project site and surrounding area as well as existing ground levels of Quirks Quarry. The vertical resolution of the topographic contours varied between 0.25 and 10 metres. Where required, ground topography data was manipulated to provide a reasonable representation of future quarry or landfill sites.

5.1.2 Nearest Sensitive Receivers

Noise and Vibration sensitive receivers are shown in Figure 3-1. All sensitive receivers for the purpose of this assessment have been defined as residential premises.

All sensitive receivers were modelled 1.5 m above ground level.

5.1.3 Noise Sources

GHD conducted noise measurements of quarry and landfill equipment during site visits to Quirks Quarry and Stotts Creek RRC. The plant and equipment that would be used at future quarry and landfill sites within the project area has been assumed to be identical to these operating facilities.

Sound power levels (L_W) for all identified noise sources are based on field measurements or, where measurement data could not be taken, typical noise levels produced by equipment anticipated to be used on site were sourced from AS 2436-2010 *Guide to noise and vibration control on construction, demolition and maintenance sites* and from BS 5228-1:2009 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise.* These standards provide sound measurement data based on measurements of individual plant and equipment at quarry and landfill sites.

Modelled overall sound power levels for quarry and landfill equipment are summarised in Table 5-1 and Table 5-2 respectively. These sound power levels are maximum levels produced when machinery is operating under full load.

Table 5-1 Modelled Noise Sources – Landfill

Noise Source	Sound Power Level (L_W) dB(A)	Modelled Height (m)	% of time operating [1]
Cat 330 Excavator	106	2.5	0
Cat D7 Dozer	114	2.5	100
Cat 350 Dump Truck	108	2.5	100
Cat 826 Compactor	107	2.5	0
Cat 120G Grader	114	2.5	0
Water Truck	110	2.5	0

[1] See comments in Section 5.1.4 below.

Table 5-2 Modelled Noise Sources – Quarry

Noise Source	Sound Power Level (L_W) dB(A)	Modelled Height (m)	% of time operating [1]
Excavator	106	2.5	80
Cat IT 62 Wheeled Loader	105	2.5	80
Cat D7 Dozer	114	2.5	80
Volvo L180 Wheeled Loader	101	2.5	80
Daewoo Mega 300V Wheeled Loader	100	2.5	80
Pneumatic Hard Rock Drill [2]	118	2.5	100 (when operating)
Primary Crusher	116	2.0	100
Secondary Crusher	112	2.0	100
Screening Plant – Finlay 683	111	2.0	100
Screening Plant – Finlay 542	102	2.0	100
Screening Plant – Finlay 640	108	2.0	100
Conveyor	81	1.0	100
Water Truck	110	3.0	50
Haul/Dump Truck	110	3.0	50

[1] See comments in Section 5.1.4 below.

[2] As the hard Rock Drill is only required for blasting preparations, it is not considered part of 'normal' day-to-day operations and therefore has been included in a separate model run for noise model predictions.

5.1.4 Model Assumptions

The noise model was configured based on the following assumptions:

- Layout of fixed processing plant (e.g. crushers, screens and conveyors) at each of the proposed quarries was based on the layout at the existing Quirks Quarry.
- Landfill and quarry plant and equipment were modelled as operating a various percentages of time based on current 'worst-case' operations.
- A maximum of two mobile plant items at each Landfill would operate simultaneously and continuously over a 15-minute assessment period. Based on existing landfill operations at Stotts Creek, only one of the following pairs of equipment would operate at any time:
  - Dozer and dump truck.
  - Excavator and dump truck.
  - Dozer and compactor.

  As a conservative measure, the worst-case pair of one dozer and one dump-truck was modelled.
- Heavy vehicles on the internal haul road between Stotts Creek RRC and Quirks Landfill would be within the site boundaries and have been considered as part of site noise and been included in the assessment against the INP. Due to the low vehicle numbers, vehicles along the haul road were modelled as a series of point sources, rather than a roadway. A maximum of up to 15 heavy vehicles per hour was modelled along the haul road. A more detailed description of traffic generation is discussed in Section 6.

5.1.5 Validation of Noise Model Predictions

In order to validate the noise model and assumptions made, model sound pressure level predictions were compared against attended measurement data taken near the Quirks Quarry site office during operations of the existing quarry. Although this assessment is focused on noise from future activities on this site (Quirks Landfill) and quarry/landfill activities on different sites (West Valley and North Valley) validating the noise model under existing conditions will provide confidence in predicting future noise levels from the site.

Attended noise measurements were taken on 22 March 2011 over 15 minute periods to capture quarry noise. Table 5-3 below summarises the noise monitoring results.

The noise model was configured to represent the operations during measurements based on the sound power data supplied in Table 5-2. A comparison of the measured and predicted noise levels under the same site operations show a close correlation (less than 1 dB difference). Therefore, the noise model is shown to have an acceptable degree of accuracy and predictions can be made of future operations with confidence.

Table 5-3 Quirks Quarry Attended Measurements

Location	Time	Notes	Measured $L_{Aeq\ (15\ minute)}$ dB(A)	Predicted $L_{Aeq\ (15\ minute)}$ dB(A)
Site office	14:40	◗ Screening plant operating. ◗ 2 x Front end Loaders moving between screening plant and stockpiles. ◗ 1 x 45 tonne excavator feeding screening plant. ◗ Plant and equipment operating continuously throughout the 15 minute period. ◗ Plant and equipment located towards south-eastern section of site. ◗ Calm winds.	54.2	54.7
Site office	15:00	◗ Screening plant operating. ◗ 2 x Front end Loaders moving between screening plant and stockpiles. ◗ 1 x 45 tonne excavator feeding screening plant. ◗ Plant and equipment operating continuously throughout the 15 minute period. ◗ Plant and equipment located towards south-eastern section of site. ◗ Haul truck entered past site office (30 seconds) during measurement. ◗ Calm winds.	55.5	56.4

5.1.6 Modelling Scenarios

Noise modelling was undertaken for each of the possible site configurations as outlined in the Concept Plan project description. Based on the proposed time line of the Concept Plan, only one quarry and one landfill would operate at any given time. Therefore, three site configurations were modelled:

◗ Configuration 1: Quirks Landfill and West Valley Quarry. Stage 1 of the proposed Concept Plan (2012 – 2021).

- Configuration 2: West Valley Landfill and North Valley Quarry. Stage 2 of the proposed Concept Plan (2022 – 2033).
- Configuration 3: North Valley Landfill only (2034 – 2045).

5.2 Predicted Noise Levels

Table 5-4 summarises the predicted noise levels at each identified sensitive receiver under neutral weather conditions. Noise levels have been predicted with and without the use of the hard rock drill. Noise levels for normal operations (without hard rock drill) have also been predicted at the end of each Stage of the project (i.e. quarry pit at lowest point and landfill at full capacity). This has provided a guide as to the change in noise levels at the landscape of the quarry and landfill change and noise sources become more or less exposed to sensitive receivers.

The adopted project specific noise goal at all receivers is 47 dB(A) L_{Aeq}.

Table 5-4 Predicted Operational Noise Levels – dB(A)

Model Configuration	Scenario (1, 2)	Receiver						
		R1	R2	R3	R4	R5	R6	R7
1 (West Valley Quarry and Quirks Landfill)	Without drill at open	44	40	**49**	39	27	34	43
	With drill at open	44	41	**50**	40	27	34	43
	Without drill at close	46	37	45	37	26	40	46
2 (West Valley Landfill and North Valley Quarry)	Without drill at open	40	36	46	39	26	35	40
	With drill at open	41	41	**48**	41	27	36	41
	Without drill at close	39	34	**47**	38	22	33	39
3 (North Valley Landfill only)	Open	32	27	38	32	16	28	34
	Close	32	36	38	34	21	28	35

[1] Open scenario refers to the equipment height at quarry and landfill opening. i.e. Quarry is at existing ground level and landfill is at previous quarry pit level.

[2] Close scenario refers to the equipment height at quarry and landfill close. i.e. Quarry is at lowest pit level and landfill is at maximum capacity (assumed to be approximately natural ground height).

The predicted noise contours for each modelled scenario are provided in Appendix C.

The separate contribution of the quarry and landfill at each of the sensitive receivers has also been analysed. A comparison of contribution levels show that, upon opening, the quarry is generally the controlling noise source when compared to the landfill. However, as the landscape of the quarry and landfill change into the future, the noise contributions are shown to reverse, with the landfill becoming the controlling noise source at most sensitive receivers. This change is purely due to the level of exposure of equipment as they are increasingly or decreasingly shielded by local topographical features, such as the active quarry face.

5.3 Discussion of Noise Model Results

The noise model results indicate the following:

5.3.1 Configuration 1 (West Valley Quarry and Quirks Landfill)

- Configuration 1 indicates that noise levels from normal operations of the West Valley Quarry and Quirks Landfill are expected to meet the daytime criteria at all identified residential receivers, except for at Receiver 3 where a potential 2 dB exceedance is predicted. Analysis of the noise contribution data shows the quarry processing plant to be the dominant source of noise at this receiver. It is noted however that Receiver 3 has been acquired by Council and is no longer considered a sensitive receiver.
- The operation of the hard rock drill has potential to increase noise levels by up to 1 dB(A), causing a further exceedance at Receiver 3. Noise levels at all other receivers are predicted to remain below the adopted criteria.
- As the landscape of the quarry and landfill change, the contributions of individual sources are also changed. As the quarry pit deepens and the quarry processing plant becomes more shielded by the active wall, noise levels at all receivers are predicted to reduce and comply with the adopted goals.
- Options for noise control are provided in Section 8 of this report.

5.3.2 Configuration 2 (North Valley Quarry and West Valley Landfill)

- Configuration 2 indicates that noise levels from normal operations from the North Valley Quarry and West Valley Landfill are expected to meet to adopted criteria at all identified residential receivers.
- The operation of the hard rock drill at North Valley Quarry has potential to increase noise levels by up to 5 dB(A), causing a 1 dB exceedance at Receiver 3. Noise levels at all other receivers are predicted to remain below the adopted criteria.
- As the landscape of the quarry and landfill change, the contributions of individual sources are also changed. As the quarry pit deepens and the quarry processing plant becomes more shielded by the active wall, noise levels at all receivers are generally predicted to reduce and comply with the adopted goals.

5.3.3 Configuration 3 (North Valley Landfill only)

- Configuration 3 indicates that noise levels from operations of the North Valley Landfill are expected to readily comply with the adopted criteria at all identified residential receivers.
- As the landscape of the landfill changes, noise levels at receivers are predicted to increase slightly, but remain under the adopted noise goals.

For all scenarios, it should be borne in mind that mobile machinery would likely move about, variously altering the directivity of the noise source with respect to individual receivers. During any given period the machinery items to be used on site would operate at maximum sound power levels for only brief stages. At other times the machinery may produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all equipment would be operating at their maximum sound power levels at any one time. Therefore, the model results are considered to be conservative (i.e. potential to overestimate noise impacts). Furthermore, the final layout of fixed plant at each quarry will be determined during detail design, therefore the modelled results should only be used as a guide for comparative purposes at this point in time. The model will be revised with future stages of development.

This Concept Plan study is based on the processes and technologies used in quarry and landfill activities at the time of this assessment. The assessment does not take into consideration emerging technologies in heavy vehicle machinery, resource recovery, alternatives to land filling and increased regulation of waste minimisation and landfill diversion targets. As the Concept Plan has an expected life of approximately 30 years, it is highly likely that improvements in technology will see a reduction in site noise emissions associated with the proposed activities.

6. Road Traffic Noise Assessment

6.1 Existing Traffic

With only a few residential houses within the Leddays Creek road catchment area background traffic is limited with the majority of traffic being from the existing Stotts Creek RRC. Peak traffic along Tweed Valley Way occurs at 8:00 – 9:00 AM and 3:00 – 4:00 PM.

Traffic data was provided by Council for the following locations:

- Entrance to Stotts Creek RRC (Leddays Creek Road).
- Eviron Road (off Duranbah Road).
- Tweed Valley Way (north of the southern entrance to Tumbulgum).

Key statistics for these three locations including the average daily traffic (ADT), morning and afternoon peak hour traffic volumes and the percentage of heavy vehicles is provided in the following table.

Table 6-1 Existing Two-Way Traffic Conditions (Source: GHD Traffic Study[1])

Time Period	Entrance to Stotts Creek RRC (Leddays Creek Road)	Eviron Road	Tweed Valley Way
ADT – Weekday	625	345	10698
ADT – Weekend	425	390	10449
ADT – 7 days	568	358	10321
% Heavy Vehicles [2]	31%	12%	6%
AM Peak	75	38	893
PM Peak	79	43	1001

[1] GHD report number 843355994, dated November 2010.

[2] Class 3 and above. Heavy Vehicles generated as part of landfill and quarry activities are considered Class 4 and above. E.g. Kerbside waste collection vehicles and quarry haul trucks.

6.2 Site Access

The existing access point for Quirks Quarry onto Eviron Road will be discontinued. For this reason the access on to Eviron Road has not been included in this assessment. The access point for all activities associated with the Concept Plan (including Stage 1) will be through the existing Stotts Creek RRC via Tweed Valley Way and Leddays Creek Road.

As described above, the expected hours of operation of the landfill sites are 7 am to 4 pm Monday to Friday and 9 am to 4 pm Saturday and Sunday, whilst quarrying activities will operate between 7 am and 5 pm Monday to Friday and 7 am to 12 pm Saturday. All heavy vehicles would be expected during these times. Light vehicular traffic from site staff may occur before and after opening hours.

Waste collection vehicles and quarry haul trucks will proceed through the Stotts Creek facility and along the proposed haul road to the landfill or quarry, whilst light vehicular traffic (i.e. domestic and small commercial customers) will continue to utilise the transfer station facility at the Stotts Creek RRC and will not access the proposed haul road.

6.3 Traffic Generation

Traffic generation is discussed in detail in the GHD Traffic Impact Assessment[1] and the predictions made in this report have been adopted as part of the traffic noise impact assessment. Traffic generation data was derived based on traffic data provided by Council for the existing quarry and landfill operations and the traffic counts for nearby intersections. Overall it is noted that the traffic generation has been assumed based on information on expected maximum quarry outputs and expected maximum landfill intake. All facilities as part of the Concept Plan will use the same access and route to Tweed Valley Way, via the Stotts Creek RRC and Leddays Creek Road.

6.3.1 Landfill

The expected traffic generated from Landfill activities has been assumed to be directly proportional to the maximum landfill waste acceptance rates. Table 6-2 shows the expected traffic generation from each of the three proposed landfills. Note that the maximum landfill waste acceptance rates increases over time due to the expected increase in population and associated need for waste disposal. This traffic would travel on Leddays Creek Road and Tweed Valley Way.

Table 6-2 Expected Landfill Traffic Generation

Landfill	Operating years	Maximum Waste Acceptance Rates (tonnes per annum)	Peak Hour(1) Heavy Vehicles(2)	Peak Hour(1) Light vehicles
Quirks	2012 – 2021	70000	7	48
West Valley	2022 – 2033	100000	10	69
North valley	2034 – 2045	150000	15	103

[1] Peak hour was assumed to comprise of 10% of daily traffic.

[2] Class 4 vehicles and above.

The traffic levels associated with the landfill component are currently already accounted for within the existing road network (i.e. due to the presence and use of the existing Stotts Creek RRC). The expected growth rate would be consistent with traffic on any road network.

Traffic associated with waste disposal facilities both at Stotts Creek will remain the dominant source of traffic on Leddays Creek Road.

[1] GHD report number 843355994. Tweed Shire Council Report for Eviron Road Quarry and Landfill Proposal, Traffic Impact Assessment, November 2010.

6.3.2 Quarry

It is expected that a maximum of 200,000 tonnes will be extracted and removed from the operating quarry each year. It has been assumed that haulage vehicles are truck and dog trailers with an average 25 tonnes per load capacity. Whilst the quarry haulage regime will be highly variable and dependent of the availability and demand for quarry resource an average traffic generation of 26 vehicles a day has been adopted. This has been derived from the expected tonnages and average capacity of a truck and dog trailer. Based on the traffic count provided by Council for Eviron road, the number of heavy vehicles generated by the proposed quarry is consistent with the existing traffic counts. As the maximum capacity for future quarries will be the same as the existing Quirks Quarry, there is not expected to be any additional traffic generated from quarry activities. A daily traffic generation of 26 trucks would equate to 3 vehicles during peak hour. Traffic associated with site employees would contribute ten vehicles during peak hour.

The proposed haulage route from all quarries will be through the internal haul road to Stotts Creek RRC, then right onto Leddays Creek Road and on to Tweed Valley Way.

Heavy vehicle traffic on Eviron Road associated with quarrying activities will be eliminated upon establishment of the proposed haul road and closure of the current Quirks Quarry site access road. However this traffic will be diverted to Leddays Creek Road and Tweed Valley Way via the new haul road. The split of traffic travelling east or west on Tweed Valley Way will be dependent on the required destination of quarry materials, however it is assumed that this is a 50/50 split. The addition of on average 26 heavy vehicles a day associated with the quarry, will impact upon Leddays Creek Road increasing heavy vehicles by approximately 13% (or 3 heavy vehicles during peak hour). This increase indicates that the landfill activities will still largely be responsible for the bulk of the traffic generation along Leddays Creek Road.

6.4 Expected Increase in Road Traffic Noise

Table 6-3 shows the existing and expected increase in road traffic during AM and PM peak hour periods at project opening.

Table 6-3 Predicted Increases in Road Traffic Noise at Project Opening

Roadway	Peak Hour	Existing		Generated [1]		% Increase in Total Traffic[2]	Increase in Noise Emission Level (dB)
		HV	LV	HV	LV		
Leddays Creek Road	AM	23	52	3	10	17%	0.7
	PM	25	54	3	10	16%	0.7
Tweed Valley Way	AM	54	839	3	10	1%	0.1
	PM	60	941	3	10	1%	0.1

[1] Generated traffic was derived from Quarry operations only since Landfill traffic is part of existing vehicles. HV denotes Heavy vehicles and LV denotes Light Vehicles.

[2] Generated traffic during peak hour is expected to comprise of the same proportion of heavy vehicles as currently exist (approximately 30% on Leddays Creek Road).

Long term road traffic noise monitoring was not undertaken in the areas surrounding the site. Therefore, in order to gain an understanding of the existing levels of traffic noise along these roadways, traffic noise modelling was undertaken. Road traffic noise modelling was undertaken with consideration to the Calculation of Road Traffic Noise (CoRTN) algorithm, developed by the United Kingdom Department of Transport (1998).

There is only one identified receiver in the vicinity of Leddays Creek Road, which is located close to the entrance to the Stotts Creek RRC. It is understood this property is owned by Tweed Shire Council but is used for residential purposes.

Predictive modelling (including a 2.5 dB façade correction factor) indicated an existing daytime traffic noise level of 53 dB $L_{Aeq(1\ hour)}$, which is below the 55 dB $L_{Aeq(1\ hour)}$ traffic noise goal for local roads. Allowing for the expected increase in road traffic noise due to quarry vehicles entering and exiting via Leddays Creek Road results in a daytime road traffic noise level of approximately 54 dB $L_{Aeq(1\ hour)}$. Therefore, road traffic noise is expected to comply with the NSW ECRTN criteria for local roads and is expected to increase by less than 1 dB under Stage 1 of the Concept Plan.

The NSW ECRTN also requires that road traffic noise levels be assessed at a period of 10 years after project opening. At this point it is expected that the Concept Plan would be at Configuration 2 (Stage 2) stage. The expected traffic noise increase for the 10 year predicted levels are shown in Table 6-4. The predicted increase in road traffic noise is expected to be less than 2 dB and total traffic noise levels should remain below the NSW ECRTN criteria for local roads.

Table 6-4 Predicted 10-Year Increase in Road Traffic Noise

Roadway	Peak Hour	Existing [1]		Generated [2]		% Increase in Total Traffic[3]	Increase in Noise Emission Level (dB)
		HV	LV	HV	LV		
Leddays Creek Road	AM	23	52	6	31	49%	1.7
	PM	25	54	6	31	47%	1.7
Tweed Valley Way	AM	54	839	6	31	4%	0.6
	PM	60	941	6	31	4%	0.6

[1] Existing traffic volumes were assumed to be equal to existing since the Concept Plan would generate the majority of traffic on Leddays Creek Road. This is conservative foe Tweed Valley Way as it does not account for annual traffic growth.

[2] Generated traffic was derived from West Valley Landfill and North Valley Quarry operations. The existing Stotts Creek Landfill traffic volumes were subtracted from the expected North Valley Landfill traffic to derive the growth in traffic from existing conditions. HV denotes Heavy vehicles and LV denotes Light Vehicles.

[3] Generated traffic during peak hour is expected to comprise of the same proportion of heavy vehicles as currently exist (approximately 30% on Leddays Creek Road).

With an increase in traffic volumes of approximately 1% on Tweed Valley Way, additional traffic generated as part of the Concept Plan is expected to have negligible impact on traffic noise levels.

7. Blasting Vibration Assessment

7.1 Quirks Quarry Blast Monitoring Results

TSC provided GHD with a blast monitoring report from vibration monitoring of blasts from the existing Quirks Quarry. Blast monitoring was undertaken during July 2008. The blast design and evaluation report can be found in Appendix B.

A summary of the site blast design and site parameters is provided below in Table 7-1.

Table 7-1 Measured Vibration Levels and Parameters

Parameter	
Blast hole diameter	89 mm
Stemming length	3 m
Rock density	2.6 tonnes/m^3
Number of holes	54
Average hole length	10 m
Maximum charge mass per hole	55 kg
Distance from blast to monitor	400 m
Maximum measured airblast at monitor	**109 dB(L)**
Maximum measured PPV at monitor	**1.97 mm/sec**

The above results indicate that, based on the parameters of these blasts, the vibration criteria are met at the monitoring location (400 metres from the blast) for both ground vibration and airblast overpressure.

GHD have adopted the results of the above blast monitoring reports to use in predictions of the ground vibration and airblast overpressure over varying distances on the assumption that the blast parameters at Quirks Quarry would be representative of the conditions at the proposed West Valley Quarry and North Valley Quarry. GHD has adopted this information assuming that the blast procedure and vibration monitoring were undertaken with consideration to the relevant publications and standards, including:

- Australian and New Zealand Environment Conservation Council (ANZECC), "*Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*" (1990).
- Australian Standard AS 2187.2 – 2006, "*Explosives – Storage, transport and use. Part 2: Use of explosives*".

7.2 Blast Predictions

Estimations for ground vibration and airblast overpressure during blasting have been made with consideration to Australian Standard AS2187.2–2006.

7.2.1 Airblast Calculations

Airblast radiates outwards from the blast site and attenuates with distance.

Airblast levels have been estimated using the following cube root scaling formula:

$$P = K_a \left(\frac{R}{Q^{1/3}} \right)^a$$ **Equation (2)**

Table 7-2 summarises the constants in Equation (2) and the values that have been assumed to estimate airblast levels, based on the provided monitoring results.

AS2187.2–2006 states that for confined blasthole charges, which would most likely be the case for blasting associated with the proposed quarries, a good estimation may be obtained by using a site exponent (a) of -1.45.

Table 7-2 Airblast Parameters and Assumptions

Parameter	Definition	Assumed Value
P	Pressure (kPa)	N/A
Q	Explosive charge mass per hole (kg)	55 (1)
R	Distance from charge (m)	Range: 200 to 700
a	Site exponent	-1.45
K_a	Site constant	5 (2)

(1) Charge mass has been adopted from the blast design and evaluation report provided in Appendix B.

(2) K_a site constant has been determined by using the known airblast pressure level, site exponent, charge mass and distance for the Quirks Quarry blast results provided.

7.2.2 Ground Vibration Calculations

Ground vibration radiates outwards from the blast site and gradually reduces in magnitude with distance from the blast.

Factors that affect the level of ground vibration arriving at a point from a blast typically include:

- Charge mass fired per hole.
- Distance.
- Ground transmission characteristics.

As many site factors will affect the transmission of vibration through the ground, the most accurate assessment of ground vibration from a site will be from vibration measurements taken on-site. Ground vibration levels have been estimated using the following formula.

$$V = K_g \left(\frac{R}{Q^{1/2}} \right)^{-B}$$ **Equation (3)**

Table 7-3 summarises the constants in Equation (3) and the values that have been assumed to estimate ground vibration levels.

AS2187.2–2000 states that when blasting is carried out to a free face in average field conditions, the mean vector peak particle velocity may be estimated by assuming the value of the site exponent (B) to be 1.6.

Table 7-3 Ground Vibration Parameters and Assumptions

Parameter	Definition	Assumed Value
V	Ground vibration in Vector Peak Particle Velocity (VPPV) (m/s)	N/A
R	Distance from charge (m)	Range: 200 to 700
Q	Maximum charge mass (kg)	55 (1)
K_g, B	Constants related to site and rock properties for estimation purposes	K_g = 1167 (2) B = 1.6

(1) Charge mass has been adopted from the blast design and evaluation attached as Appendix B.

(2) K_g site constant has been determined by using the known ground vibration level, site exponent, charge mass and distance.

7.3 Blast Prediction Results

Figure 7-1 displays a plot of airblast overpressure and ground vibration against distance from the blast. These plots have been based on the assumptions and values outlined above in Table 7-2 and Table 7-3.

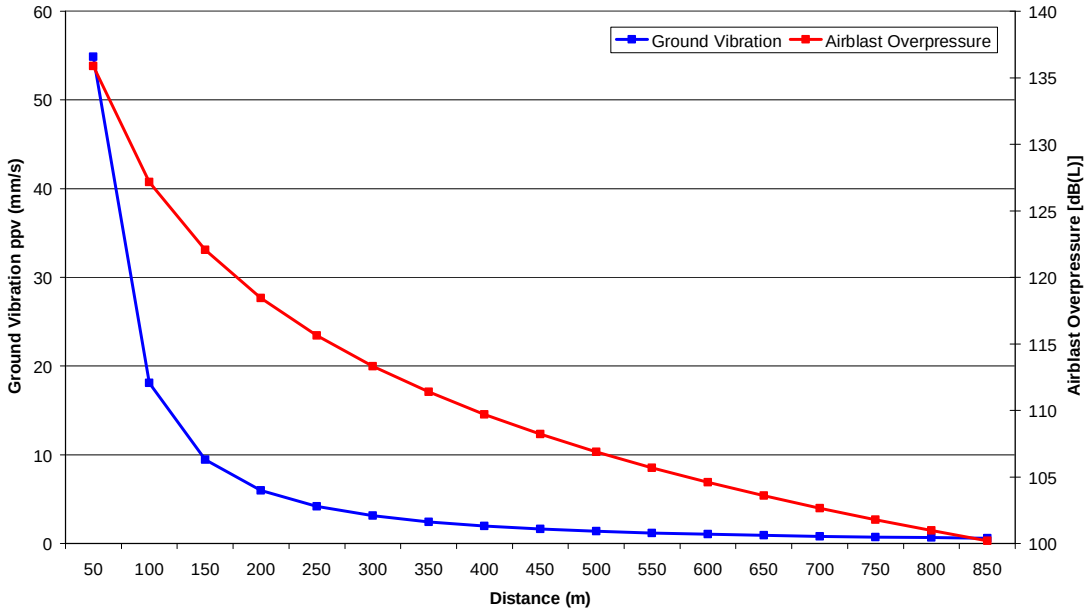


Figure 7-1 Estimated Ground Vibration and Airblast Overpressure Levels from Blasting

Based on the assumptions outlined above, estimated ground vibration and airblast levels from blasting suggest that the recommended limits of 5 mm/sec and 115 dB(L) would be achieved at a minimum distance of approximately 230 m and 260 m respectively from the blast location. Therefore, the blasting guidelines should be met under the assumed conditions at all receivers, except for at Receiver 3, if blasting occurs close to the south-western boundary of West Valley Quarry. The occupants of Receiver 3 should be notified of any blast events within West Valley Quarry. Further options for mitigating impacts from blasting are discussed in Section 8.

Adverse meteorological conditions such as temperature inversions and wind direction can significantly increase airblast overpressure levels. Temperature inversions are most common during night and early morning periods, therefore should not affect blasting during the recommended standard operating hours. Prevailing winds are generally from the southeast and southwest, which are generally away from the residential premises except for Receiver 2 when blasting occurs at West Valley Quarry. To assist in the reduction of airblast overpressure propagation, blasting should not be conducted when the prevailing winds are blowing towards residential receivers.

8. Recommendations

8.1 General Control Measures

- All activities on site should be confined between the hours of 7:00 am to 6:00 pm from Monday to Saturday. In particular, haul trucks should not arrive on site (or depart it) before 7:00 am.
- All equipment used on site should be in good condition and good working order.
- Plan to use equipment which is appropriate for the required tasks in terms of power requirements.
- All engine covers should be kept closed while equipment is operating.
- As far as possible, materials dropping heights into or out of trucks should be minimised.
- All combustion engine plant should be checked to ensure they produce minimal noise with particular attention to residential grade exhaust silencers.
- Vehicles should be kept properly serviced and fitted with appropriate mufflers. The use of exhaust brakes should be eliminated, where practicable.
- Where practical, machines should be operated at low speed or power and should be switched off when not being used rather than left idling for prolonged periods.
- Machines found to produce excessive noise compared to industry best practice should be removed from the site or stood down until repairs or modifications can be made.
- Although the model assumptions were deemed conservative, it is recommended that equipment noise levels be monitored once the Quarry and Landfill are operating to verify noise emissions are in line with the model assumptions.
- It is also recommended that attended noise measurements be undertaken under a variety of weather conditions at identified noise receivers upon commission of the Eviron Landfill and Quarry Site. Attended noise measurements will allow for the validation of predicted noise levels. This, in turn will more accurately represent the site noise levels and confirm whether or not specific noise control measures are required.

8.2 Specific Control Measures

- The hard rock drill has been identified as a significant noise source within the quarry equipment list. Although its operation is expected to be limited, it has potential to cause short-term noise impacts at the nearest receivers. Therefore, the use of other quarry equipment, such as the processing plant and dozer should be limited (or ceased) during times when drilling is occurring. This will assist in minimising the cumulative noise impact on nearby receivers.

- The quarry processing plant is also identified as a significant noise source during normal operations. This is particularly the case when quarrying activities are at West Valley. Therefore, it is recommended that specific noise mitigation measures be implemented at West Valley Quarry to reduce the impacts of noise from the processing plant. Mitigation options could include:
  - A mobile or fixed noise wall. This could either be in the form of an artificial wall (i.e. shipping container or noise wall) or natural wall (i.e. earth bund). The wall should be located with the aim to block the line of sight between the processing plant and Receiver 3. A potential reduction of approximately 5 dB could be achieved through the use of a noise wall. However it is noted that as Receiver 3 is now owned by Council, this option is unlikely to be required.
  - Locating the processing plant in locations on site which are naturally shielded by the existing topography will also assist in minimising noise impacts. A potential reduction of up to 5 dB is likely to be achieved through this method.
  - As a last resort, treating the building facades of affected receivers will assist in minimising internal noise. Building treatments should generally be considered only when other measures, such as noise barriers are impractical or not cost-effective. Approaches to the acoustic treatment of buildings include improved window glazing and insulation to external walls.

8.3 Blasting

Blasting should only occur from 10 am to 4 pm, Monday to Friday and should not generally take place more than once per day.

Blasting can cause noise and vibration impacts; however counteractive measures such as reducing the Maximum Instantaneous Charge (MIC) can be used to reduce the impact caused without sacrificing fragmentation. Amendment to the type and performance of the explosive charge, as well as the type of initiation system and the duration of delays can also assist.

Blasting usually results in both overpressure and ground vibration. The generation of fly rocks is potentially dangerous and can impact on neighbours. Therefore blasting practices should be designed and managed in order to reduce the risk to staff and the greater community.

Although the blast noise is unlikely to cause hearing damage to anyone outside the direct work area, blasting noise is more commonly an annoyance noise or discomfort. Therefore, potentially affected receivers should be notified in advance of blasting occurring at quarries.

Blasting will not occur at night and should be limited to times when condition are suitable and avoided at times, as outlined below:

- Avoid at times of adverse wind condition, as this may promote the impact of blast over pressure.
- Avoid at times of temperature inversion.
- Avoid overfilling holes with blasting agent.
- Avoid firing holes in the front row which have insufficient burden.
- Orientation of blast face.

All blasting designs should contain considerations to minimise factors such as ground vibration and air blast. It is recommended that the drilling and blasting at the quarry is under taken by qualified contractors to reduce risks associated with these activities. The blast design should include an assessment of noise and vibration impacts based on blast specific parameters.

It should also be noted that the blast parameters provided in this report are indicative only and different charges should be tested and monitored in the planning phase to provide overpressure and vibration data specific to the effect of blasting on this site. If test blasts exceed or approach the criteria levels, then this should be taken as a benchmark, overriding charge limitations advised in this report.

9. Conclusions

An assessment of potential noise and vibration impacts on the surrounding environment associated with the proposed activities within the overall Concept Plan and Stage 1 Project Application has been undertaken. The findings and conclusions are summarised below.

Industrial Noise

- Based on the assumptions made in this assessment, it is predicted that the operational noise goals should be met at identified receivers surrounding the development under all stages of the Concept Plan, except for at Receiver 3 under worst-case operations of West Valley Quarry, however as this property is now owned by Council it is not considered to be a sensitive receiver. It should be noted that noise predictions are considered to be conservative and it is recommended that actual impacts be quantified through attended measurements upon commissioning of the quarry.
- The hard rock drill and processing plant at the quarry were identified as the most significant noise sources. Noise control options for these items have been provided in Section 8 of this report. The implementation of these control measures should allow for the adopted noise goals to be met at all receivers.

Road Traffic Noise

- A comparison of existing and project-generated traffic noise levels show a relatively small increase in vehicle numbers due to the proposed Concept Plan. The additional vehicles are expected to cause an increase of less than 1 dB on local roads and the ECRTN traffic noise goals are predicted to be met under all operating configurations.

Blasting Impacts

- Representative vibration monitoring reports provided to GHD and subsequent predictions of airblast overpressure and ground vibration levels from blasting at the Quarry indicate that the ANZECC blasting criteria should be achievable at the nearest sensitive receivers if recommended management measures are implemented.

10. Limitations

This Noise Impact Assessment ("Report"):

- Has been prepared by GHD Pty Ltd ("GHD") for Tweed Shire Council (TSC).
- May only be used and relied on by TSC.
- Must not be copied to, used by, or relied on by any person other than TSC without the prior written consent of GHD.
- May only be used for the purpose of the scope of work outlined in Section 1.2 of this report (and must not be used for any other purpose).

GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any person other than TSC arising from or in connection with this Report.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the Report are excluded unless they are expressly stated to apply in this Report.

The services undertaken by GHD in connection with preparing this Report were limited to those specifically detailed in Section 1.2 of this Report.

The findings of this report represent the findings apparent at the date and time of the assessment. It is the nature of environmental assessments that all variations in environmental conditions cannot be accessed and all uncertainty concerning the conditions of the ambient noise environment cannot be eliminated. Professional judgement must be exercised in the investigation and interpretation of observations.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking services and preparing the Report, including (but not limited to):

- Noise prediction modelling assumptions detailed in Section 5, 6 and 7 of this report.

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect.

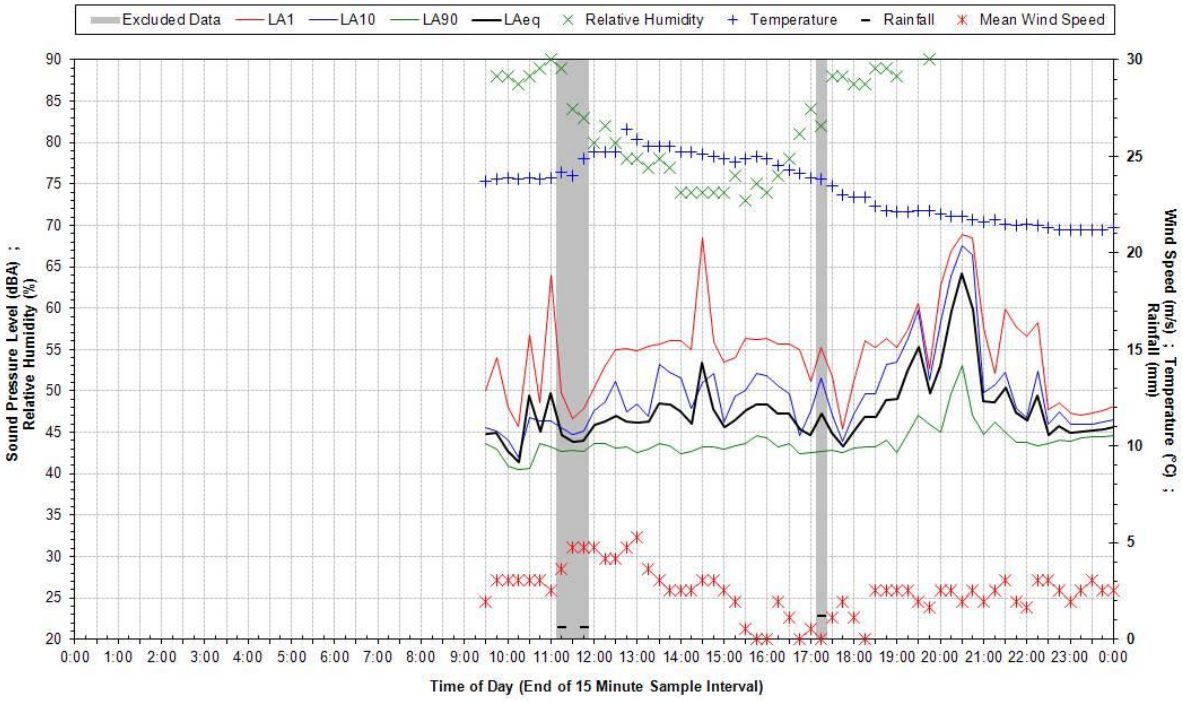
Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation of this Report.

Appendix A

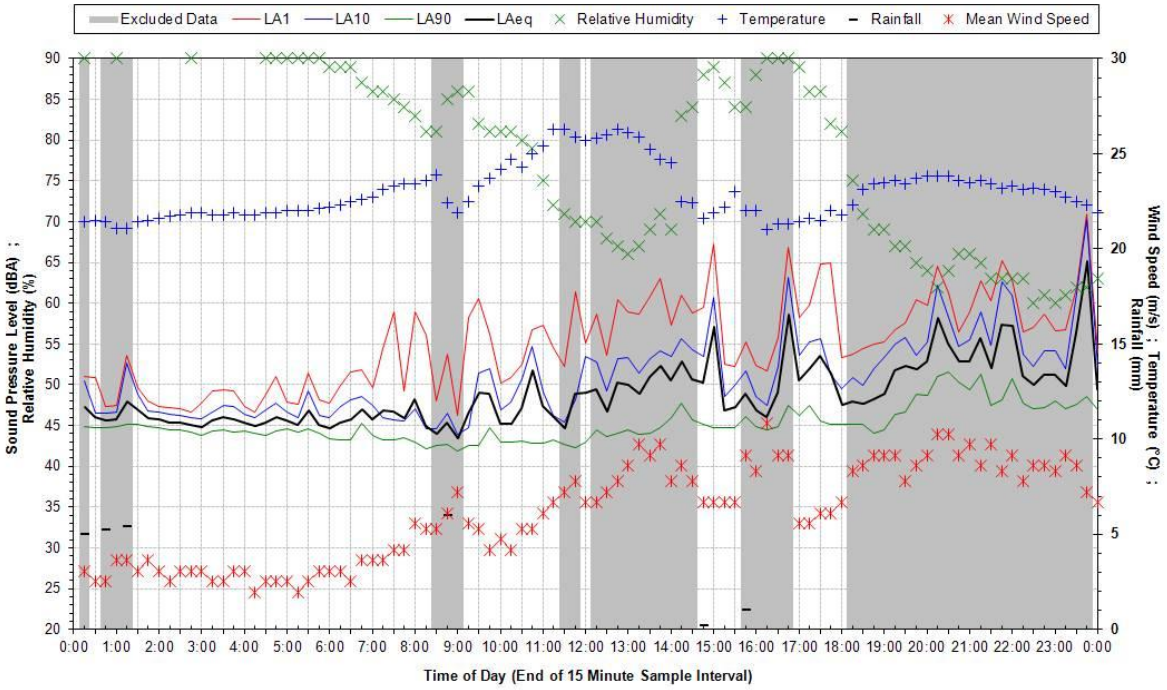
Long Term Noise Monitoring Results

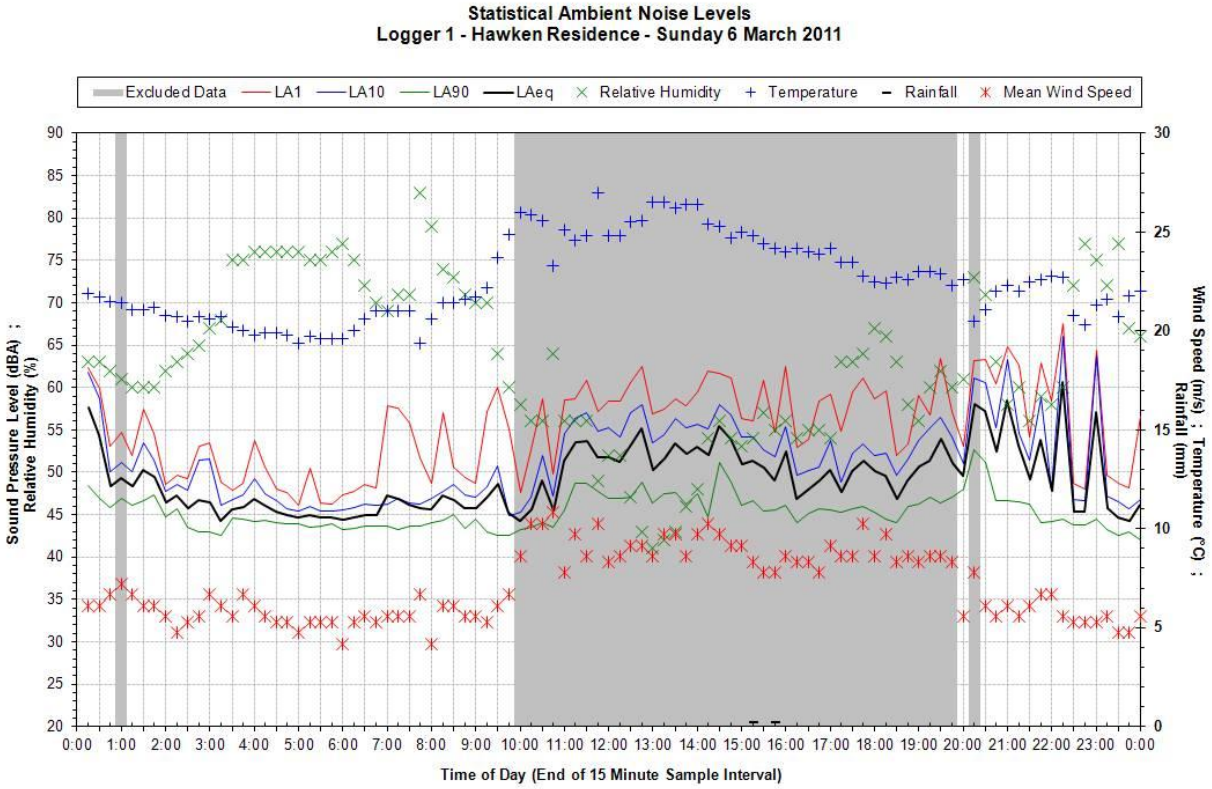
Statistical Noise Data

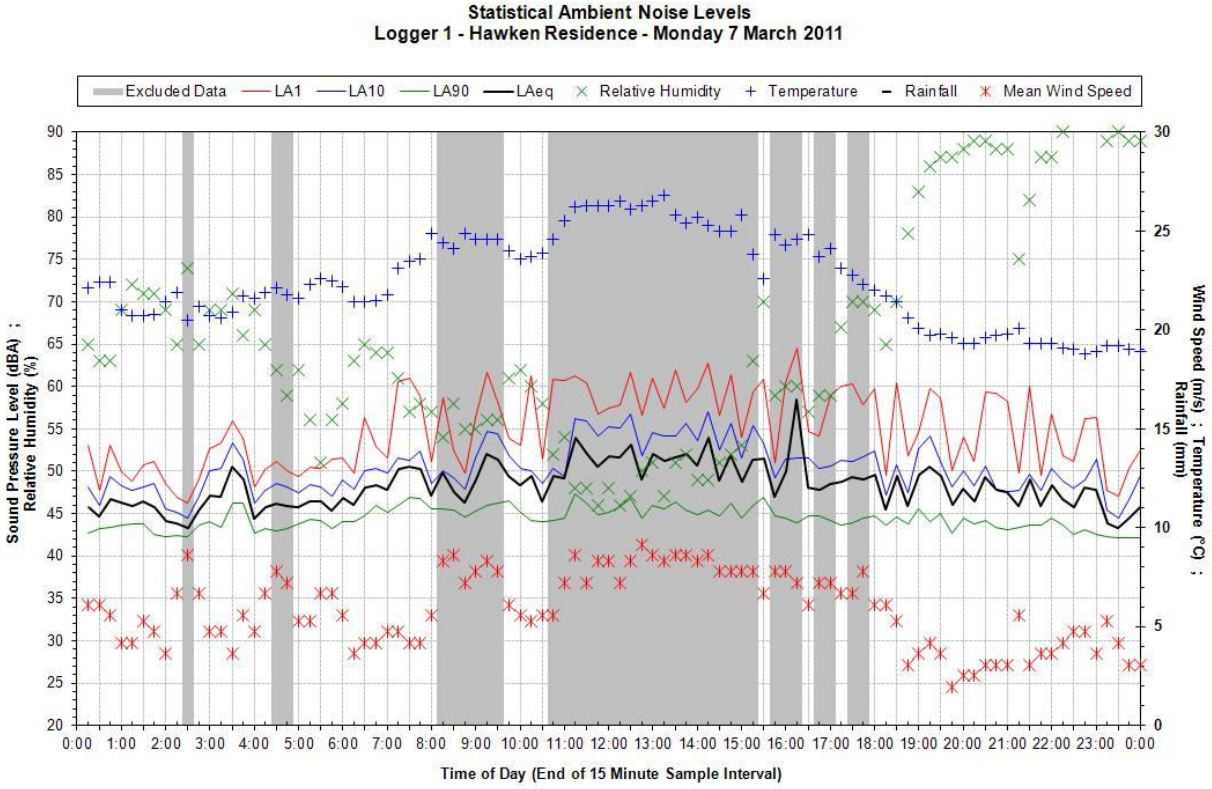
Statistical Ambient Noise Levels
Logger 1 - Hawken Residence - Friday 4 March 2011

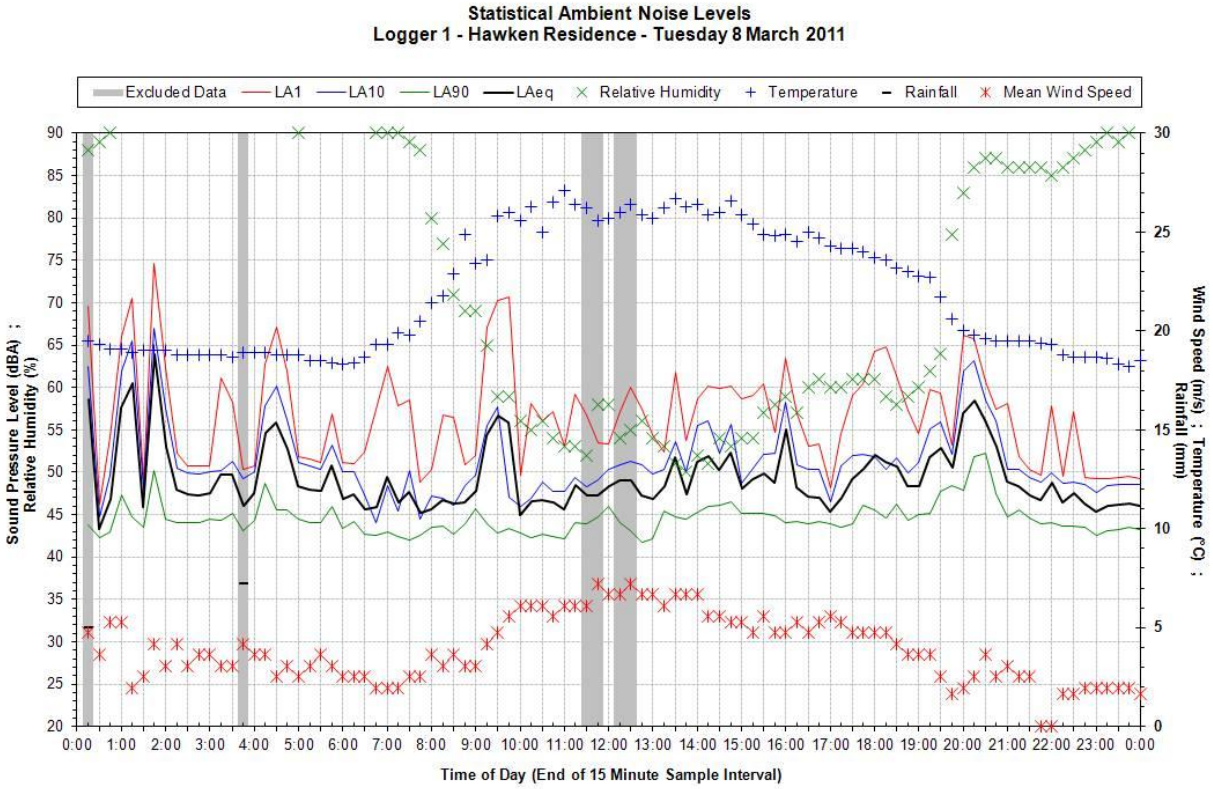


Statistical Ambient Noise Levels
Logger 1 - Hawken Residence - Saturday 5 March 2011




Statistical Ambient Noise Levels
Logger 1 - Hawken Residence - Sunday 6 March 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Rainfall (mm) ; Temperature (°C) ;
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Logger 1 - Hawken Residence - Monday 7 March 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Rainfall (mm) ; Temperature (°C) ;
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Logger 1 - Hawken Residence - Tuesday 8 March 2011
Excluded Data
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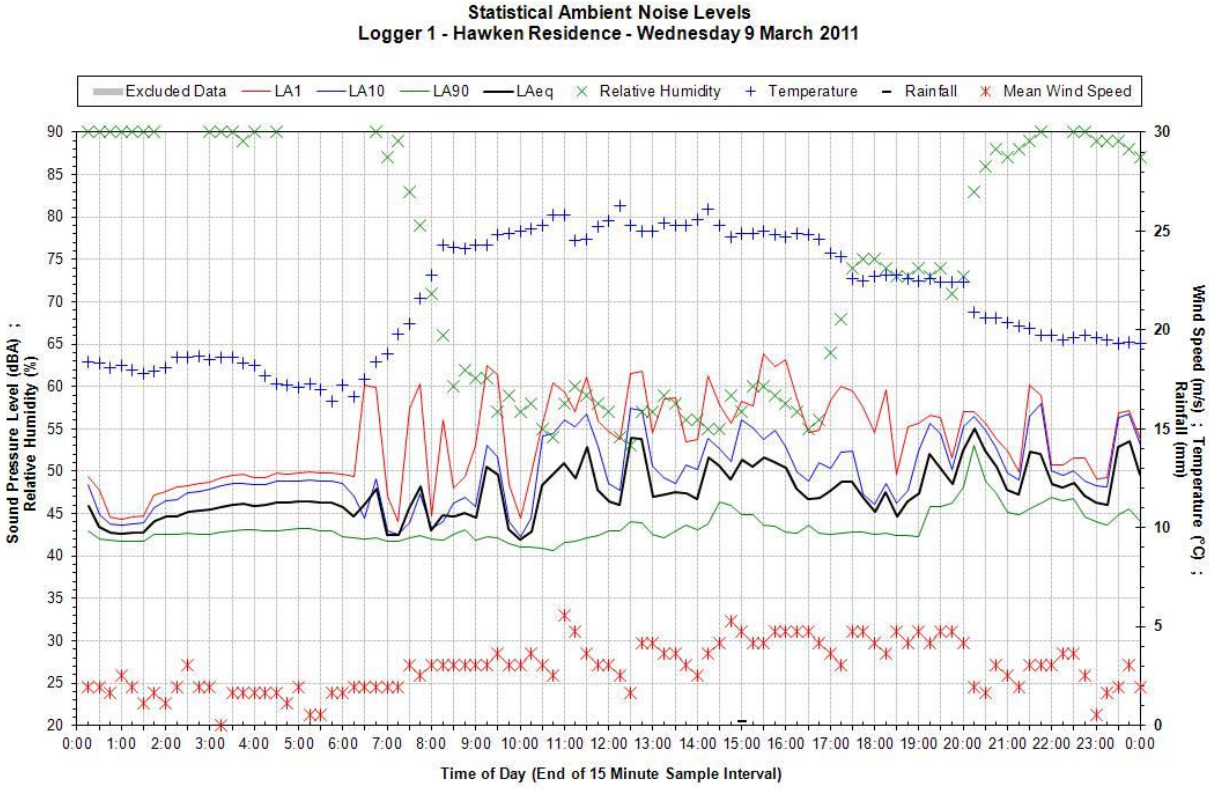
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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Logger 1 - Hawken Residence - Wednesday 9 March 2011
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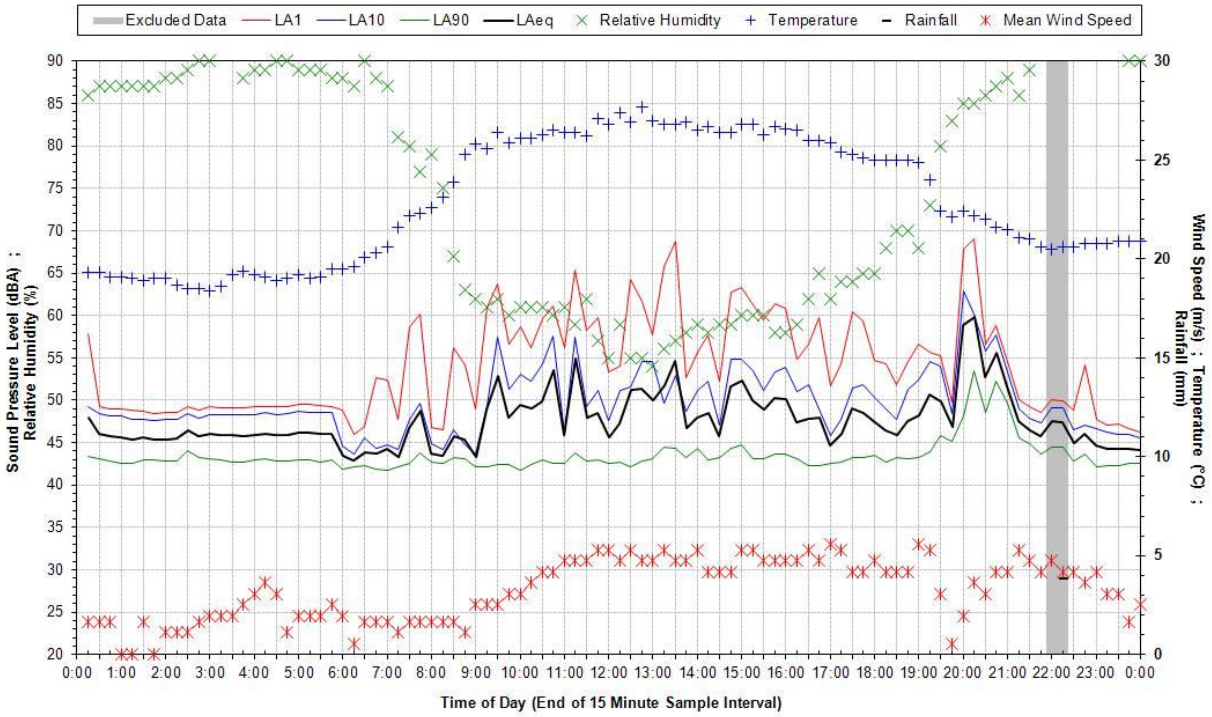
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

Statistical Ambient Noise Levels
Logger 1 - Hawken Residence - Thursday 10 March 2011



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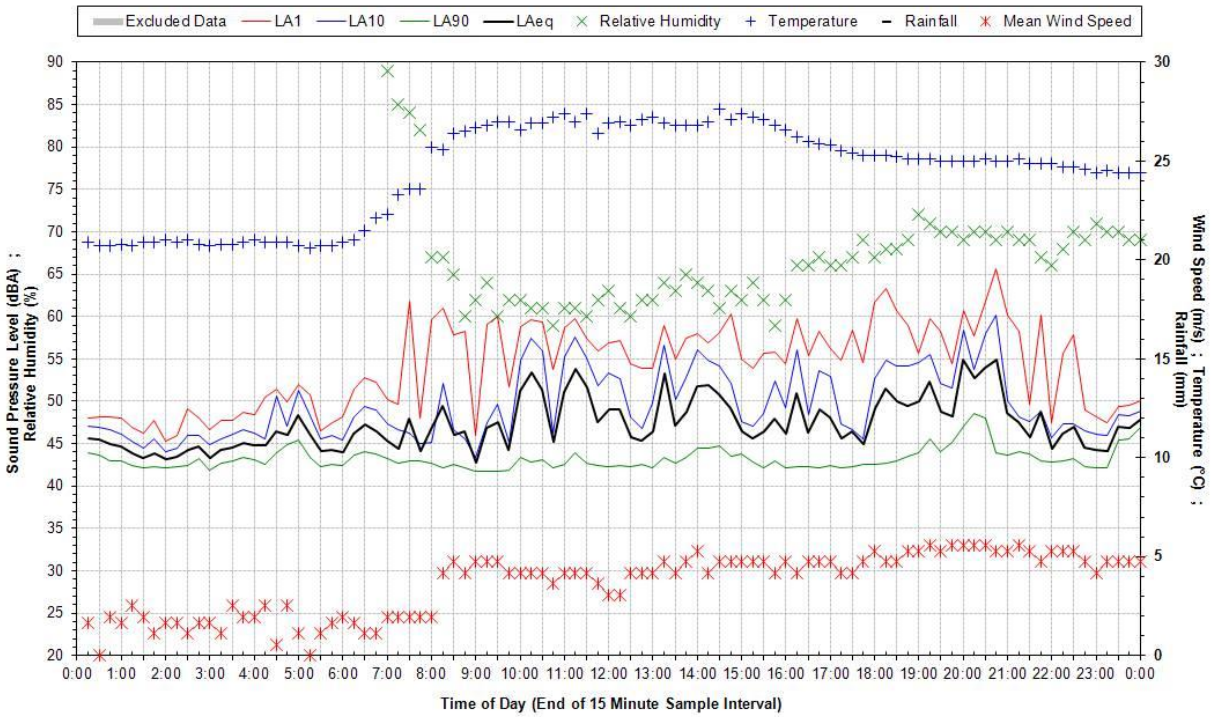

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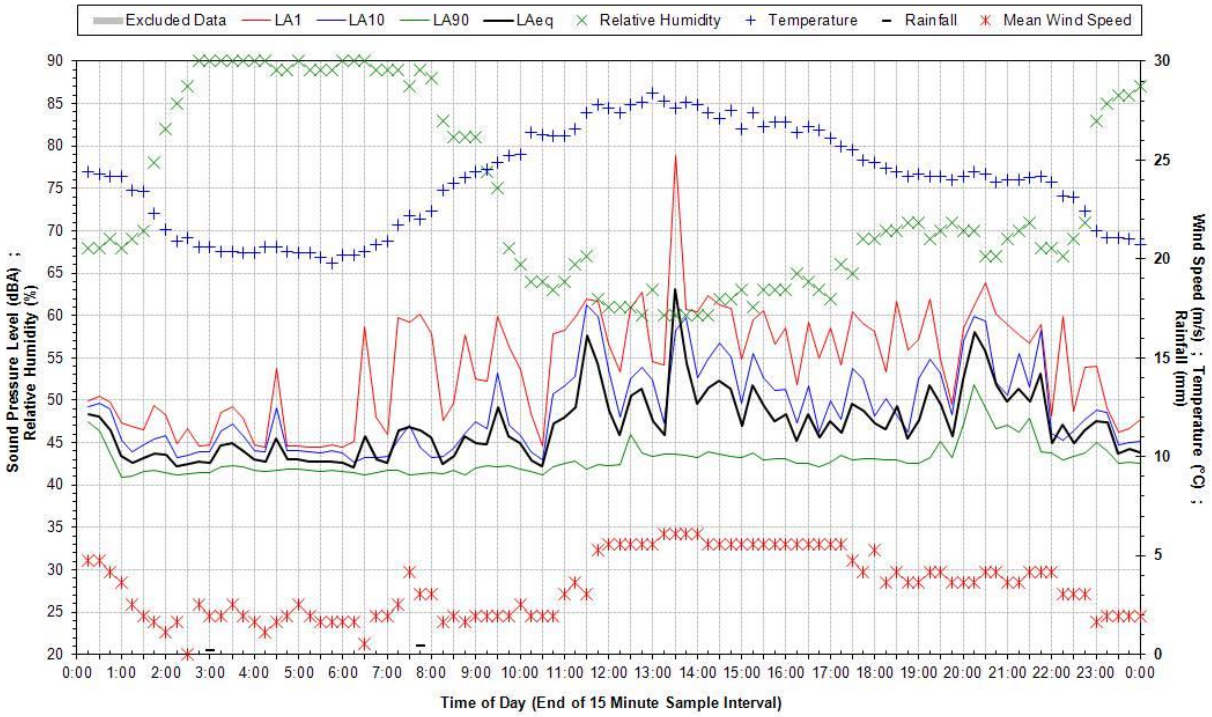

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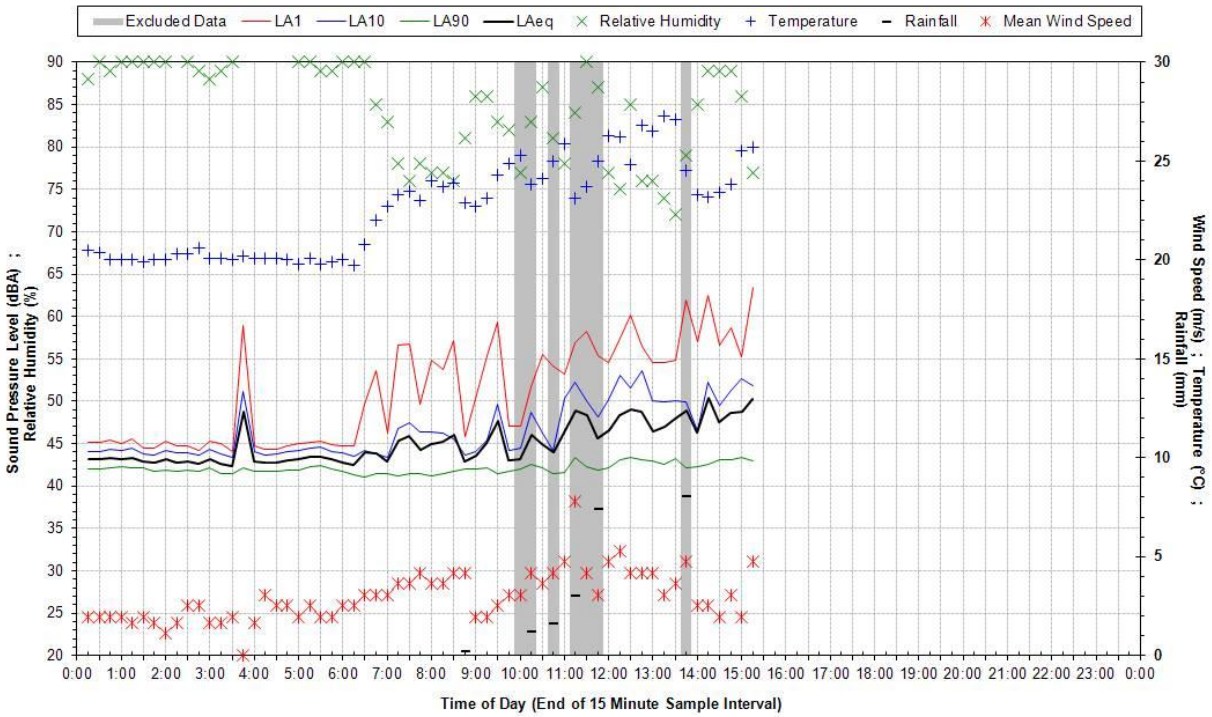
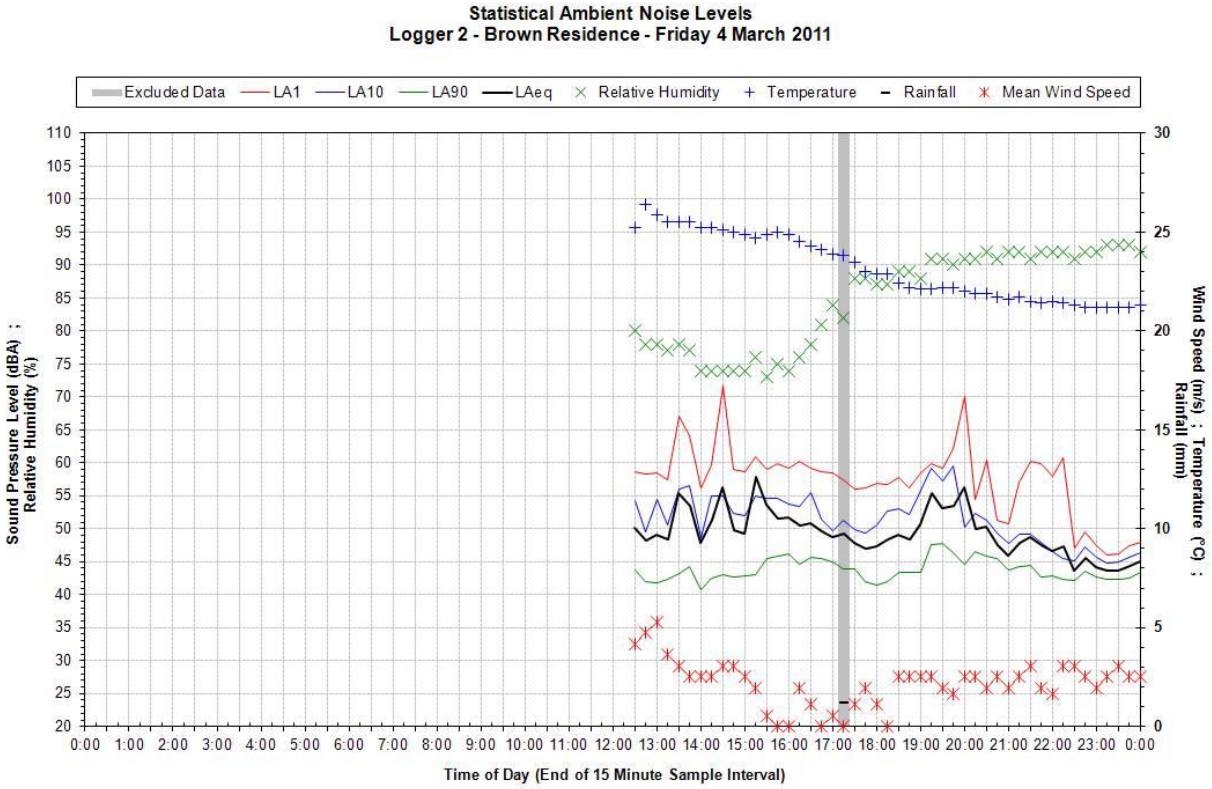
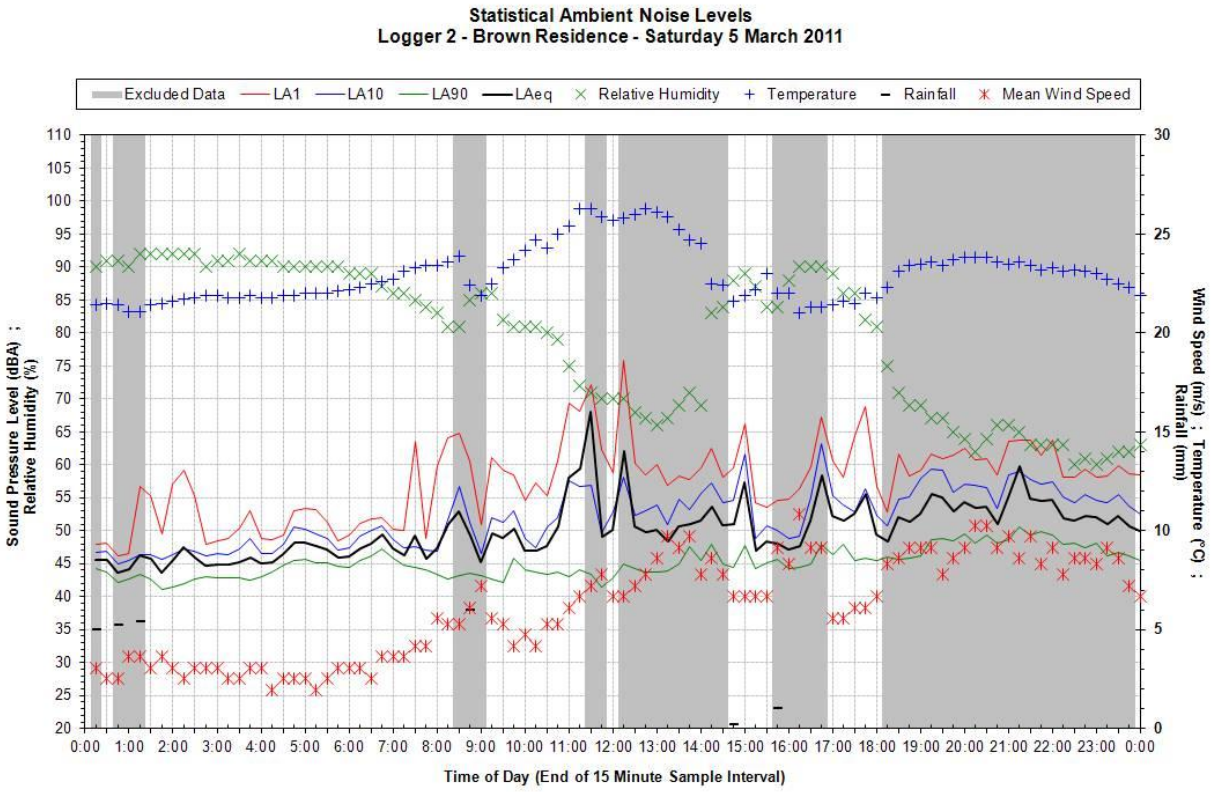
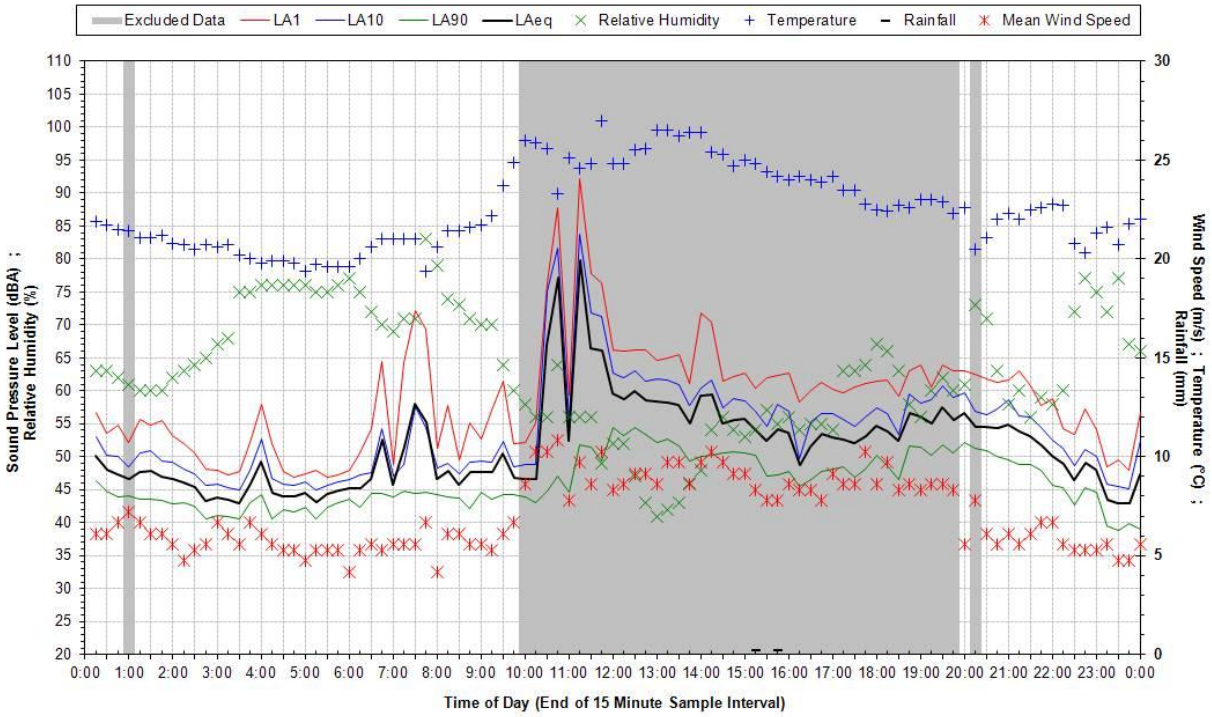


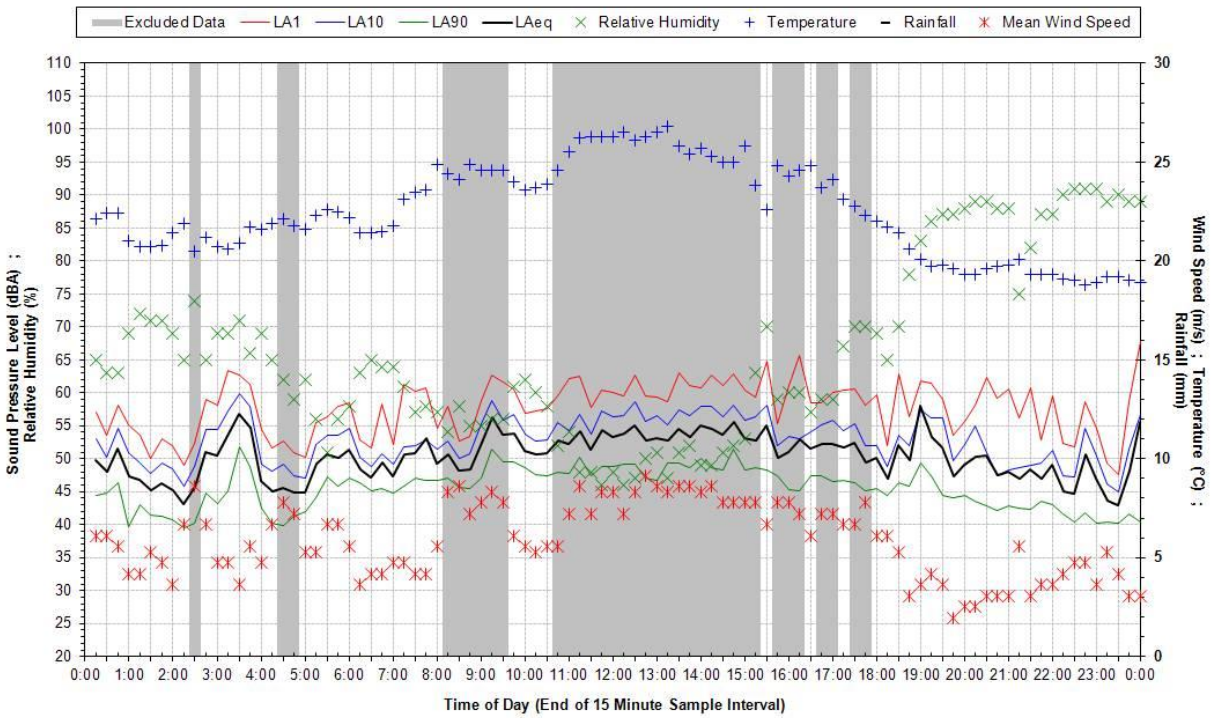

Statistical Ambient Noise Levels
Logger 2 - Brown Residence - Friday 4 March 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Rainfall (mm) ; Temperature (°C) ;
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Logger 2 - Brown Residence - Saturday 5 March 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Rainfall (mm) ; Temperature (°C) ;
Time of Day (End of 15 Minute Sample Interval)

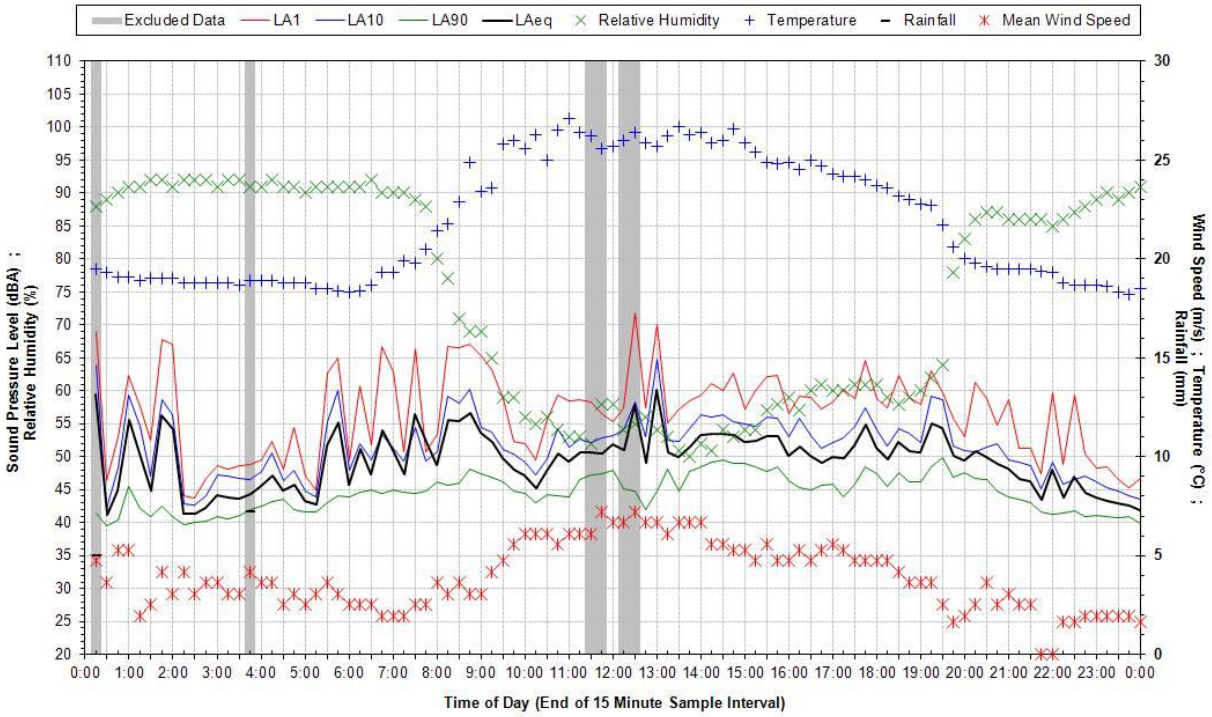
Statistical Ambient Noise Levels
Logger 2 - Brown Residence - Sunday 6 March 2011



Statistical Ambient Noise Levels
Logger 2 - Brown Residence - Monday 7 March 2011



Statistical Ambient Noise Levels
Logger 2 - Brown Residence - Tuesday 8 March 2011



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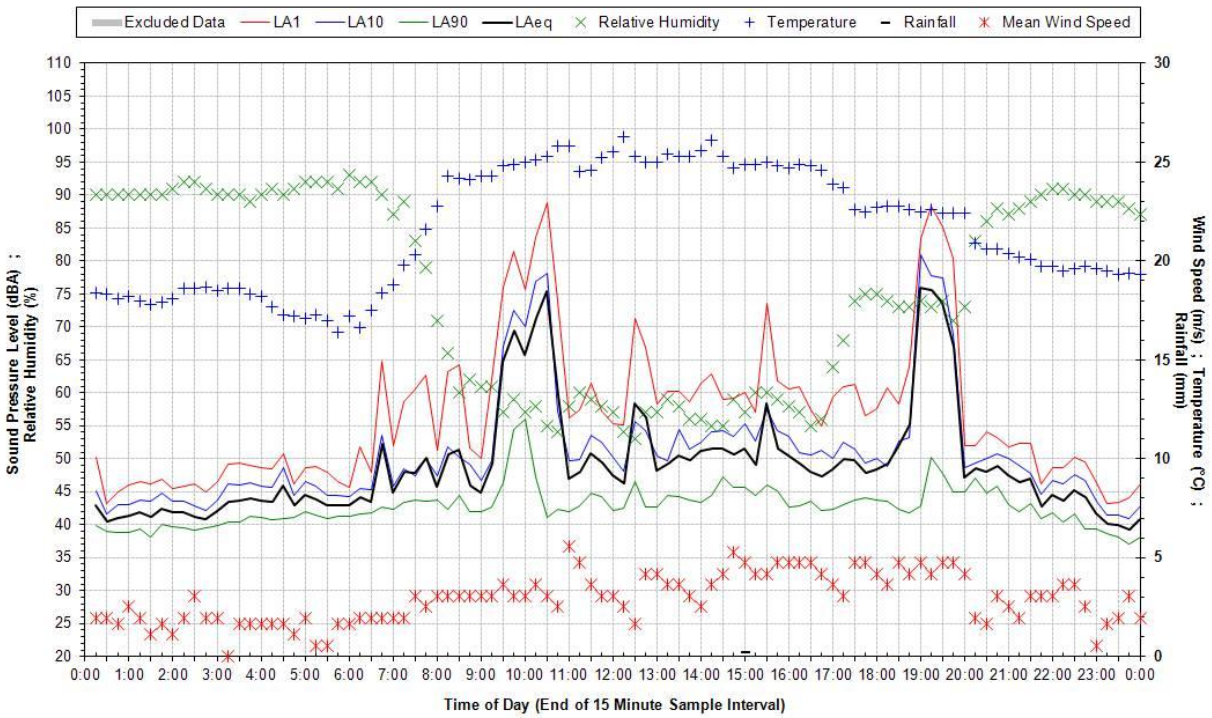

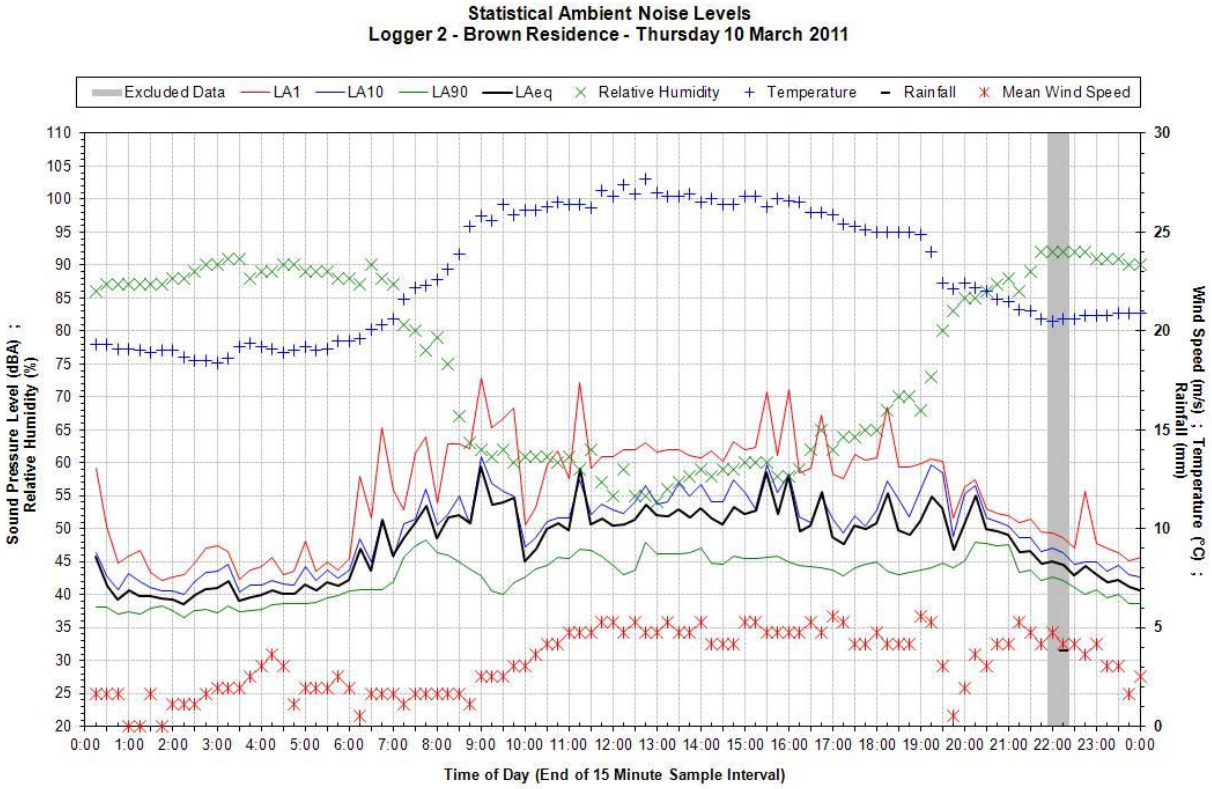
Statistical Ambient Noise Levels
Logger 2 - Brown Residence - Thursday 10 March 2011
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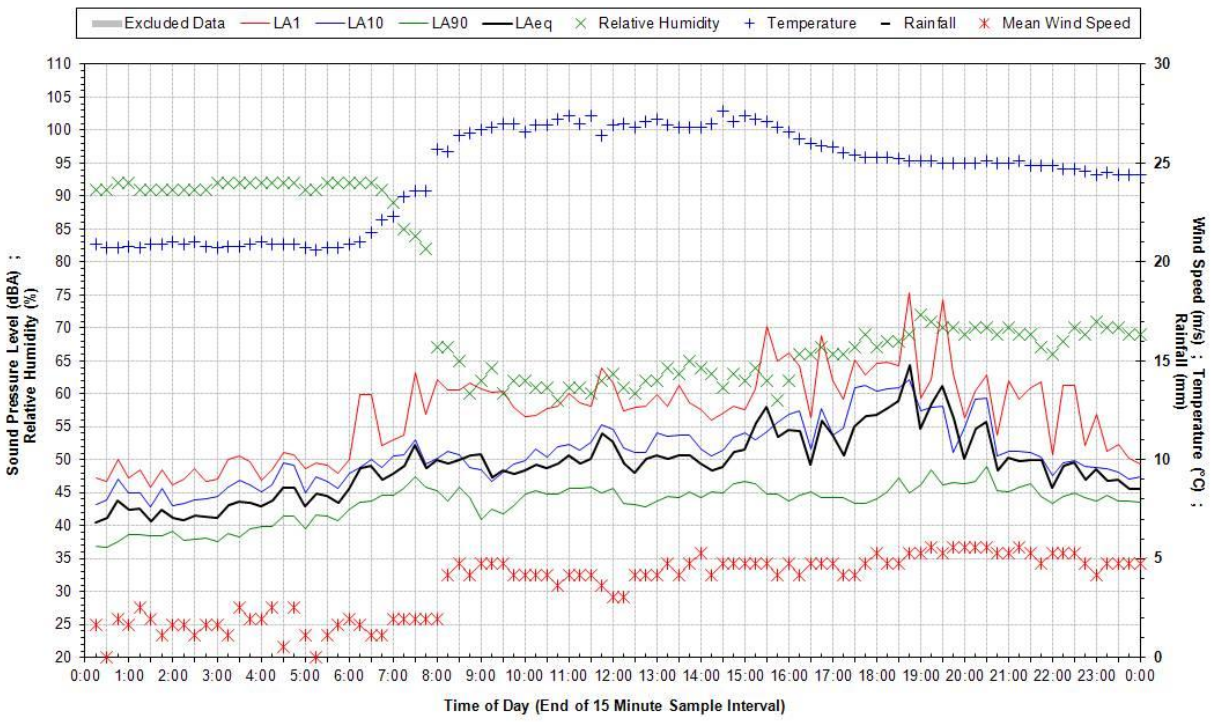
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Logger 2 - Brown Residence - Friday 11 March 2011
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LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

Statistical Ambient Noise Levels
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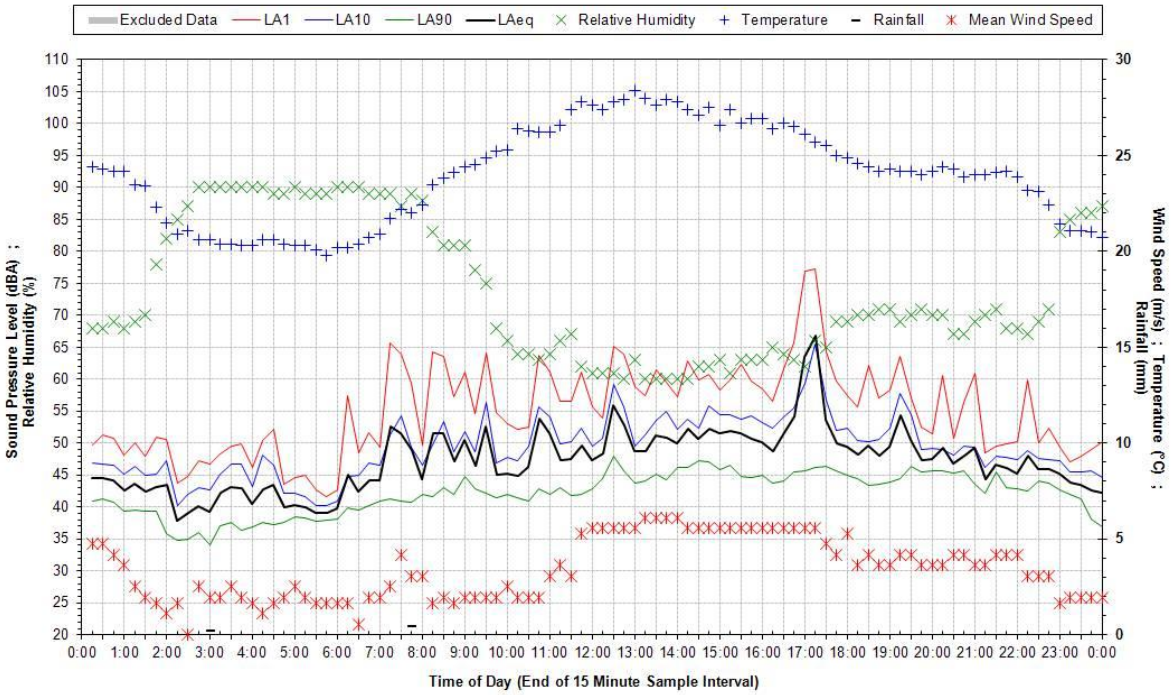
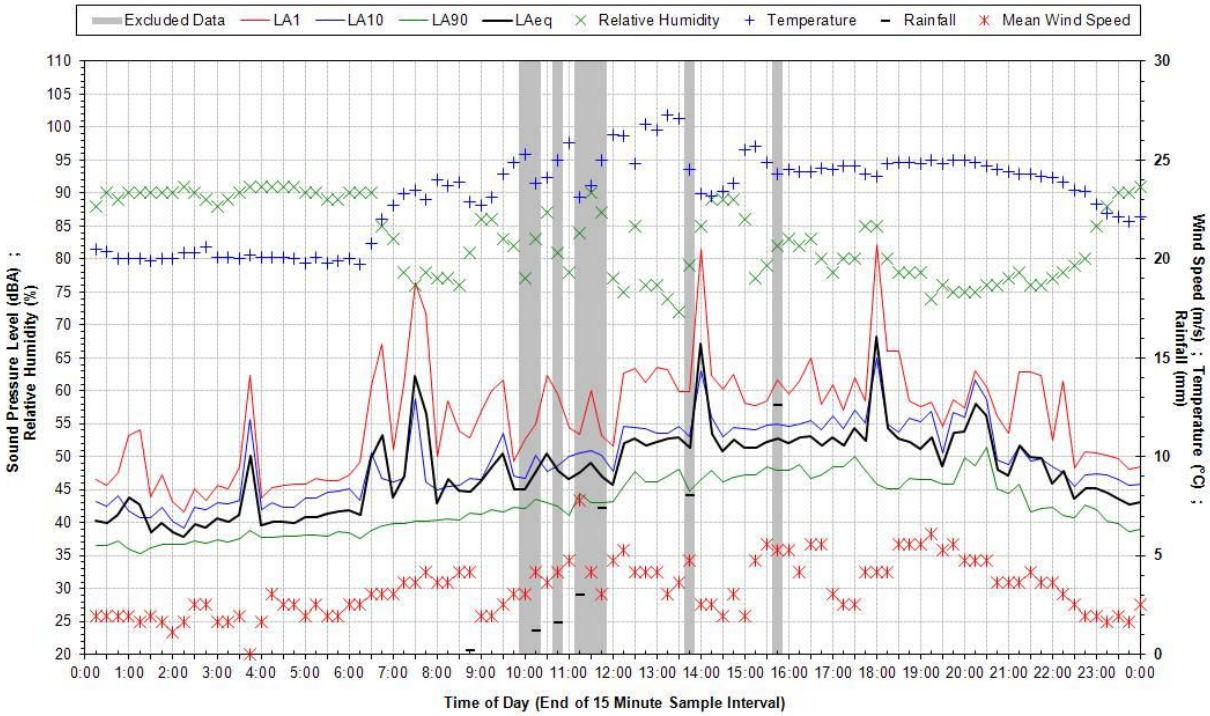


Statistical Ambient Noise Levels
Logger 2 - Brown Residence - Sunday 13 March 2011



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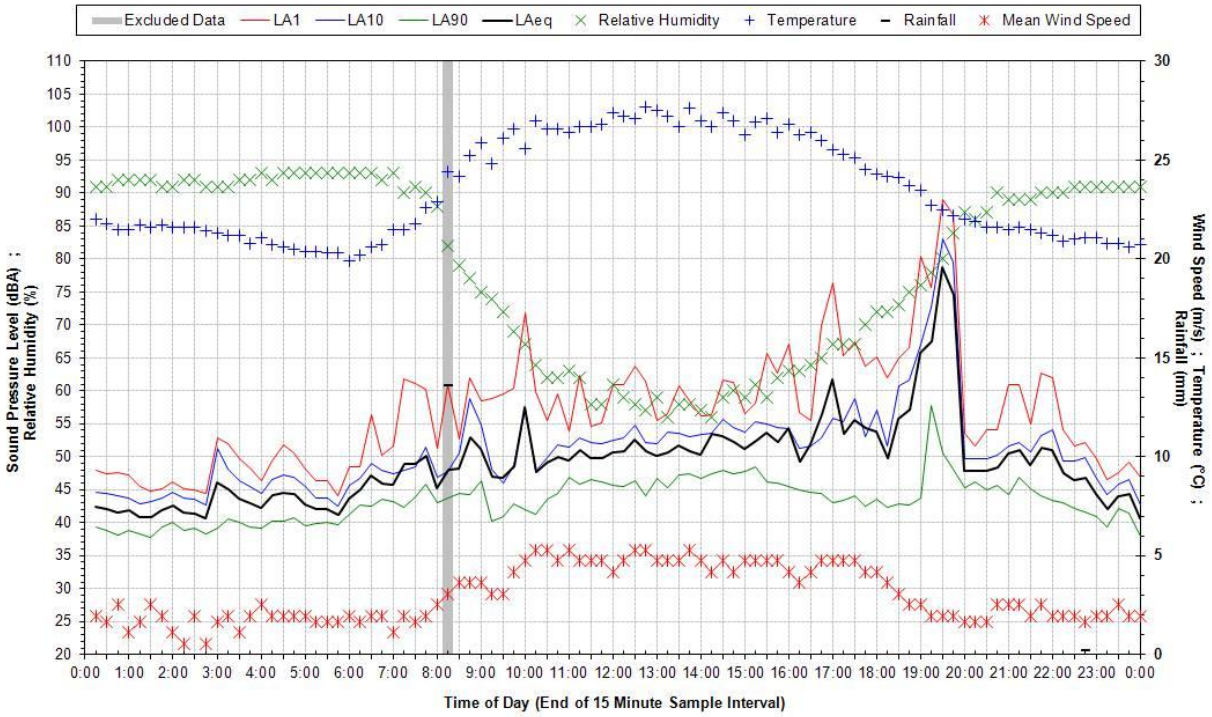

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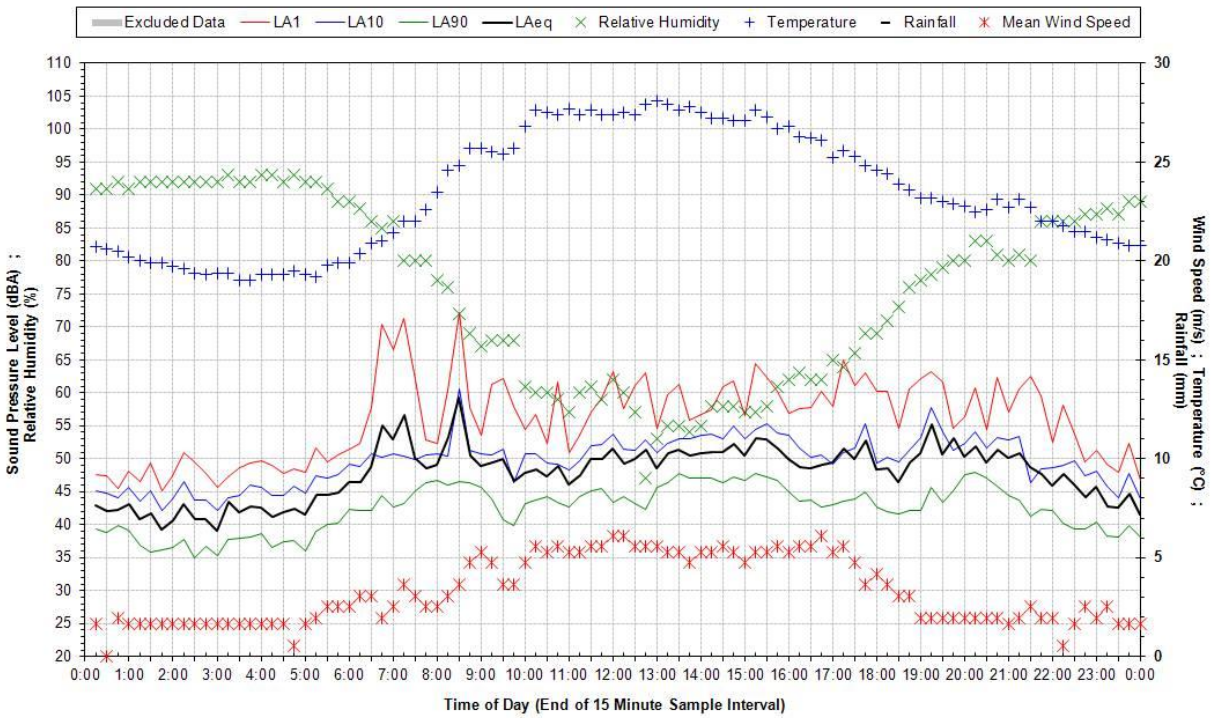

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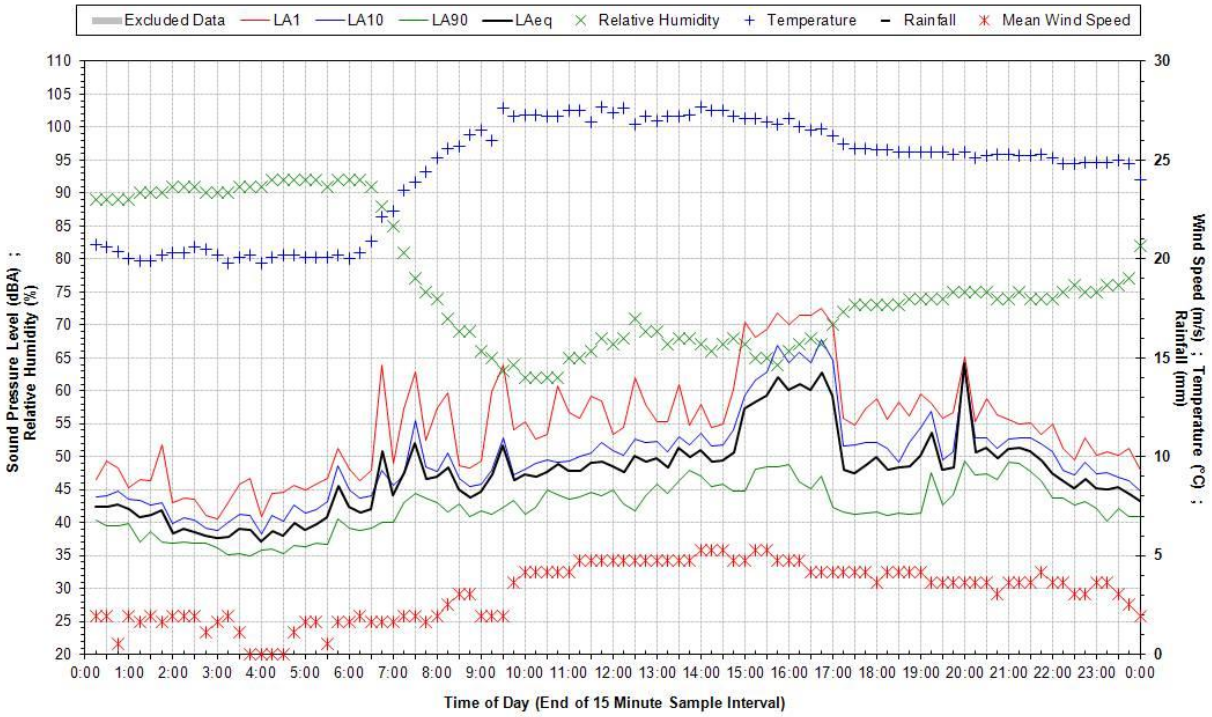

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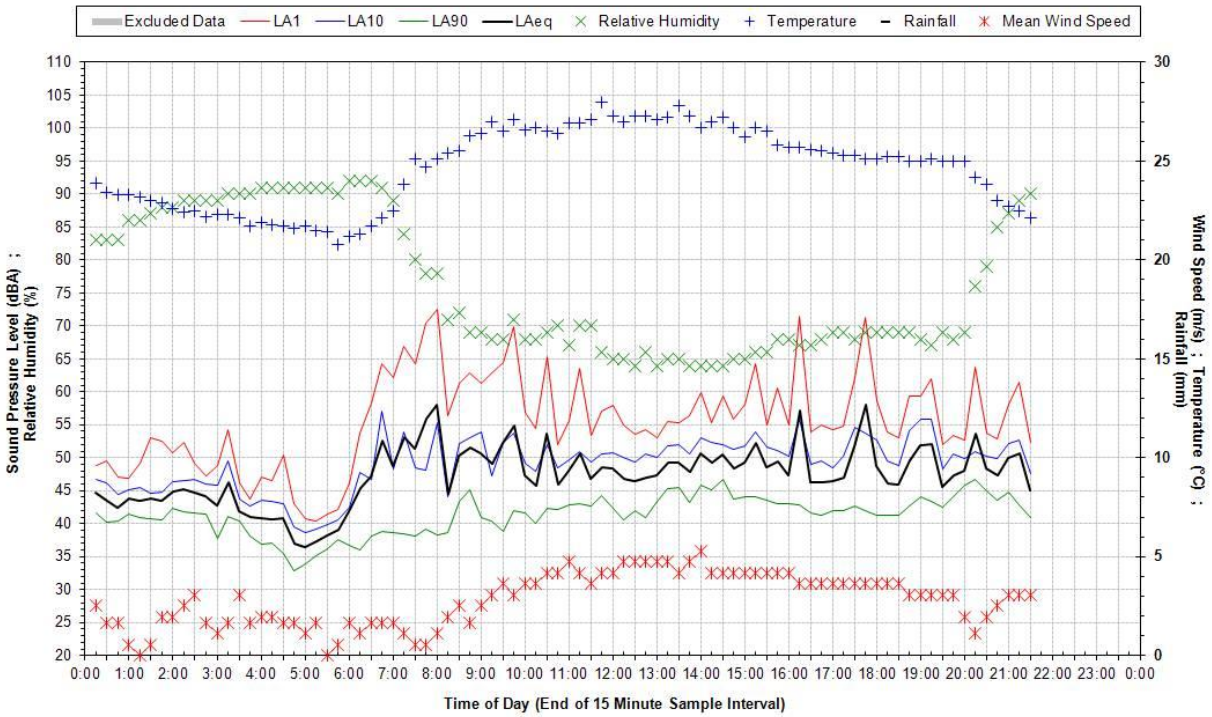
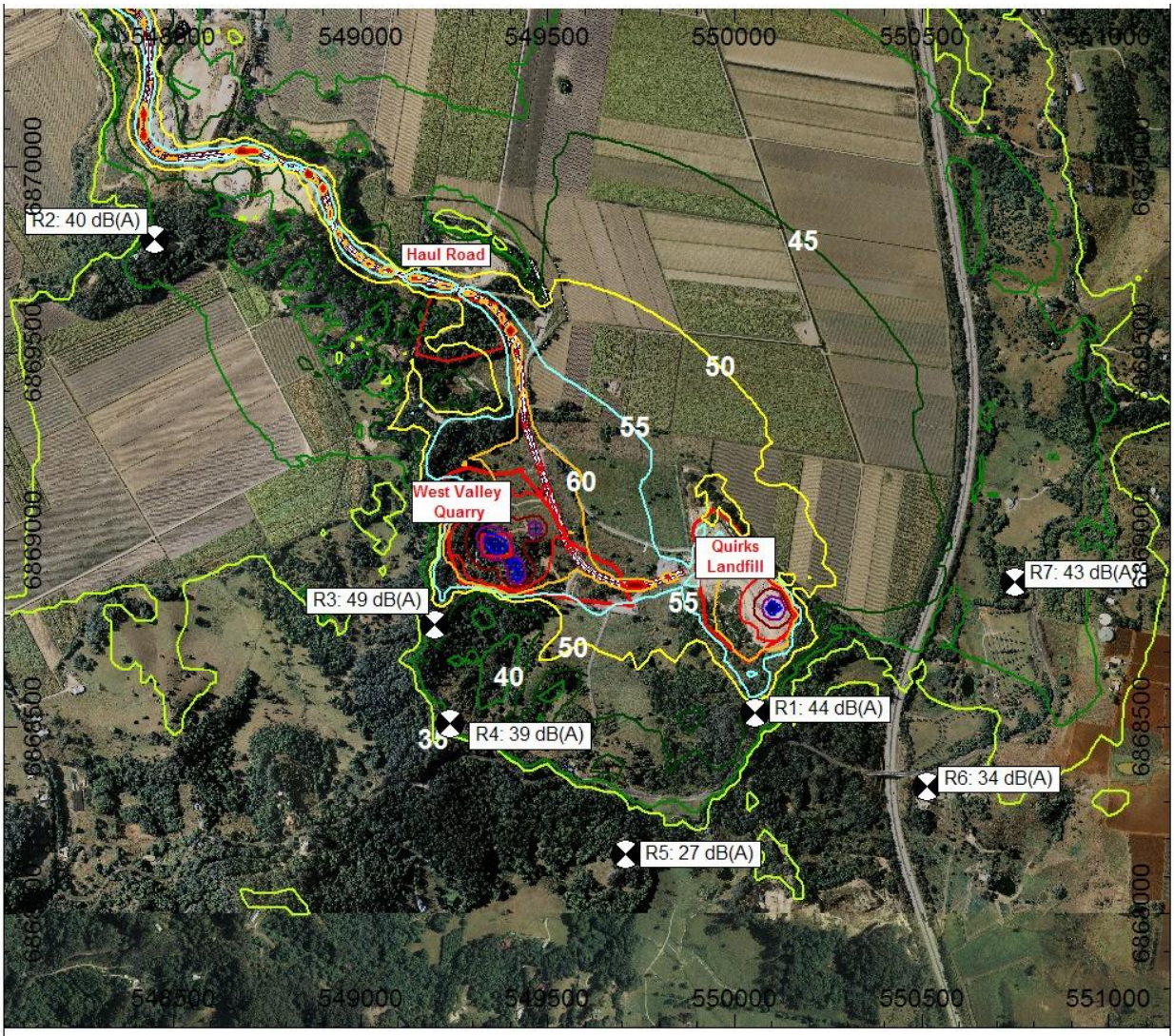


Appendix B

Blast Monitoring Report

Appendix C

Predicted Noise Level Contour Maps

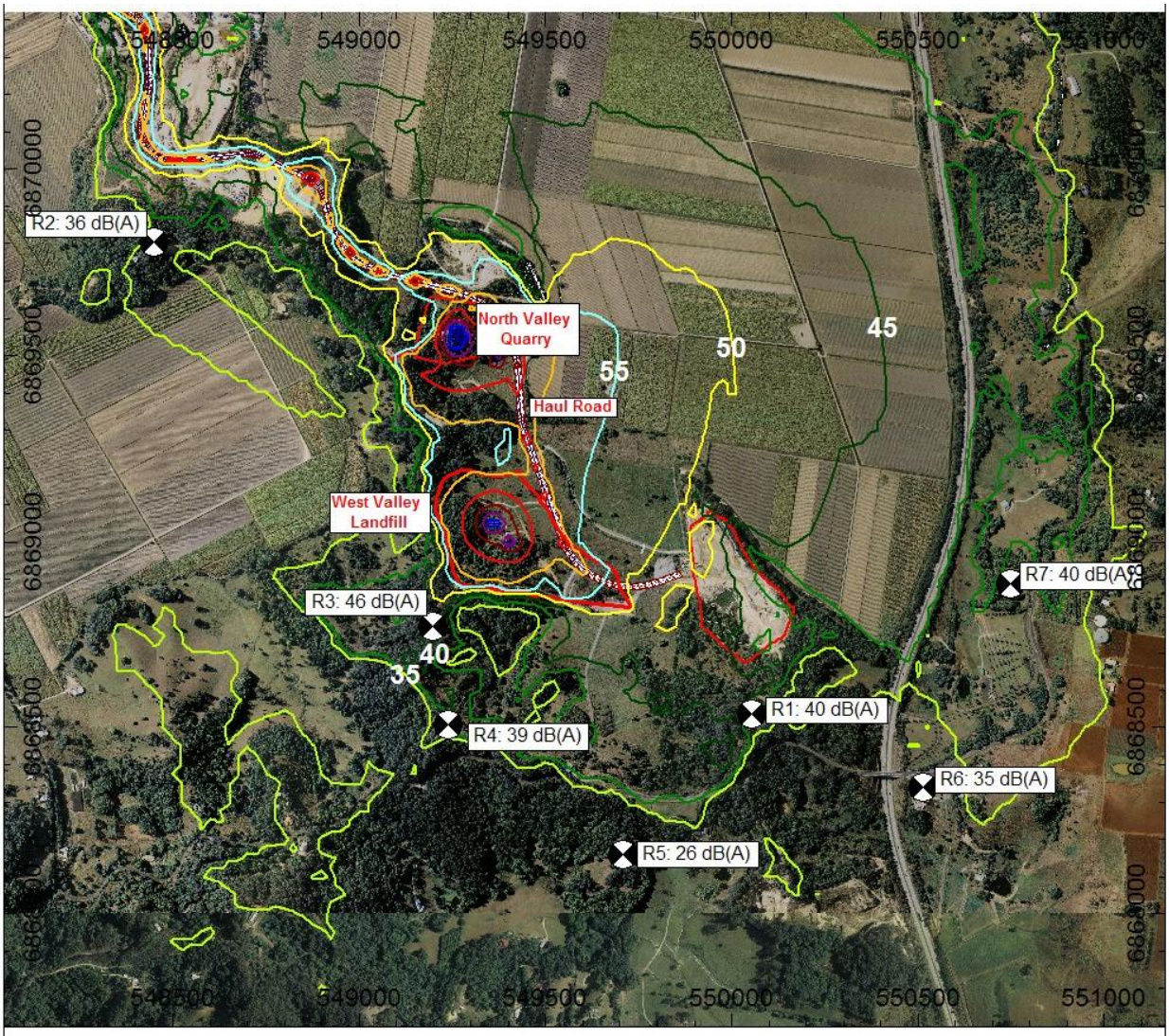


Eviron Quarry and Landfill

Configuration 1
Quirks Landfill and West Valley Quarry

Sound Pressure Level dB(A)

Noise Contours: LAeq
Grid height: 1.5m
Neutral Meteorological Conditions

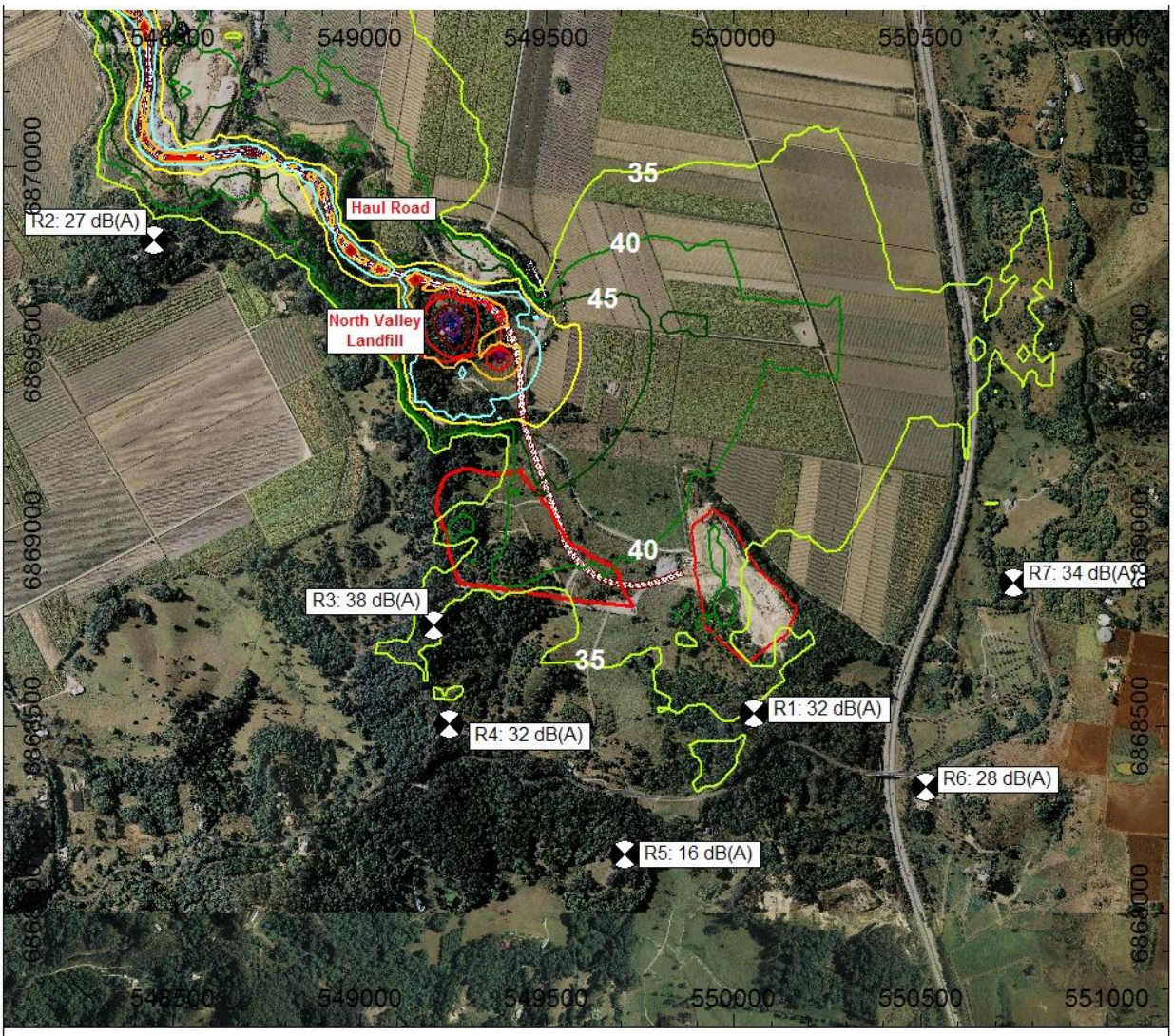


Eviron Quarry and Landfill

Configuration 2
West Valley Landfill and North Valley Quarry

Noise Contours: LAeq
Grid height: 1.5m
Neutral Meteorological Conditions

Sound Pressure Level dB(A)



Eviron Quarry and Landfill

Configuration 3
North Valley Landfill Only

Noise Contours: LAeq
Grid height: 1.5m
Neutral Meteorological Conditions

Sound Pressure Level dB(A)

GHD

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
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