Sutton Forest Quarries Pty Ltd

ABN 66 158 999 994

Noise and Vibration Impact Assessment

Specialist Consultant Studies Compendium

Volume 1, Part 4

Prepared by

Spectrum Acoustics Pty Limited

March 2018

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ABN 66 158 999 994

Noise and Vibration Impact Assessment

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EXECUTIVE SUMMARY

A noise and vibration impact assessment has been conducted for the proposed construction and operation of the Sutton Forest Sand Quarry for production of sand products. The Site is in a locality referred to as Sutton Forest, approximately 28km southwest of Berrima and 14km northeast of Marulan. The Site is located approximately 1km west of the Hume Highway and approximately 1.7 km southwest of the intersection of Hume Highway and Sallys Corner Road. The proposed operating hours are as follows.

Activity	**Monday to Friday**	**Saturdays**	**Sundays or Public Holidays**
Site Establishment and Construction[1]	6:00am to 10:00pm	6:00am to 10:00pm	Nil (unless required for external roadworks)
Extraction Operations	5:00am to 10:00pm	5:00am to 10:00pm	5:00am to 10:00pm
Blasting Operations (as required)	9:00am to 5:00pm	9:00am to 5:00pm	Nil
Processing Operations	24 hours / day	24 hours / day	24 hours / day
Product Despatch	24 hours / day	24 hours / day	24 hours / day
Maintenance	24 hours / day	24 hours / day	24 hours / day

1. Site establishment and construction activities beyond 6:00pm, Monday to Saturdays would be restricted to those activities that are not audible at surrounding residences.

Documents referred to in conducting the assessment include:

- *NSW Noise Policy* for *Industry* (NPI), EPA (2017); and
- *NSW Road Noise Policy* (RNP), OEH (2011).

For the purpose of this assessment, residences on Lot 4 DP 253435 (the subject site) and Lot 2 DP 253435_are subject to negotiated agreements and are considered project related. Noise impacts at those residences have not been assessed.

Ambient noise monitoring was conducted at five locations near the Site from 24 September to 3 October 2013 to determine background noise levels (Rating Background Levels (RBLs), as defined in the NPI) and enable setting of project noise trigger levels. The local area is generally rural but traversed by the Hume Highway. Such an environment would have no cause to vary acoustically over time and the data remain valid for the current assessment. Ambient L_{eq} and background (RBL) levels are summarized below. All values are dB(A). Receiver locations are shown on **Figure 3**.

Leq(day)	Leq(evening)	Leq(night)	RBL(day)	RBL(evening)	RBL(night)
The Trustees of the Pauline Fathers and Brothers (N1) - Shrines					
69	49	47	39	41	36
The Trustees of the Pauline Fathers and Brothers (N2)					
58	50	45	36	38	32
Birdram Proprietary Limited (N3)					
52	49	45	38	43	36
VM Hofman (N4)					
53	47	45	38	39	34
G Firriolo (N5)					
58	58	57	47	48	41

An assessment of available meteorological data found that while strong winds are a feature of the area, winds with average speeds up to 2.7 m/s from the southeast and up to 2.1 m/s from the west occurred for more than 30% of the time during some seasons and time periods, implying that these winds are an assessable feature with regards to noise impact assessment.

Noise modelling was conducted to produce point to point calculations for three operational scenarios to individual residential receivers surrounding the Site. Results are presented in tabular form.

Predicted operational noise levels were less than the project noise trigger levels at all assessed receivers with the proposed noise controls in place.

The Proposal would operate with standard industry noise controls and the use of noise barriers. The barriers would either be earthen barriers or roadside panel barriers adjacent to the southern and northern sides of the east-west section of the Quarry Access Road. The proposed north-south section of the northeastern barrier would be constructed to a height of 10 m above the surface of the Quarry Access Road.

Ground vibration levels from heavy vehicles passing the nearest residential receiver are expected to be less than one-tenth of the minimum night time human comfort vibration criterion for residential receivers.

Ground vibration levels from blasting are predicted to be well below the criterion for all assessed receivers including the Aboriginal rock shelter site (54-4-0323), a grotto and outdoor shrines at “Penrose Park” and the gas and water pipelines assessed for realistic charge weights. Overpressure levels are predicted to be below the human comfort criterion at the Grotto when blasting occurs at the nearest point 500m from the Grotto. However unlikely it is that impacts would occur, the Applicant would maintain communication with the Pauline Fathers to ensure that all planned blasting events within the Site are discussed prior to final planning for each blast.

Predicted cumulative noise levels at all receivers are below the adopted cumulative Project noise trigger levels.

Roads and Maritime Services (RMS) traffic count stations at nearby locations on the Hume Highway indicate approximately 240 heavy vehicles per hour pass the Site, compared to a maximum of 50 heavy vehicles per hour from the Proposal. The calculated increase in traffic noise level from the Proposal is less than 1 dB which is less than the allowable 2 dB increase under the NSW RNP for which mitigation is not required.

In summary, the assessment has found that the Proposal would be able to operate in compliance with the relevant criteria for operational and road traffic noise emissions and for potential overpressure and vibration impacts as a result of blasting or road traffic.

1. INTRODUCTION

1.1 SCOPE OF THE PROPOSAL

Spectrum Acoustics Pty Ltd has been commissioned by R.W. Corkery & Co. Pty Limited on behalf of Sutton Forest Quarries Pty Ltd (the Applicant) to undertake an assessment of the Proposal to construct and operate the Sutton Frost Quarry (the Quarry) producing high quality sand products. The Site for the proposed Quarry is in a locality called Sutton Forest, approximately 28km southwest of Berrima and 14km northeast of Marulan. The Quarry Operations Area is located approximately 1km west of the Hume Highway and approximately 1.7km southwest of the intersection of Hume Highway and Sallys Corner Road (see **Figure 1**).

This report provides:

- an overview of the acoustic environment around the Site, based upon a series of background noise measurements;
- an outline of the acoustic criteria relevant to the Proposal;
- an assessment of the predicted noise levels associated with the Proposal and as to the adverse impacts on the existing acoustic environment in vicinity of the proposed operations including traffic noise; and
- an outline of the required noise mitigation measures and monitoring.

This noise and vibration impact assessment has been prepared in accordance with the NSW Noise Policy for Industry (EPA, 2017), Road Noise Policy (OEH, 2011) and the Director-General's Requirements (DGRs) for the Proposal, issued on 7 February 2014 by the then NSW Department of Planning and Infrastructure (DP&I). The requirements provided by DP&I from the Environment Protection Authority (EPA) and the Division of Resources and Geoscience (DRG) (formerly the Division of Resources and Energy) have also been considered during the preparation of this report. **Appendix 1** records the coverage of the requirements from DP&I, EPA and DRG within this report.

1.2 OVERVIEW OF THE PROPOSAL

The proposed extraction and processing areas, as shown on **Figure 2**, have been defined based upon the occurrence of friable sandstone within the Quarry Operations Area, and taking advantage of the local topography that would provide long term protection to control the propagation of noise to the south and limit the visibility of operational areas from the adjoining properties and the Hume Highway. An estimated 34 million tonnes of friable sandstone has been defined within the proposed extraction area and the footprint of the processing and stockpiling area. This resource is capable of yielding approximately 29 million tonnes of high quality sand products. Negligible overburden is present within the proposed extraction area as the friable sandstone in a number of areas lies directly beneath the soil.

A fixed wash plant and two mobile screening plants would be used to process the extracted raw sand to produce high quality sand products meeting nominated Australian Standards and customers' individual specifications. The principal products produced would be various grades of washed concrete sand and mortar (brickie's) sands. The fixed wash plant would be used to produce concrete sand and blended products whereas mobile screening plants would be used to produce brickie's sand products.

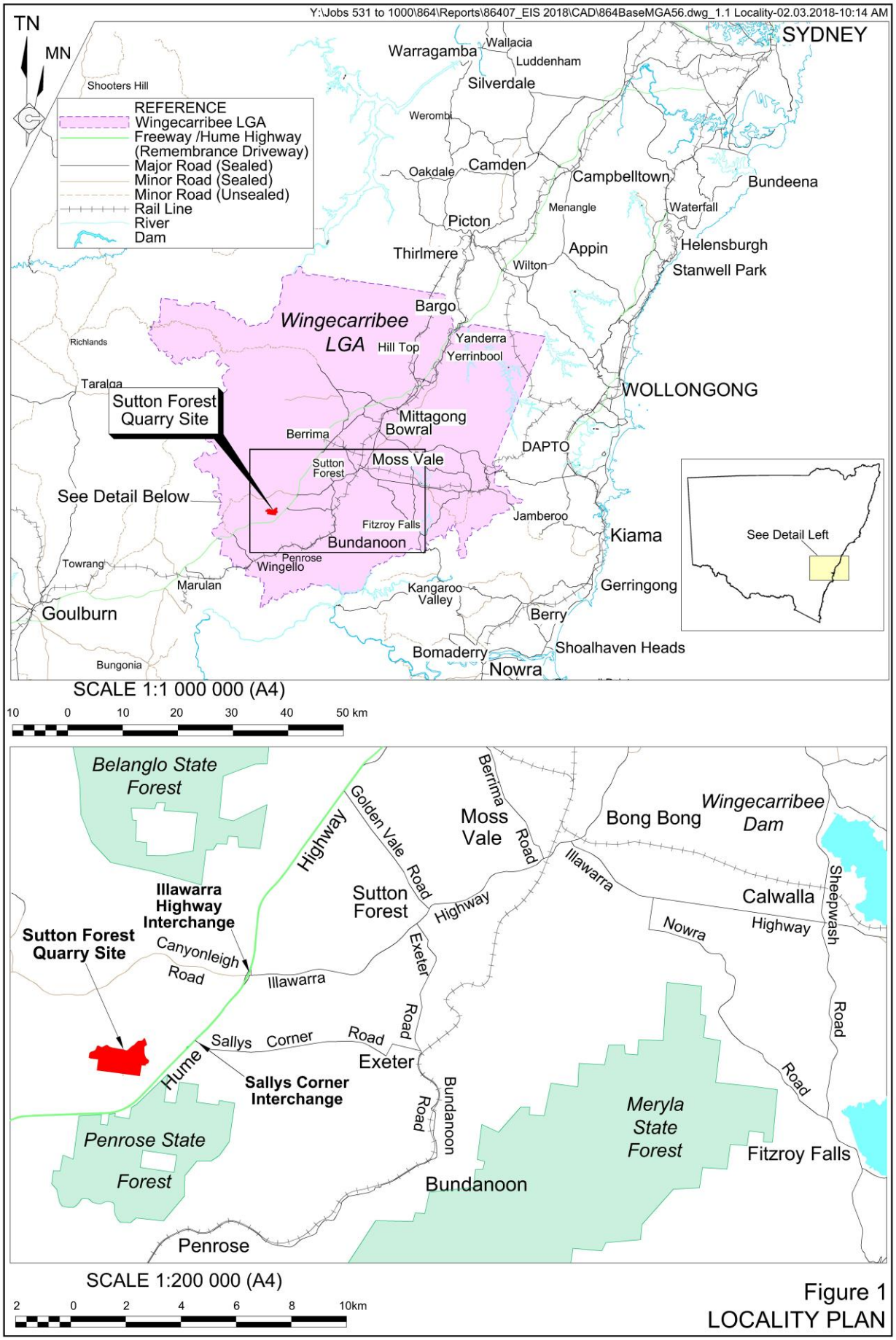

Figure 1
LOCALITY PLAN

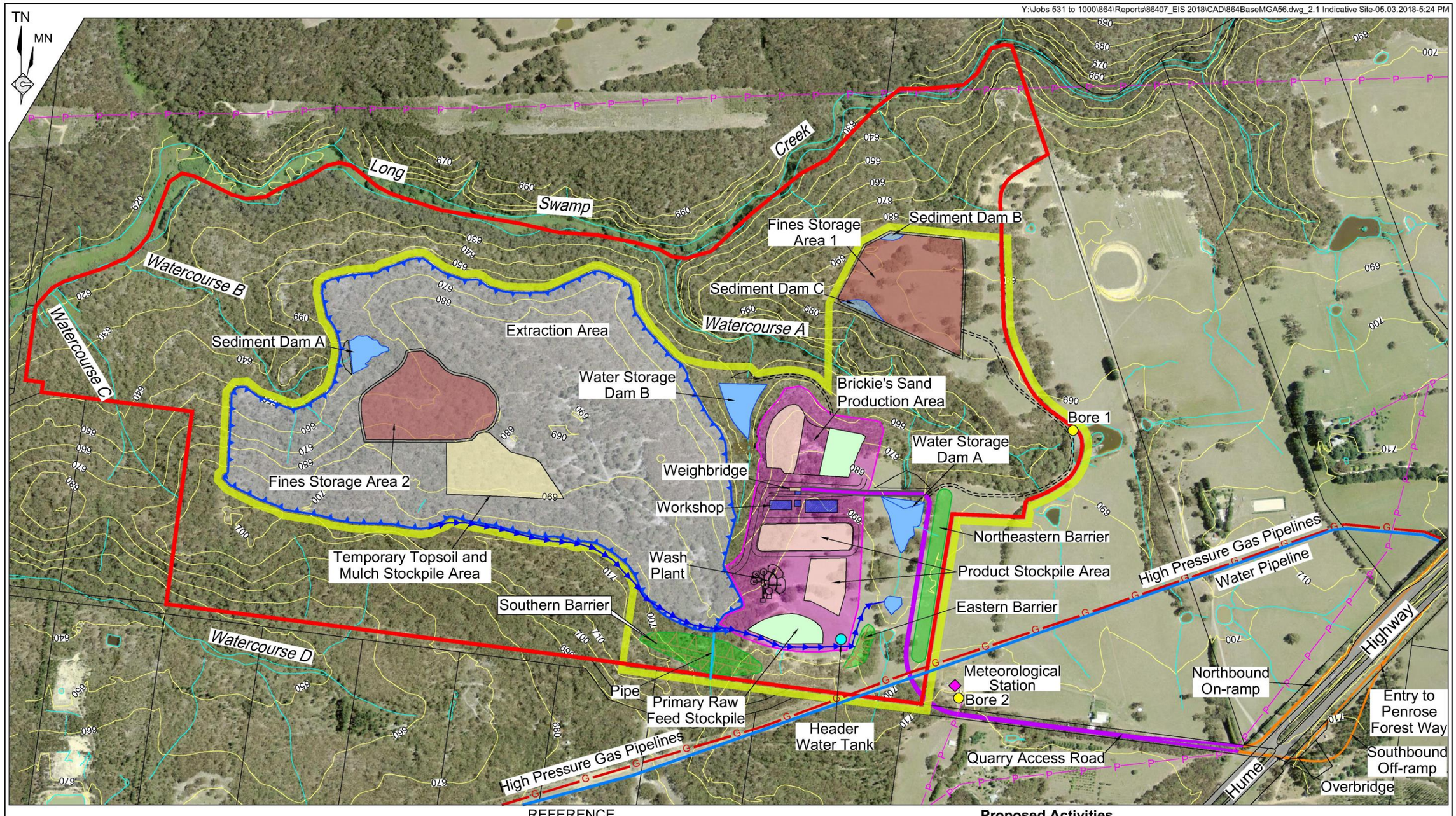

Figure 2
INDICATIVE SITE LAYOUT

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The sand extraction and processing operations have been designed to optimise the recovery of sand whilst satisfying both site and surrounding environmental constraints and progressively backfilling the extraction void with the residual fines from the processing operations together with Virgin Excavated Natural Material (VENM) and Excavated Natural Material (ENM) to create a free draining final landform with features that would support the ongoing agricultural and nature conservation land uses.

Figure 2 displays the following principal components of the Proposal.

- An extraction area covering approximately 47ha with its footprint typically between 660m AHD and 700m AHD.
- A processing and stockpiling area covering approximately 13ha incorporating a fixed wash plant involving washing, screening, dewatering and product stockpiling beneath radial and fixed stackers.
- Two mobile brickie's sand plants would ultimately be located within the northern part of the processing and stockpiling area and/or close to the active extraction area.
- A temporary topsoil and mulch stockpile area within the footprint of the extraction area for the storage of topsoil recovered from the early extraction stages and mulched timber from the areas cleared.
- Two fines storage areas to contain fines produced from the sand washing process during the first three stages of extraction.
- Two water storage dams located to the east and west of the processing and stockpiling area to provide water for dust suppression as well as a supplementary supply for the wash plant.
- A diversion drain along the southern boundary of the proposed Quarry Operations Area to divert runoff away from operational areas and capture for reuse in processing and dust suppression.
- The site weighbridge and office would be positioned adjacent to the product stockpiling area. One weighbridge would be constructed initially with provision for a second weighbridge, as production ramps up in the future.

The overall operational footprint would be kept as small as practicable and ultimately rehabilitated to provide for ongoing agricultural land uses and long-term nature conservation and wildlife corridor values within the local area.

Access to and from the Quarry Operations Area would be from the Hume Highway via the Quarry Interchange and Quarry Access Road. **Figure 2** displays the location of the Quarry Access Road and the Quarry Interchange.

Product despatch would predominantly involve the use of 19m B-Double trucks, 19m truck and dog trailers as well as rigid trucks.

The maximum rate of production would result in product despatch levels of 860 000tpa. For the purpose of assessment, of operational noise impacts, operational scenarios based on product sales of 430 000tpa and an estimated average product despatch level of 700 000tpa have also been considered.

The defined sandstone resource would be extracted in a staged manner, i.e. over eight extraction stages (Stages 0 to 7). The development consent currently being sought would enable extraction of the resource until Year 30. Assuming an average rate of extraction is maintained, extraction Stage 5 would be completed by Year 30. The completion of the subsequent extraction stages (Stages 6 and 7) would require an additional development consent beyond Year 30.

The proposed operating hours are listed in **Table 1**.

Table 1
Proposed Hours of Operation

Activity	Monday to Friday	Saturdays	Sundays or Public Holidays
Site Establishment and Construction[1]	6:00am to 10:00pm	6:00am to 10:00pm	Nil (unless required for external roadworks)
Extraction Operations	5:00am to 10:00pm	5:00am to 10:00pm	5:00am to 10:00pm
Blasting Operations (as required)	9:00am to 5:00pm	9:00am to 5:00pm	Nil
Processing Operations	24 hours / day	24 hours / day	24 hours / day
Product Despatch	24 hours / day	24 hours / day	24 hours / day
Maintenance	24 hours / day	24 hours / day	24 hours / day

1. Site establishment and construction activities beyond 6:00pm, Monday to Saturdays would be restricted to those activities that are not audible at surrounding residences.

1.3 ASSESSED RECEIVERS

Privately-owned residential properties within approximately 2km of the Site considered in this assessment and noise monitoring locations are shown in **Figure 3** and listed in **Table 2**. These residences are largely to the east, southeast, south and southwest of the proposed extraction area and fronting onto either the Hume Highway or Hanging Rock Road. Additional residences are located at greater distance to the north and north-northwest of the proposed extraction area.

In addition to residential receivers, the receivers displayed on **Figure 3** include an Aboriginal rock shelter, high pressure gas and water pipelines and the shrines and Grotto at “Penrose Park”. Residence 17 is occupied by a monastery which is run by the Pauline Fathers and known as “Penrose Park”. The monastery is frequently used for both indoor and outdoor religious services. The monastery site contains a shrine church, accommodation facilities and over 40 small outdoor shrines and chapels located around the northern end of the property. A Grotto containing statues and other sacred areas built into an outcropping of sandstone is 170m from the Extraction Area boundary and 330m from the proposed processing plant. The property is open to the public on a daily basis (from 8:00am to 6:00pm) with regular masses held in either English or Polish. Major mass services attract large crowds (up to 7 000 people) to the monastery.

For the purpose of the noise assessment, the monastery is considered to be a sensitive receiver as outlined in the NSW Noise Policy for Industry. The areas on “Penrose Park” are considered for the noise assessment at the closest residential building and the Grotto (as this is closest to the Site).

Table 2
Assessed Residential Receivers

Residence*	Landowner
R2	VM Hofman
R4	G Firriolo
R5	S & S Leaning
R8	M Radovac
R11	SC & PF Samuel
R12	NK & VM Ford
R13	L & D Petkovski
R15	Birdram Proprietary Limited
R16	Latham Property Holdings Pty Limited
R17A	The Trustees of the Pauline Fathers and Brothers
R17B	The Trustees of the Pauline Fathers and Brothers
R18	DW & SL Hutton
R19	A Beverley
R20	TB Brown & KL Maher
R21	CJ & KG Zelinski
R22	AJ & AP Palk
R23	G & AB Bishop, SA Palk
R24	R & J Kuhn
R25	Coca Cola Amatil (Aust) Pty Limited
R26	Youth Off The Streets Limited
R27	Tranteret Family Business Pty Ltd
R28A	E. Kirk
R28B	MJ&MD O'Dowd
R28C	TA Pall & M Adamson
R30	Paul D Edwards Pty Limited
R31	ML & SE Ridewood
R33	SJ Kearney
R35	Warette Pastoral Company Pty Limited
* See **Figure 3**	

It is noted that the assessed receiver locations other than the Grotto and outdoor shrines on "Penrose Park" have been grouped based generally upon their respective proximity to the Hume Highway, as follows.

- R15.
- R16, R18, R19, R20, R21, R22, R23, R24, R25 and R26.
- R2, R8, R11, R12 and R13.
- R4 and R5.
- R27, R28A, 28B, R30, R31, R33 and R35.

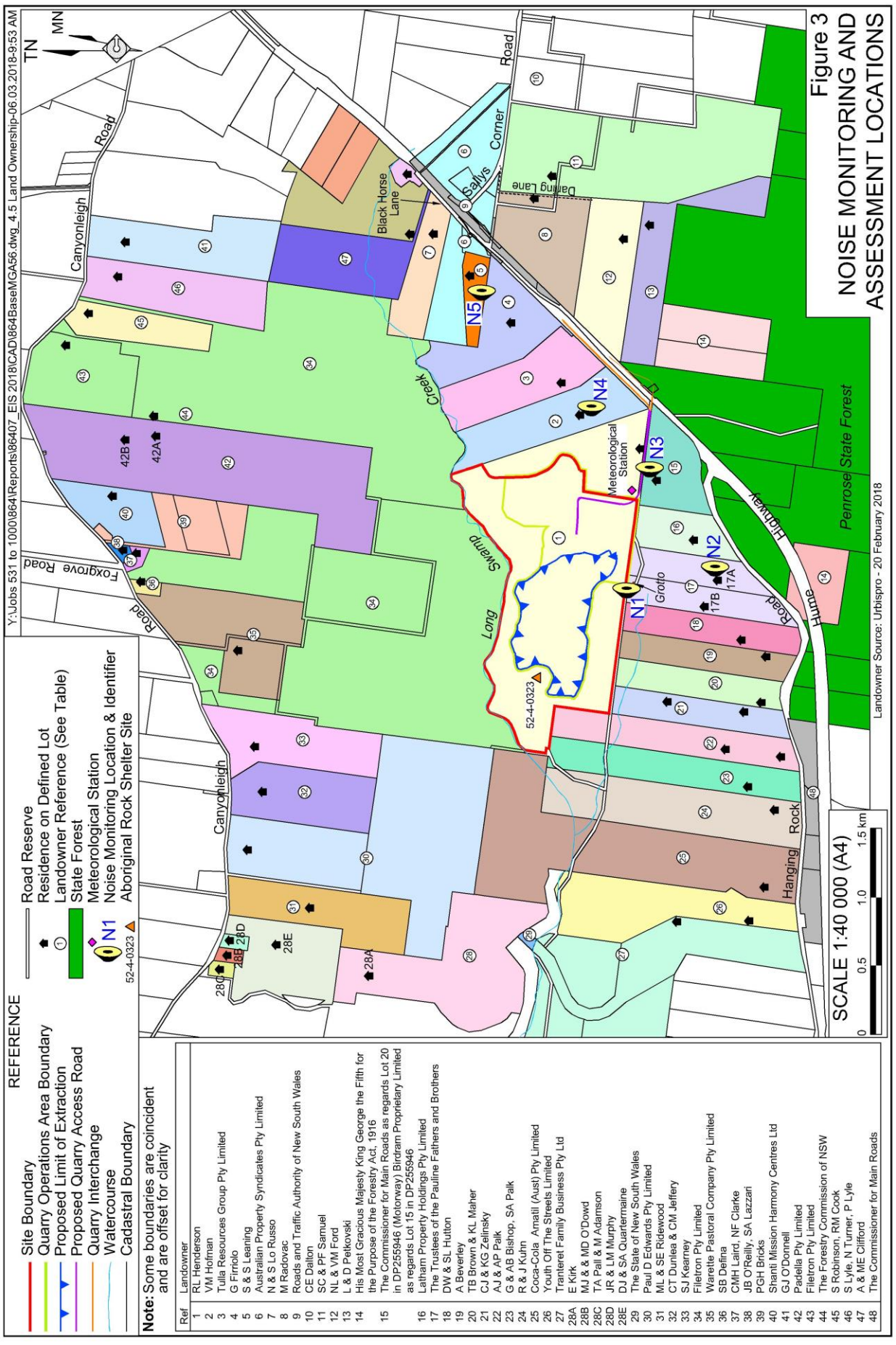


Figure 3
NOISE MONITORING AND ASSESSMENT LOCATIONS
REFERENCE
Site Boundary
Quarry Operations Area Boundary
Proposed Limit of Extraction
Proposed Quarry Access Road
Quarry Interchange
Watercourse
Cadastral Boundary
Road Reserve
Residence on Defined Lot
Landowner Reference (See Table)
State Forest
Meteorological Station
Noise Monitoring Location & Identifier
Aboriginal Rock Shelter Site
Note: Some boundaries are coincident and are offset for clarity
Ref Landowner
1 RL Henderson
2 VM Hofman
3 Tulla Resources Group Pty Limited
4 G Firriolo
5 S & S Leaning
6 Australian Property Syndicates Pty Limited
7 N & S Lo Russo
8 M Radovac
9 Roads and Traffic Authority of New South Wales
10 CE Dallon
11 SC & PF Samuel
12 NL & VM Ford
13 L & D Petkovski
14 His Most Gracious Majesty King George the Fifth for the Purpose of the Forestry Act, 1916
15 The Commissioner for Main Roads as regards Lot 20 in DP255946 (Motorway) Birdram Proprietary Limited as regards Lot 15 in DP255946
16 Latham Property Holdings Pty Limited
17 The Trustees of the Pauline Fathers and Brothers
18 DW & SL Hutton
19 A Beverley
20 TB Brown & KL Maher
21 CJ & KG Zelinsky
22 AJ & AP Palk
23 G & AB Bishop, SA Palk
24 R & J Kuhn
25 Coca-Cola Amatil (Aust) Pty Limited
26 Youth Off The Streets Limited
27 Tranteret Family Business Pty Ltd
28 E Kirk
28A MJ & & MD O'Dowd
28B TA Pall & M Adamson
28C JR & LM Murphy
28D DJ & SA Quartermaine
28E The State of New South Wales
29 Paul D Edwards Pty Limited
30 ML & SE Ridewood
31 CT Dunlea & CM Jeffery
32 SJ Kearney
33 Filetron Pty Limited
34 Warette Pastoral Company Pty Limited
35 SB Defina
36 CMH Laird, NF Clarke
37 JB O'Reilly, SA Lazzari
38 PGH Bricks
39 Shanti Mission Harmony Centres Ltd
40 GJ O'Donnell
41 Padella Pty Limited
42 Filetron Pty Limited
43 The Forestry Commission of NSW
44 S Robinson, RM Cook
45 S Lyle, N Turner, P Lyle
46 A & ME Clifford
47 The Commissioner for Main Roads
48
SCALE 1:40 000 (A4)
0 0.5 1.0 1.5 km
Landowner Source: Urbispro - 20 February 2018
Y:\Jobs 531 to 1000\864\Reports\86407_EIS 2018\CAD\864BaseMGA56.dwg_4.5 Land Ownership-06.03.2018-9:53 AM
TN
MN
Canyonleigh Road
Foxgrove Road
Black Horse Lane
Sallys Corner Road
Daring Lane
Swamp Creek
Long Swamp
Canyonleigh
Hanging Rock
Grotto
Meteorological Station
Penrose State Forest
Hume Highway
N1
N2
N3
N4
N5
52-4-0323

2. DESCRIPTION OF TERMS

Table 3 contains the definitions of commonly used acoustical terms and is presented as an aid to understanding this report.

Table 3
Definition of Acoustical Terms

Term	Description
dB(A)	The quantitative measure of sound heard by the human ear, measured by the A-Scale Weighting Network of a sound level meter expressed in decibels (dB).
SPL	Sound Pressure Level. The incremental variation of sound pressure above and below atmospheric pressure and expressed in decibels. The human ear responds to pressure fluctuations, resulting in sound being heard.
STL	Sound Transmission Loss. The ability of a partition to attenuate sound, in dB.
Lw	Sound Power Level radiated by a noise source per unit time re 1pW.
Leq	Equivalent Continuous Noise Level - taking into account the fluctuations of noise over time. The time-varying level is computed to give an equivalent dB(A) level that is equal to the energy content and time period.
LAFmax	Maximum Noise Level - the maximum noise level during the monitoring period.
L90	"Background" Noise Level - the level exceeded for 90% of the monitoring period.

3. EXISTING ENVIRONMENT AND CRITERIA

The existing meteorological and acoustical environments of the Site and its surrounds have been studied to determine prevailing conditions and to allow noise goals to be set.

3.1 METEOROLOGY

The atmospheric conditions most relevant to noise assessments are temperature inversions, gentle winds (indicative of possible wind shear) and relative humidity. Fact Sheet D of The NSW Noise Policy for Industry (NPI) (EPA, 2017) provides assessment methods to determine the occurrence and intensity of temperature inversions, with the requirement that inversions be considered in a noise impact assessment if Pasquil stability classes F and G occur more often than 30% of night times during winter. These stability classes correspond to very stable atmospheric conditions with wind speeds generally less than 2 m/s. Analysis of site meteorological data conducted by Pacific Environment Pty Ltd (PE) for the Proposal has found that stable atmospheric conditions are a feature of the Site, therefore the NPI default 4^0C/100m inversion strength has been adopted for noise modelling. There are natural hills and/or noise barriers/bunds between source locations and receivers and a drainage wind has not been included with the inversion.

The NPI also states that wind effects need to be assessed where source to receiver winds (at 10m height) of 3m/s or below occur for 30% or more of the time in any season in any assessment period.

Seasonal wind roses generated by PE for the Proposal using data from the site meteorological station for the years 2014/2015 were relied upon for the assessment of prevailing winds. The analysis found that while strong winds are a feature of the area, winds with average speeds up to 2.7 m/s from the southeast and up to 2.1 m/s from the west occurred for more than 30% of the time during some seasons and time periods, implying that these winds are an assessable feature with regards to noise impact assessment.

The following points are the most significant with respect to noise propagation and were adopted as parameters for noise modelling.

- Extremes of relative humidity (RH) are rarely experienced. A value of 70% RH was adopted.
- Noise modelling was carried out under the prevailing condition of neutral atmospheric conditions (20°C, no wind), a 4^0C/100m inversion and wind conditions of 2.7 m/s from the south east and 2.1 m/s from the west.

3.2 EXISTING ACOUSTIC ENVIRONMENT

In order to quantify the existing acoustic environment, Australian Research Laboratories (ARL) Type 215 environmental noise loggers were deployed from 24 September to 3 October, 2013 at five locations displayed on **Figure 3**, and described in **Table 4**. There is no reason to believe that the acoustic environment of the study area would have changed significantly since the logging was conducted. **Table 5** summarises the ambient LAeq and Rating Background Levels (RBL, L_{A90}) noise levels arising from the noise measurements according to procedures in the NSW NPI. Plots of the raw data are included in **Appendix 2**.

Table 4
Noise Monitoring Locations

Location	Landowner
N1	The Trustees of the Pauline Fathers and Brothers[1]
N2	The Trustees of the Pauline Fathers and Brothers[2]
N3	Birdram Proprietary Limited
N4	VM Hofman
N5	G Firriolo

[1] Outdoor shrines at northern end of property.
[2] Residential buildings on property.

Table 5
Summary of Ambient LAeq and Rating Background Levels (RBLs), dB(A)

The Trustees of the Pauline Fathers and Brothers (N1)						
Day/Date	**Leq(day)**	**Leq(eve)**	**Leq(night)**	**L90(day)**	**L90(eve)**	**L90(night)**
Tuesday 24 Sep 2013	48.6	47.7	47.1	40.6	44.0	38.5
Wednesday 25 Sep 2013	48.5	48.6	48.5	36.5	44.8	40.3
Thursday 26 Sep 2013	57.9	47.4	47.0	43.7	41.0	37.3
Friday 27 Sep 2013	45.5	47.1	43.9	33.0	41.5	33.5
Saturday 28 Sep 2013	56.0	50.4	42.9	42.5	38.8	31.5
Sunday 29 Sep 2013	79.2	41.4	43.4	33.0	35.5	32.5
Monday 30 Sep 2013	45.6	49.2	45.8	34.2	38.0	38.0
Tuesday 1 Oct 2013	60.7	52.1	45.4	44.2	43.3	36.3
Wednesday 2 Oct 2013	54.5	46.7	52.2	40.7	40.8	36.3
Thursday 3 Oct 2013	52.6	52.8	46.4	36.2	37.3	36.0
LAeq	69	49	47	--	--	--
RBL, L_{A90}	--	--	--	39	41	36
The Trustees of the Pauline Fathers and Brothers (N2)						
Date	**Leq(day)**	**Leq(eve)**	**Leq(night)**	**L90(day)**	**L90(eve)**	**L90(night)**
Tuesday 24 Sep 2013	50.7	47.4	41.6	41.2	40.0	34.0
Wednesday 25 Sep 2013	48.5	39.7	40.5	34.2	34.0	31.0
Thursday 26 Sep 2013	64.7	52.1	48.9	39.2	40.3	36.3
Friday 27 Sep 2013	37.6	39.7	40.2	30.5	35.0	30.8
Saturday 28 Sep 2013	63.4	57.7	42.3	40.2	41.8	31.0
Sunday 29 Sep 2013	41.2	40.6	40.1	31.5	34.0	32.0
Monday 30 Sep 2013	40.5	36.2	38.4	31.5	31.3	31.8
Tuesday 1 Oct 2013	60.5	52.7	41.7	40.0	44.3	35.0
Wednesday 2 Oct 2013	52.2	45.6	49.4	38.2	39.5	36.5
Thursday 3 Oct 2013	46.4	44.6	46.3	33.1	36.5	32.5
LAeq	58	50	45	--	--	--
RBL, L_{A90}	--	--	--	36	38	32

Table 5 (Continued)
Summary of Ambient LAeq and Rating Background Levels (RBLs), dB(A)

EA & MT Fitzpatrick (N3)						
Date	**Leq(day)**	**Leq(eve)**	**Leq(night)**	**L90(day)**	**L90(eve)**	**L90(night)**
Tuesday 24 Sep 2013	45.4	49.4	47.3	39.5	45.0	39.5
Wednesday 25 Sep 2013	45.6	53.5	50.4	36.2	44.3	43.0
Thursday 26 Sep 2013	57.6	47.5	44.5	43.8	42.8	36.8
Friday 27 Sep 2013	40.4	49.0	44.1	32.0	44.0	34.8
Saturday 28 Sep 2013	56.1	50.4	40.4	39.7	39.3	30.0
Sunday 29 Sep 2013	40.4	39.0	41.1	31.5	35.5	32.8
Monday 30 Sep 2013	41.8	47.4	46.0	34.0	39.0	38.5
Tuesday 1 Oct 2013	55.3	48.2	42.7	43.8	44.0	35.5
Wednesday 2 Oct 2013	48.7	43.7	41.5	37.7	39.8	--
Thursday 3 Oct 2013	--	--	--	--	--	--
LAeq	52	49	45	--	--	--
RBL, L_{A90}	--	--	--	38	43	36
VM Hofman (N4)						
Date	**Leq(day)**	**Leq(eve)**	**Leq(night)**	**L90(day)**	**L90(eve)**	**L90(night)**
Tuesday 24 Sep 2013	48.1	45.3	44.5	41.9	40.0	34.3
Wednesday 25 Sep 2013	53.2	45.4	48.5	37.7	38.5	38.5
Thursday 26 Sep 2013	57.6	47.6	45.8	45.2	41.8	36.5
Friday 27 Sep 2013	44.4	49.4	44.1	36.0	44.3	34.0
Saturday 28 Sep 2013	56.7	50.9	43.1	42.2	40.8	32.5
Sunday 29 Sep 2013	46.5	43.2	42.2	34.0	35.3	31.5
Monday 30 Sep 2013	43.7	50.6	46.9	36.0	37.3	37.8
Tuesday 1 Oct 2013	54.2	44.2	42.0	44.2	40.0	33.3
Wednesday 2 Oct 2013	53.7	42.4	42.2	37.7	37.5	33.5
Thursday 3 Oct 2013	48.0	45.9	46.2	35.7	34.5	33.3
LAeq	53	47	45	--	--	--
RBL, L_{A90}	--	--	--	38	39	34
G Firriolo (N5)						
Date	**Leq(day)**	**Leq(eve)**	**Leq(night)**	**L90(day)**	**L90(eve)**	**L90(night)**
Tuesday 24 Sep 2013	56.8	57.0	57.9	50.5	48.8	42.3
Wednesday 25 Sep 2013	55.4	58.6	56.7	44.0	49.0	42.0
Thursday 26 Sep 2013	61.5	58.2	57.8	46.7	50.5	42.8
Friday 27 Sep 2013	55.9	56.1	53.6	45.5	44.0	36.0
Saturday 28 Sep 2013	60.0	57.6	52.2	47.3	46.0	34.8
Sunday 29 Sep 2013	55.0	57.9	54.9	44.0	47.5	36.8
Monday 30 Sep 2013	53.1	55.4	55.7	45.0	43.8	39.8
Tuesday 1 Oct 2013	60.6	57.9	57.2	46.7	48.5	40.0
Wednesday 2 Oct 2013	55.9	55.7	57.2	47.5	47.0	41.0
Thursday 3 Oct 2013	59.1	59.8	59.5	50.5	51.5	44.0
LAeq	58	58	57	--	--	--
RBL, L_{A90}	--	--	--	47	48	41

Noise levels in the vicinity of the Site were dominated by traffic on the nearby Hume Highway and environmental sources. Highway noise was greatest at N5 (Firriolo) (270m from the Hume Highway) with direct exposure to traffic and least at N2 ("Penrose Park"). Both the L_{Aeq} and L_{A90} levels were elevated at N1 ("Penrose Park", outdoor shrines) on Sunday 29 September, most likely due to increased activities at this location with people visiting shrines and attending prayer services.

Background noise levels at receivers north of the Site and distant from the Hume Highway have been assumed to be the NPI default RBL of 35dB(A),L_{90} (daytime) and 30dB(A),L_{90} (evening and night time).

3.3 PROJECT NOISE TRIGGER LEVELS

Proposal-generated noise within the Site is required to be assessed against the provisions of the NPI. In relation to the residences surrounding the Site, the NPI specifies two noise criteria: *intrusiveness and amenity criteria*.

The *Intrusiveness Noise Level* limits Equivalent Continuous Noise Level (Leq) from the industrial source to a value of 'background plus 5dB'. That is, the Rating Background Level (RBL) for the time period, plus 5 dB(A). The RBL (L_{A90}) is defined as the overall single figure background level representing each assessment period.

The *Amenity Noise Level* aims to protect against excessive noise levels where an area is becoming increasingly developed. Amenity criteria are dependent upon the nature of the receiver area and the existing level of industrial noise. There is very little existing industrial noise in the area and the residential area that is potentially affected by noise emissions from the Proposal is best described acoustically as an area dominated by environmental and road traffic noise.

Time periods for assessment as defined in the NPI are:

- Daytime – 7:00am (8:00am on Sundays) to 6:00pm;
- Evening – 6:00pm to 10:00pm; and
- Night – 10:00pm to 7:00am (8:00am on Sundays).

The project noise trigger levels for all residential receivers are derived from the lower of the intrusiveness noise level and the amenity noise level and the worst case or most conservative time period based on recorded background levels. If compliance is predicted during the worst case time period assessed, then compliance is assumed for the remaining time periods. For each location, the more conservative time period was the night period. Therefore, the Project noise trigger levels for the Proposal will be the intrusiveness levels of "background + 5 dB" for receivers corresponding to monitoring locations N1, N2, N3 and N4. At residences corresponding to N5, the high traffic noise amenity level (based on Section 2.4.1 of the NPI) is the more conservative criteria and has therefore been applied for assessment.

Table 6 defines the proposed operating periods relating to the hours of operation outlined in **Table 1** and **Table 7** lists the corresponding project noise trigger levels for the worst case (lowest) background noise level. The criteria to be applied at each receiver is based on the noise monitoring location taken to be a conservative representative of the predicted background noise based on the proximity from the receiver, and hence the relevant project noise trigger level at these locations.

For worship spaces such as the shrines near N1, the NPI specifies a criterion of 40 dB(A) internal when in use. It is generally accepted by acoustical consultants and regulatory agencies that the noise reduction through a normally open window to a point approximately 2m from the window within the room is 10 dB. This implies an external noise criterion of 50 dB(A) for worship areas. In the interests of conservatism and minimising noise impacts, the internal criterion of 40 dB(A) will be adopted for the outdoor shrines. This is lower than the 41 dB(A) intrusiveness noise level that would be adopted if this was a residential receiver, as the measured night time background noise level at N1 near the outdoor shrines was 36 dB(A),L_{90}.

The project noise trigger levels in **Table 7** apply to all emissions from the Site including road registered heavy vehicles moving about the Quarry Operations Area and along the Quarry Access Road.

Table 6
Proposed Operational Time Periods

Activity	Monday to Friday	Saturday	Sunday
Site Establishment	Day, evening	Day, evening	-
Extraction Operations	MS[2] (3hr), day, evening	MS[2] (3hr), day, evening	MS[2] (3hr), day, evening
Processing Operations	24 hours / day	24 hours / day	24 hours / day
Product Despatch	24 hours / day	24 hours / day	24 hours / day
Maintenance[3]	24 hours / day	24 hours / day	24 hours / day

1. Site establishment activities beyond 6:00pm, Monday to Friday and 1:00pm Saturdays would be restricted to those that are not audible at surrounding residences.
2. Morning Shoulder (MS) period (number of hours prior to 7:00am)
3. Noise attributed to maintenance activities should not be audible at surrounding receivers.

Table 7
Worst Case Noise Trigger Levels – dB(A)

Location	RBL L_{A90}			Project Noise Trigger Levels $L_{Aeq(15minute)}$		
	Day	Evening	Night	Day	Evening	Night
N1 "Penrose Park" - Worship areas	N/A			40 (when in use)		
N2 (R17A and 17B) "Penrose Park" - Residential areas Representative of R16, R18, R19, R20 R21, R22, R23, R24, R25, R26	36	36	32	41	41	37
N3 (R15)	38	38	36	43	43	41[#]
N4 (R2) Representative of R8, R11, R12 and R13	38	38	34	43	43	39
N5 (R4) Representative of R5	47	47	41	52	52	42*
R27, R28A, R28B, R30, R31, R33, R35	35	30	30	40	35	35

[#] Intrusiveness noise level applies due to absence of other industrial sources at R15. Cumulative noise at R22-R26 is discussed further in Section 6.6.

* High traffic noise amenity level is adopted at this location, in accordance with Section 2.4.1 of the NPI, as this is lower than the intrusiveness criterion.

3.4 MAXIMUM NOISE LEVELS

The potential for sleep disturbance from maximum noise level events from the Proposal during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

Where the subject development/premises night-time noise levels at a residential location exceed:

- $L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or
- L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,

a detailed maximum noise level event assessment should be undertaken. The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the NSW *Road Noise Policy*.

Other factors that may be important in assessing the extent of impacts on sleep include:

- how often high noise events will occur
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the subject development
- whether there are times of day when there is a clear change in the noise environment (such as during early-morning shoulder periods)
- current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.

Maximum noise level event assessments need to be based on the L_{AFmax} descriptor on an event basis under 'fast' time response.

The detailed assessment need to consider all feasible and reasonable noise mitigation measures with a goal of achieving the above trigger levels. The maximum noise levels assessment levels, being the greater of 52 dB(A),L_{max} and the RBL + 15 dB, are only applicable to night-time noise emissions and are summarised in **Table 8**.

Table 8
Maximum Noise Assessment Levels

Location	L_{AFmax}
N1 "Penrose Park", worship areas (outdoor shrines)[1]	52
N2 (R17A and 17B) "Penrose Park", residential areas	52
R15, R16, R18, R19, R20, R21, R22, R23, R24, R25, R26	52
R2, R8, R11, R12, R13.	52
R4, R5	56
R27, R28, R30, R31, R33, R35	52
[1] None of the outdoor shrines are visited beyond 6:00pm.	

3.5 TRAFFIC NOISE

In NSW, noise from vehicle movements associated with an industrial source is assessed in terms of the NPI if the vehicles are not on a public road. If the vehicles are on a public road, the *NSW Road Noise Policy* (RNP) applies. Noise from the Proposal must, therefore, be assessed against the project noise trigger levels of the NPI and also the criteria in the RNP.

The RNP recommends various criteria based on the functional categories of roads applied by the NSW Roads and Maritime Services (RMS). The RMS differentiates roads based on a number of factors including traffic volume, heavy vehicle use, through or local traffic, vehicle speeds and applicable traffic management options.

Vehicles accessing the Site will do so via the Hume Highway which falls under the RMS definition of a freeway or arterial road.

Table 9 shows the noise criteria relevant to arterial roads extracted from Table 3 of the RNP. For the assessment of traffic noise, the daytime period is from 7:00am to 10:00pm, whilst night is from 10:00pm to 7:00am.

Table 9
Road Traffic Noise Criteria

Situation	Recommended Criteria	
	Day (7:00am to 10:00pm)	Night (10:00pm to 7:00am)
Existing residences affected by additional traffic on existing freeway/ arterial/sub-arterial roads generated by land use developments	Leq (15-hour) 60	Leq (9-hour) 55

Section 3.4 of the RNP discusses the assessment of reasonable and feasible traffic noise mitigation measures and notes that “an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person”. Consequently, mitigation of traffic noise impacts is only considered where an increase of more than 2 dB occurs.

3.6 BLASTING AND VIBRATION

3.6.1 Residential Receivers

Human Comfort

Noise and vibration levels from blasting are assessable against criteria proposed by the Australian and New Zealand Environment and Conservation Council (ANZECC) in their publication *“Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration – September 1990”*. These criteria are summarised as follows:

- The recommended maximum overpressure level for blasting is 115 dB;
- The level of 115 dB may be exceeded for up to 5% of the total number of blasts over a 12-month period, but should not exceed 120 dB at any time;
- The recommended maximum vibration velocity for blasting is 5 mm/s Peak Vector Sum (PVS);

- The PVS level of 5 mm/s may be exceeded for up to 5% of the total number of blasts over a 12-month period, but should not exceed 10 mm/s at any time;
- Blasting should generally only be permitted during the hours of 9 am to 5 pm Monday to Saturday, and should not take place on Sundays and Public Holidays; and

Blasting should generally take place no more than once per day.

Building Damage Criteria

Building damage assessment criteria are nominated in AS 2187.2-1993 *"Explosives – Storage, Transport and Use. Part 2: Use of Explosives"* and summarised in **Table 10.**

Table 10
Building damage vibration criteria

Building Type	Vibration Level (mm/s)	Airblast Level (dB re 20 μPa)
Sensitive (and Heritage)	5	133
Residential	10	133
Commercial/Industrial	25	133

The annoyance (ANZECC) criteria are more stringent than the building damage criteria and will be taken as the governing criteria.

3.6.2 Non-residential Receivers

There are three potentially vibration-sensitive locations near the Quarry Operations Area, being:

- the outdoor shrines near the northern boundary of "Penrose Park" (R17);
- high pressure gas and water pipelines to the south of the Site; and
- an Aboriginal rock shelter identified as 54-4-0323 within Landskape (2018), all indicated on **Figure 3**.

The building damage criteria in **Table 10** are the limits for minor cosmetic damage such as paint cracking at cornice junctions. The commercial/Industrial cosmetic damage vibration criterion of 25 mm/s and the human comfort blast over pressure criterion of 115 dB will be applied to the outdoor shrines.

Underground gas and water pipelines are located near the southern boundary of the Site within approximately 250m of the nearest point of the proposed extraction area. A ground vibration criterion of 100 mm/s was applied to underground fibre optic cables near at least one Hunter valley coal mine. A criterion of 20 mm/s has been applied to road and rail culverts. A 20 mm/s criterion for the underground gas and water pipes will be adopted for conservatism.

Ground vibration criteria of 50-80mm/s for sensitive heritage rock structures has previously been applied by the EPA to coal mining projects in NSW and the more conservative criterion of 50mm/s will be applied to the assessment of the rock shelter.

4. ASSESSMENT METHODOLOGY

4.1 MODELLED SCENARIOS

A full description of the Proposal is given in Section 2 of the EIS. In discussion with the Applicant, it was determined that the following three operational noise scenarios represent worst case potential for noise impacts at the surrounding residential receivers and the outdoor shrines on "Penrose Park". The modelling was undertaken for the atmospheric conditions described in Section 3.1.

SCENARIO 1: Annual Sales 430 000 tonnes[1] – see Figure 4

Extraction Stage 0

Processing Operations

Fixed Wash Plant (WP) operating at 685m AHD.

Dry Screening Plant (DS) operating at 685m AHD.

Haul truck (HT_2) (Hitachi B50D or similar) laden hauling silt to Fines Storage Area 1 at 690m AHD.

Site Development

Bulldozer (B_1) (Komatsu 475 or similar) pushing mulch and topsoil within stockpile area at 690m AHD.

Haul Truck (HT_1) (Hitachi B50D or similar) and Water Truck on internal road to mulch and topsoil stockpile area at 690m AHD.

Bulldozer (B_2) (Komatsu 475 or similar) and Excavator (45t PC 450 or similar) shaping processing and stockpiling area

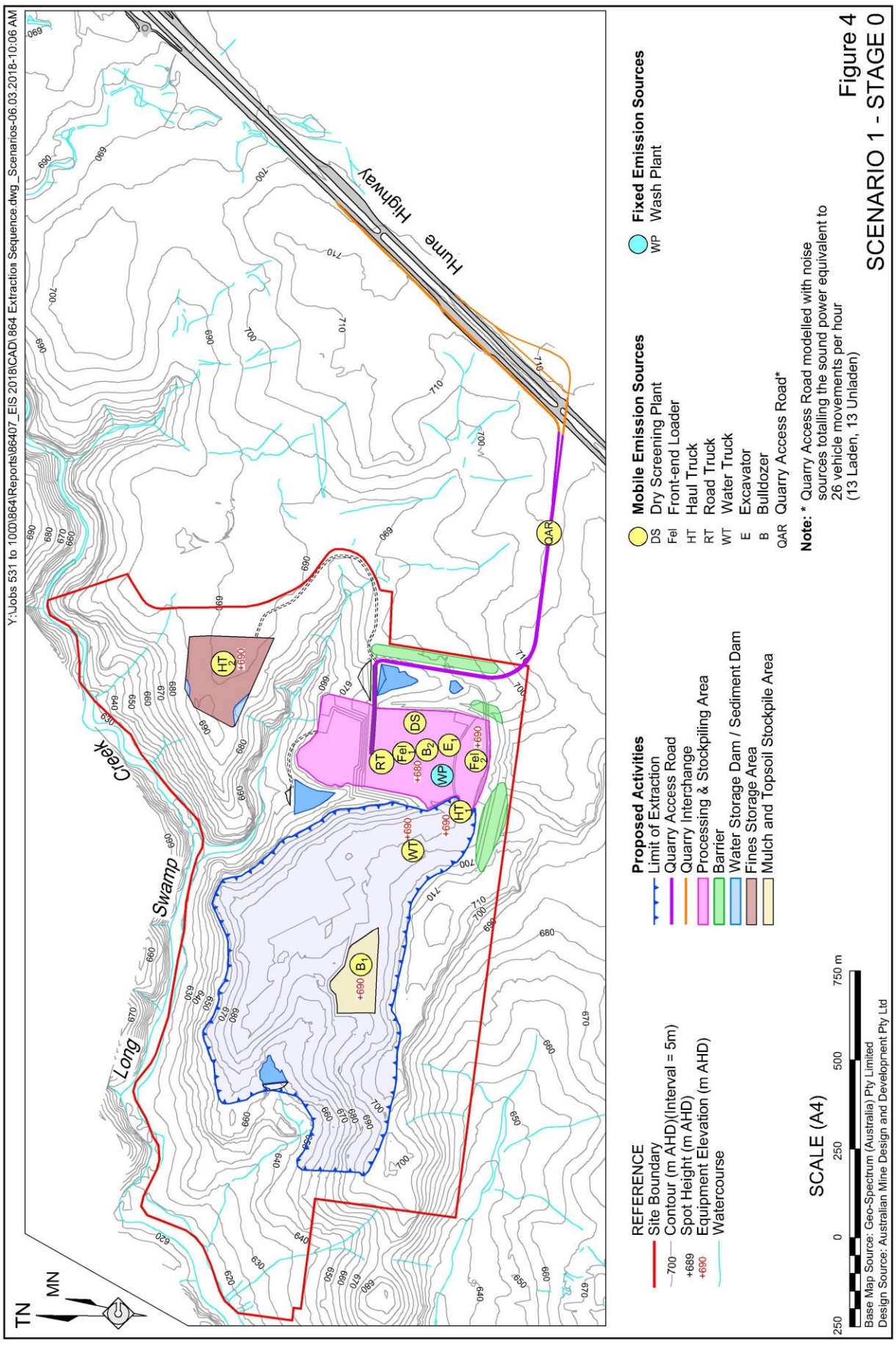
Product Loading and Despatch (assuming up to 26 movements in a 60 minute period on the Quarry Access Road)

Front-end Loaders (FeL_1 and FeL_2) (WA 500 or similar) loading trucks in processing and stockpiling area at 685m AHD.

Single road truck (RT) within the Quarry Operations Area at the weighbridge at 685m AHD.

Road truck movements along Quarry Access Road = 26/hr

[1] An estimated 500 000 tonnes of friable sandstone would need to be extracted and processed to yield 430 000 tonnes of product.


Y:\Jobs 531 to 10000\864\Reports\86407_EIS 2018\CAD\ 864 Extraction Sequence.dwg_Scenarios-06.03.2018-10:06 AM
Hume Highway
Long Swamp Creek
TN
MN
Proposed Activities
Limit of Extraction
Quarry Access Road
Quarry Interchange
Processing & Stockpiling Area
Barrier
Water Storage Dam / Sediment Dam
Fines Storage Area
Mulch and Topsoil Stockpile Area
Mobile Emission Sources
DS Dry Screening Plant
Fel Front-end Loader
HT Haul Truck
RT Road Truck
WT Water Truck
E Excavator
B Bulldozer
QAR Quarry Access Road*
Fixed Emission Sources
WP Wash Plant
Note: * Quarry Access Road modelled with noise sources totalling the sound power equivalent to 26 vehicle movements per hour (13 Laden, 13 Unladen)
REFERENCE
Site Boundary
Contour (m AHD)(Interval = 5m)
Spot Height (m AHD)
Equipment Elevation (m AHD)
Watercourse
SCALE (A4)
250 0 250 500 750 m
Base Map Source: Geo-Spectrum (Australia) Pty Limited
Design Source: Australian Mine Design and Development Pty Ltd
Figure 4
SCENARIO 1 - STAGE 0

SCENARIO 2: Annual Sales 700 000 tonnes[2] – see Figure 5

Extraction Stage 2

Processing Operations

Fixed Wash Plant (WP) operating at 685m AHD.

Dry Screening Plant (DS) operating at 660m AHD.

Haul truck (HT_2) (Hitachi B50D or similar) laden hauling silt to Fines Storage Area 2 at 680m AHD.

Bulldozer (B_1) (Komatsu 475 or similar) pushing fines within Fines Storage Area 2 at 680m AHD.

Front-end Loader (FeL_2) (WA 500 or similar) moving sand stockpiles at 690m AHD.

Extraction Operations

Two Bulldozers (B_2 and B_3) (Komatsu 475 or similar) extracting friable sand at 640m AHD and 660m AHD.

Two Excavators (E_1 and E_2) loading haul trucks at 630m AHD and 690m AHD.

Drill Rig (DR) operating at 650m AHD.

Haul Truck (HT) (Hitachi B50D or similar) on internal road to Primary Raw Feed Stockpile Area at 690m AHD.

Product Loading and Despatch (assuming up to 50 movements in a 60 minute period on Quarry Access Road)

Front-end Loaders (FeL_1, FeL_3) (WA 500 or similar) loading trucks in processing area at 660m AHD and 685m AHD.

Single road truck (RT) within the Quarry Operations Area at the weighbridge at 685m AHD.

Road truck movements along Quarry Access Road = 50/hr

[2] An estimated 820 000 tonnes of friable sandstone would need to be extracted and processed to yield 700 000 tonnes of product.

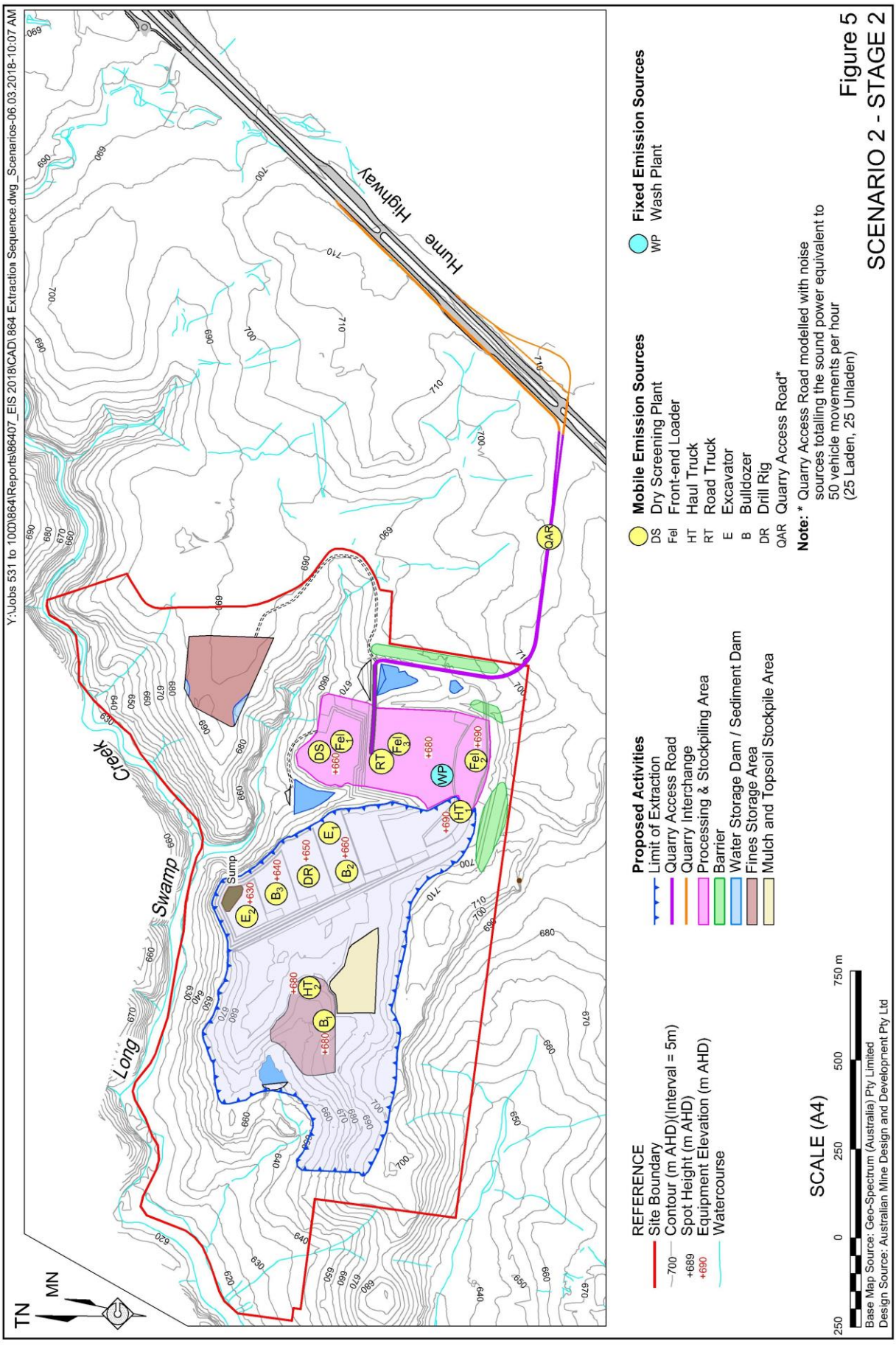


Figure 5
SCENARIO 2 - STAGE 2

SCENARIO 3: Annual Sales 860 000 tonnes[3] – see Figure 6

Extraction Stage 4

Processing Operations

Fixed Wash Plant (WP) operating at 685m AHD.

Two Dry Screening Plants (DS) Operating at 660m AHD in the processing and stockpiling area at and in the extraction area630m AHD.

Front-end Loader (FEL_2) (WA 500 or similar) moving sand stockpiles at 685m AHD.

Bulldozer (B_1) (Komatsu 475 or similar) pushing fines within Fines Storage Area 2 at 680m AHD.

Haul truck (HT_2) (Hitachi B50D or similar) laden hauling silt to Fines Storage Area 2 at 680m AHD.

Excavator (E_4) loading haul trucks with silt for backfilling extraction area at 675m AHD.

Extraction Operations

Bulldozer (B_2) (Komatsu 475 or similar) ripping and pushing scrapers at 630m AHD and 670m AHD, respectively.

Two Excavators (E_1 and E_2) loading haul trucks within extraction area at 645m AHD and 660m AHD respectively.

Two Front-end Loaders (FEL_4, and FEL_5) (WA 500 or similar) loading dry screen and haul trucks in extraction area at 630m AHD.

Haul Truck (HT_1) (Hitachi B50D or similar) on internal road to Primary Raw Feed Stockpile Area at 690m AHD.

Drill Rig (DR) operating at 650m AHD.

Product Loading and Despatch (assuming up to 50 movements in a 60 minute period on Quarry Access Road)

Front-end Loaders (FEL_1, FEL_3) (WA 500 or similar) loading trucks in processing area at 685m AHD.

Single road truck (RT) within the Quarry Operations Area at the weighbridge at 685m AHD.

Road truck movements along Quarry Access Road = 50/hr

[3] An estimated 1 million tonnes of friable sandstone would need to be extracted and processed to yield 860 000 tonnes of product.

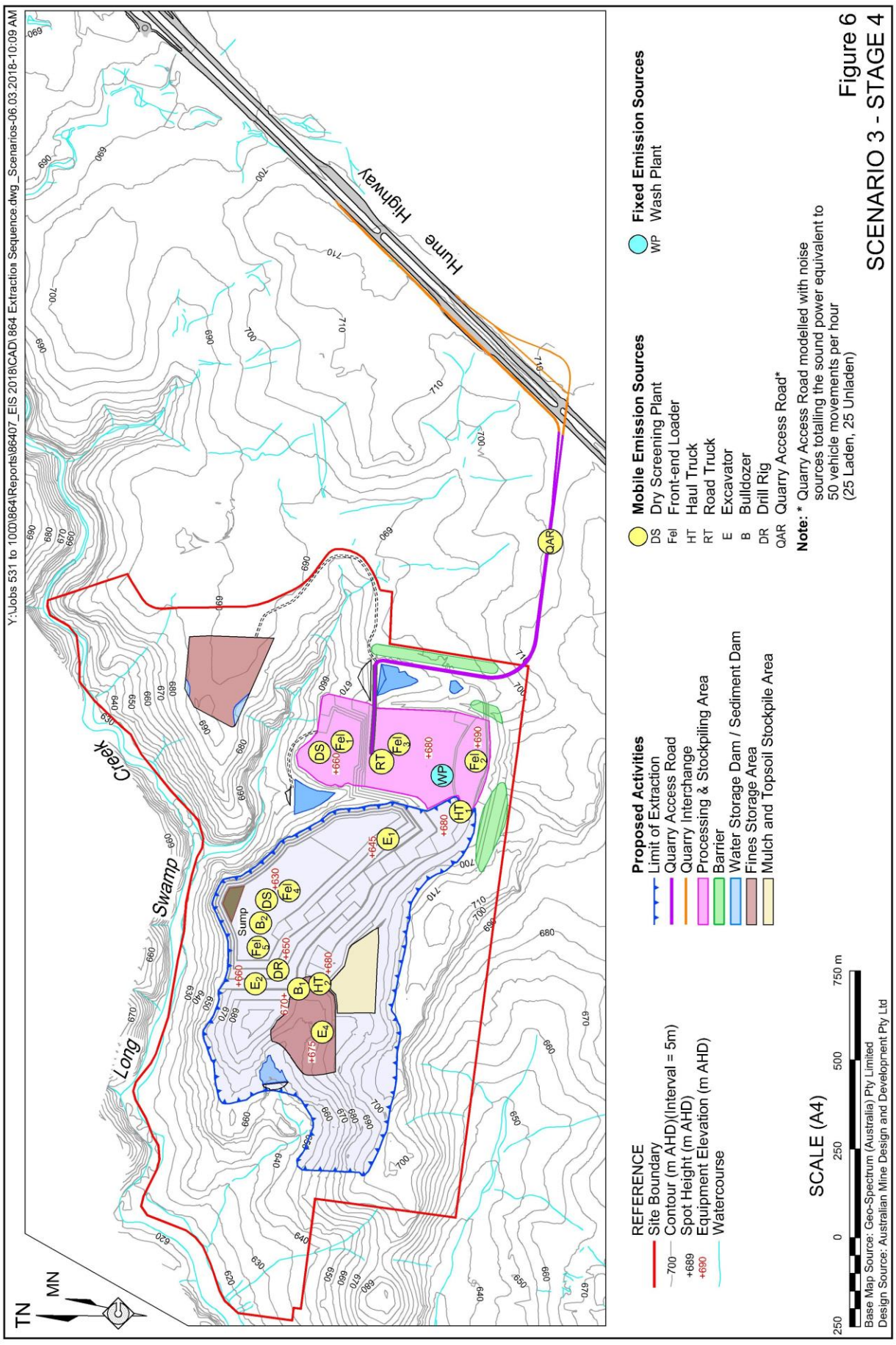


Figure 6
SCENARIO 3 - STAGE 4

4.2 NOISE SOURCES

The sound power levels of the equipment used in the modelling of each scenario are listed in **Table 11**.

Table 11
Noise Source Sound Power Levels

Equipment	Number			Use/Activity	Lw, dB(A)	
	500 ktpa	820 ktpa	1Mtpa		Leq	Lmax
Bulldozer (Komatsu 475 or similar)	1-2	2-4	3-4	Friable sandstone extraction (ripping/ pushing), site works (e.g. tree clearing).	113	121
Excavator 45t (PC 450 or similar)	1-2	2-3	3-4	Friable sandstone extraction and haul truck loading.	108	112
Haul truck 50t (Hitachi B50D or similar)	1-2	1-2	2-3	Raw material haulage to processing area.	108	113
Front-end loader (WA 500 or similar)	2-3	3-5	4-5	Haul truck and product truck loading.	106	109
Hydraulic Drill Rig (Atlas Copco ROC Series)	1	1	1	Drilling blast holes (typically for 3 – 4 days every one to two months).	110	112
Grader (Cat 140 M or similar)	1	1	1	Haul road construction. Hired for occasional use.	98	102
Water Truck (Minimum 12 000L)	1	1	1	Dust suppression activities.	108	113
Powerscreen Chieftain or similar	1	1-2	1-2	Brickie's sand production.	112	114
Front-end loader (Volvo L120 or similar)	1	1-2	1-2	Loading of brickie's sand plant.	106	109
B-double truck				Product transport	104	109
* Notes: All equipment would be periodically replaced/refurbished with better equipment of a similar capacity and noise rating. Leq value for B-doubles is calculated for 12.5 movements per 15 minutes.						
Source: Sutton Forest Quarries Pty Ltd						

4.3 MAXIMUM NOISE LEVELS

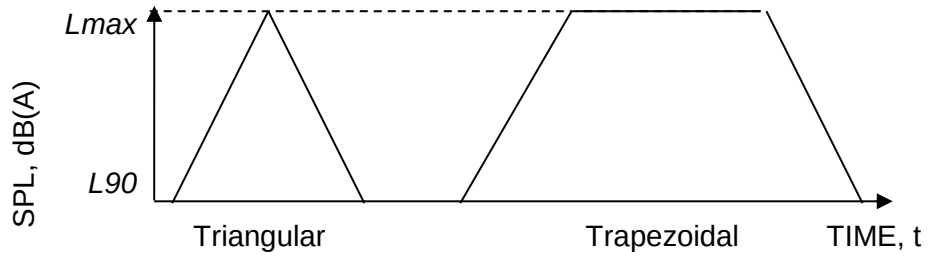
A potential for sleep disturbance would occur during operations between 10:00pm and 7:00am due to short-term high impact noises from the wash plant, front-end loader loading trucks and product trucks travelling on the Quarry Access Road. Sound power levels of modelled L_{Amax} noise sources are shown in **Table 11**. Impact noise was modelled using the ENM program under neutral conditions.

4.4 TRAFFIC NOISE

Additional traffic noise generated by the Proposal at residential receivers adjacent to the Hume Highway will be of a discrete rather than constant nature. There are many methods available for calculating the cumulative noise impact arising from discrete signals of various shapes. The methodology employed in this Section was sourced from the US Environmental Protection Agency document No. 550/9-74-004 *Information on Levels of Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, March 1974*.

The document refers to *triangular* and *trapezoidal* time signals, which are illustrated in **Figure 7**. A triangular time signal rises from the background level to a peak noise level and then immediately begins to subside. A triangular time signal is a good approximation of the Sound Pressure Level (SPL) signal of a truck as it passes an observation point. A trapezoidal time signal rises from the background level to a maximum level and sustains that level for a period of time before subsiding. The trapezoidal time signal is a good approximation of the SPL signal of a train as it passes an observation point.

Figure 7 Triangular and trapezoidal noise signals



The value of $L_{eq,T}$ for a series of identical triangular time patterns having a maximum level of L_{max} is given by **Equation 1**.

$$L_{eq},T = L_b + 10\log\left[1+\frac{ND}{T}\left(\frac{10^{(L\max - Lb)/10}-1}{2.3}-\frac{\left(L_{\max}-L_b\right)}{10}\right)\right] \quad (1)$$

Where

- L_b is background noise level, dB(A)
- L_{MAX} is vehicle noise, dB(A)
- T is the time for each group of vehicles (min)
- N is number of vehicle trips
- D is duration of noise of each vehicle (min)

For calculation purposes, L_{max} is the maximum vehicle noise at the assessment point(s), and has been based on numerous measurements of quarry truck pass-by noise taken by Spectrum Acoustics at receivers near other quarries in recent years. The background noise level is the level that existed prior to the introduction of the new noise, the L_{A90} level. The assessment period *T* corresponds to the stated criterion period, that is, 15 hours and 9 hours.

For the purposes of the road traffic noise assessment, it has been assumed the closest residence to the Hume Highway, at which the quarry-related truck noise is assessed, is the residence at “Black Horse Farm” at a distance of 30m from the highway.

4.5 BLASTING AND VIBRATION ASSESSMENT

4.5.1 Potential Blasting Impacts

The following subsections provide standard equations for predicting blast overpressure and ground vibration levels, sourced from the United States Bureau of Mines and supported by the NSW EPA.

Blast Overpressure

Unweighted airblast overpressure levels (OP) are predicted from **Equation 1** below.

$$OP = 165 - 24(\log_{10}(D) - 0.3 \log_{10}(Q)), dB \quad (1)$$

where D is distance from the blast to the assessment point (m) and
Q is the weight of explosive per delay (kg).

Blast Vibration

The basic equations for calculation of peak particle vibration (PPV) levels from blasting are as follows:

$$PPV = 1140\left(\frac{D}{Q^{0.5}}\right)^{-1.6}, \text{ mm/s (for average ground type)} \quad (2)$$

$$PPV = 500\left(\frac{D}{Q^{0.5}}\right)^{-1.6}, \text{ mm/s (for hard rock)} \quad (3)$$

where D and Q are defined as in Equation 1. Equation 3 has been adopted to provide a conservative assessment as no specific site law has been established through trial blasting.

4.5.2 Road Traffic Vibration

The effect of vibration on humans and structures is normally considered and evaluated in terms of annoyance and structural damage. Annoyance criteria are significantly lower than structural damage criteria and will be adopted for the assessment of potential vibration impacts on the nearest residential receiver from project-related heavy vehicle movements. Trucks will pass by R15 at a distance of approximately 85m from the centre of the road lane to the building facade.

The EPA's *Assessing Vibration: a technical guideline* (AVTG, 2006) recommends goals for assessing human response and potential disturbance to the occupants of buildings. **Table 12** presents a summary of levels (root mean square, rms) relevant to third-octave frequency band adjusted by multiplying factors (in brackets) for residential receptors referenced to human response (BS 6472-1992, Figure B1.4).

Table 12
Vibration Levels for Assessment of Human Comfort

Frequency (Hz)	Vibration level, mm/s			
	Continuous Vibration		Intermittent Vibration	
	Day (2)	Night (1.4)	Day (60)	Night (20)
1	3.2	2.2	95	31
1.25	2.3	1.6	68	22
1.6	1.6	1.1	47	15
2	1.1	0.8	33	11
2.5	0.8	0.6	24	8.0
3.15	0.6	0.4	17	5.8
4	0.4	0.3	19	4.0
5	0.3	0.2	9.5	3.2
6.6	0.3	0.2	7.6	2.5
8	0.2	0.1	6.0	2.0
10	0.2	0.1	6.0	2.0
12.5	0.2	0.1	6.0	2.0
16	0.2	0.1	6.0	2.0
20	0.2	0.1	6.0	2.0
25	0.2	0.1	6.0	2.0
31.5	0.2	0.1	6.0	2.0
40	0.2	0.1	6.0	2.0
50	0.2	0.1	6.0	2.0
63	0.2	0.1	6.0	2.0
80	0.2	0.1	6.0	2.0

Table 2.1 of AVTG (2006) defines passing heavy vehicles as an intermittent source, so the night time values in **Table 12** for intermittent vibration will be adopted as a worst case for product transport in **Table 6**. For a comparison of vibration levels in terms of human response, **Table 13** presents a summary of vibration levels and likely perception.

Table 13
Human Perception of Vibration

Vibration Levels, mm/s	Likely Perception
0.15	Perception threshold
0.35	Barely noticeable
1.0	Noticeable
2.2	Easily noticeable
6.0	Strongly noticeable
14.0	Very strongly noticeable
Ref: German Standard DIN 4150 (1986)	

5. MANAGEMENT AND MITIGATION MEASURES

5.1 INTRODUCTION

The principal mechanism for management of noise and blasting at the Site would be the preparation and implementation of a Noise and Vibration Management Plan. The plan would incorporate the following components and be prepared in consultation with DPE.

- Details of noise mitigation measures and strategies.
- A noise monitoring program (see Section 6).
- Protocols for incident identification and notification.
- Protocols for management of noise complaints.
- Blast monitoring protocols.
- Blast notification protocols for those residences within 2km of the extraction area.

In addition, noise and blast-related sensitivities and expectations would be incorporated in site-specific inductions for all site personnel and contractors.

5.2 NOISE

Noise mitigation measures incorporated into the design of the Proposal include the construction of the following acoustic barriers.

- The southern barrier would infill a saddle in the natural ridge line southwest of the processing plant to reduce noise propagated from the plant in that direction.
- The eastern barrier would be positioned east of the primary raw feed stockpile area to reduce noise propagated to the east from the trucks and/or front-end loader operating in this area.
- The northeastern barrier would be positioned immediately adjacent to the north-south section of the Quarry Access Road principally to reduce noise from product trucks travelling on the road and from the activities within the processing and stockpiling area. This barrier would be up to 10m above the road level and comprise an earthen base with a fence to the required height.
- Two roadside acoustic barriers at least 250m long with a maximum height of 3.8m above road level would be constructed adjacent to the Quarry Access Road to the north of Residence 15 and to the south of Residence 1 as shown in **Figure 8**.

Any acoustic barrier for vehicle noise mitigation purposes requires a mass of at least 15kg/m^2. The barrier must make contact with the ground and have no significant cracks or gaps. Suitable materials included marine ply (hoarding), 9mm compressed fibre cement, any form of masonry, Hebel panels or lapped and capped 19mm timber palings that are overlapped by at least 25% of the paling width, on each side.

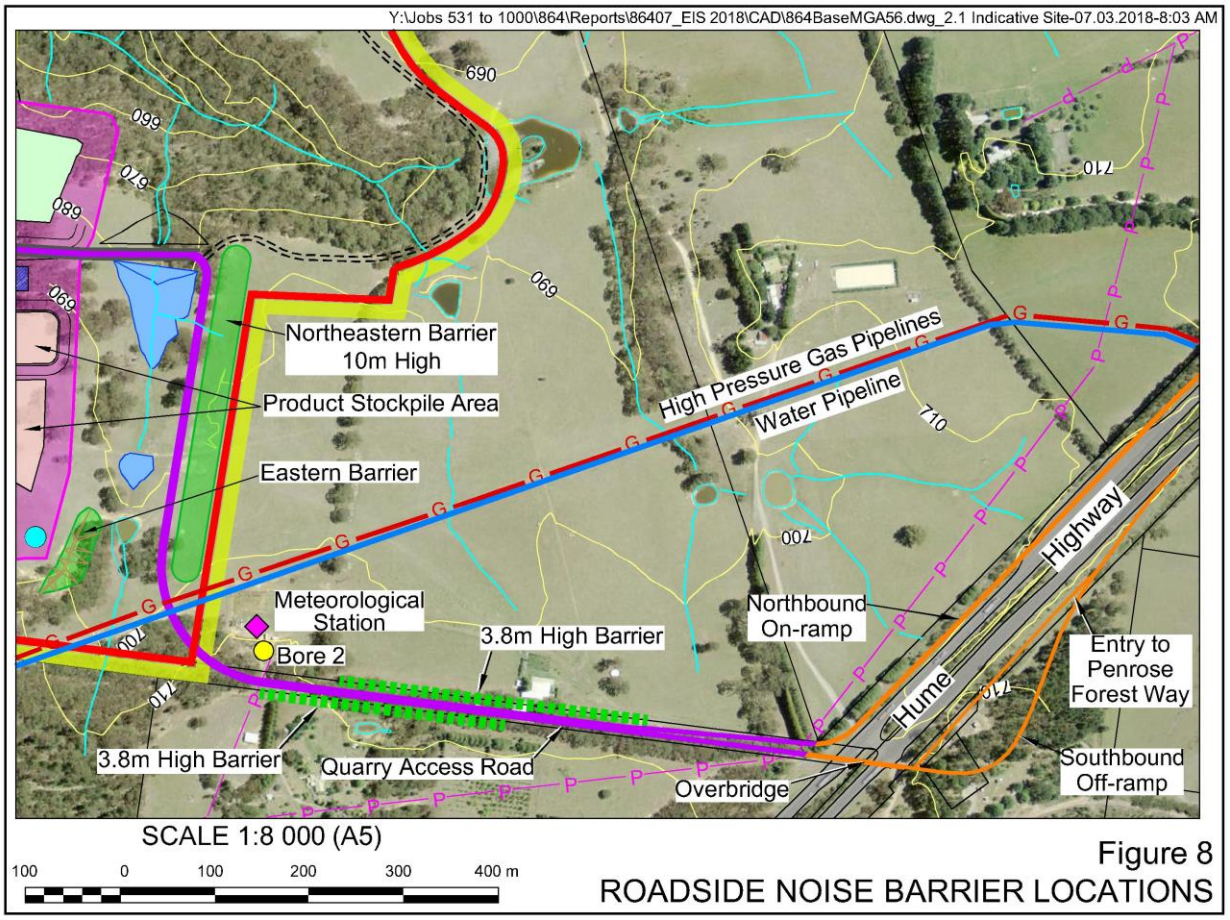


Figure 8
ROADSIDE NOISE BARRIER LOCATIONS

Operational Safeguards

- All hours of operation presented in **Table 1** would be adhered to.
- The Quarry Access Road would be sealed to the weighbridge.
- The internal unsealed road network would be graded, as required, to limit or avoid body noise from empty trucks.
- Noisy mobile plant operating simultaneously close together would be avoided, wherever possible.
- The Quarry Access Road will be constructed with suitable application of cut and fill to produce a relatively consistent surface and elevation which would limit the need for compression braking.
- Truck speeds on the Quarry Access Road would be limited to 70km/hr and truck speeds on internal roads limited to 40km/hr.
- Maintenance work on all plant and equipment would be carried out away from noise sensitive areas and confined to standard daytime operational hours when practicable. Any inaudible maintenance could be undertaken beyond the daytime hours.

5.3 BLASTING

Blasting is expected to occur no more than 12 times per year.

The Applicant would control the adverse effects of blasting within the extraction area principally through the design of each blast. The approach to the design of each blast and the design variables would be reviewed by the blast contractor following each blast with a focus upon minimising both airblast overpressure and ground vibration, within practical and operational constraints.

The Applicant would adopt the following measures to complement the blast design-related safeguards for blasting.

- Any blasting that occurs on site would be limited to the period between 9:00am to 5:00pm Monday to Saturday and would not occur on Sundays or public holidays. No blasting would occur on any Fatima Day celebrated at “Penrose Park”.
- A notification protocol for blasting impacts would be prepared for all the occupants of residences within 2km of the extraction area and for the Pauline Fathers regarding use of the outdoor shrines at “Penrose Park”. Residents would be consulted to establish their preferred method for notification (i.e. letterbox drop, SMS, email or phone call).
- No blasting would occur within 0.5km of the Grotto within “Penrose Park”.
- Blasting would take place no more than once per week.
- Blast design and impacts would be monitored during each blast to ensure that blast characteristics are not resulting in overpressure or vibration levels that are not consistent with the nominated criteria.

There would be no need for any specific management or mitigation measures to protect the gas and water pipelines located to the south of the extraction area other than at the location where the Quarry Access Road crosses the easement. No other public infrastructure is located within the vicinity that requires protection.

6. RESULTS AND DISCUSSION

6.1 PREDICTED OPERATIONAL NOISE LEVELS

Noise levels were modelled using Renzo Tonin Associates (RTA) *Environmental Noise Model* v3.06 (ENM) software. Point to point calculations were performed for all assessed receivers listed in **Table 2**.

Predicted noise levels for the three modelled scenarios are summarised in **Tables 14** to **16**. Criteria are taken from **Table 7** and represents the worst case scenario period (night time) assuming that compliance during this period indicates compliance during the day time and evening periods.

Noise contours for the worst case modelled scenarios of inversion and West wind conditions are shown in **Figures 9** to **14.**

Table 14
Predicted noise levels, dB(A),$L_{eq(15min)}$ Scenario 1

Receiver*	Noise trigger levels			Meteorological condition			
	Day	Evening	Night	Neutral	Inversion	SE wind	W wind
R2	43	43	39	34	37	34	37
R4	52	52	42	28	35	26	33
R5	52	52	42	24	32	22	29
R8	43	43	39	22	30	20	28
R11	43	43	39	21	29	<20	28
R12	43	43	39	24	31	21	30
R13	43	43	39	24	30	20	30
R15	43	43	41	38	40	37	39
R16	41	41	37	24	31	22	24
R17 (Grotto)	40	40	40	32	35	33	33
R17A	41	41	37	24	26	23	23
R17B	41	41	37	25	28	25	23
R18	41	41	37	21	26	22	21
R19	41	41	37	20	25	20	20
R20	41	41	37	<20	20	<20	<20
R21	41	41	37	22	26	23	20
R22	41	41	37	<20	21	<20	<20
R23	41	41	37	<20	<20	<20	<20
R24	41	41	37	<20	<20	<20	<20
R25	41	41	37	<20	<20	<20	<20
R26	41	41	37	<20	<20	<20	<20
R27	40	35	35	<20	20	<20	<20
R28A	40	35	35	<20	26	26	<20
R28B	40	35	35	<20	26	26	<20
R28C	40	35	35	<20	26	26	<20
R30	40	35	35	22	27	27	21
R31	40	35	35	22	28	29	20
R33	40	35	35	21	31	30	21
R35	40	35	35	21	30	30	21

* See Figure 8.

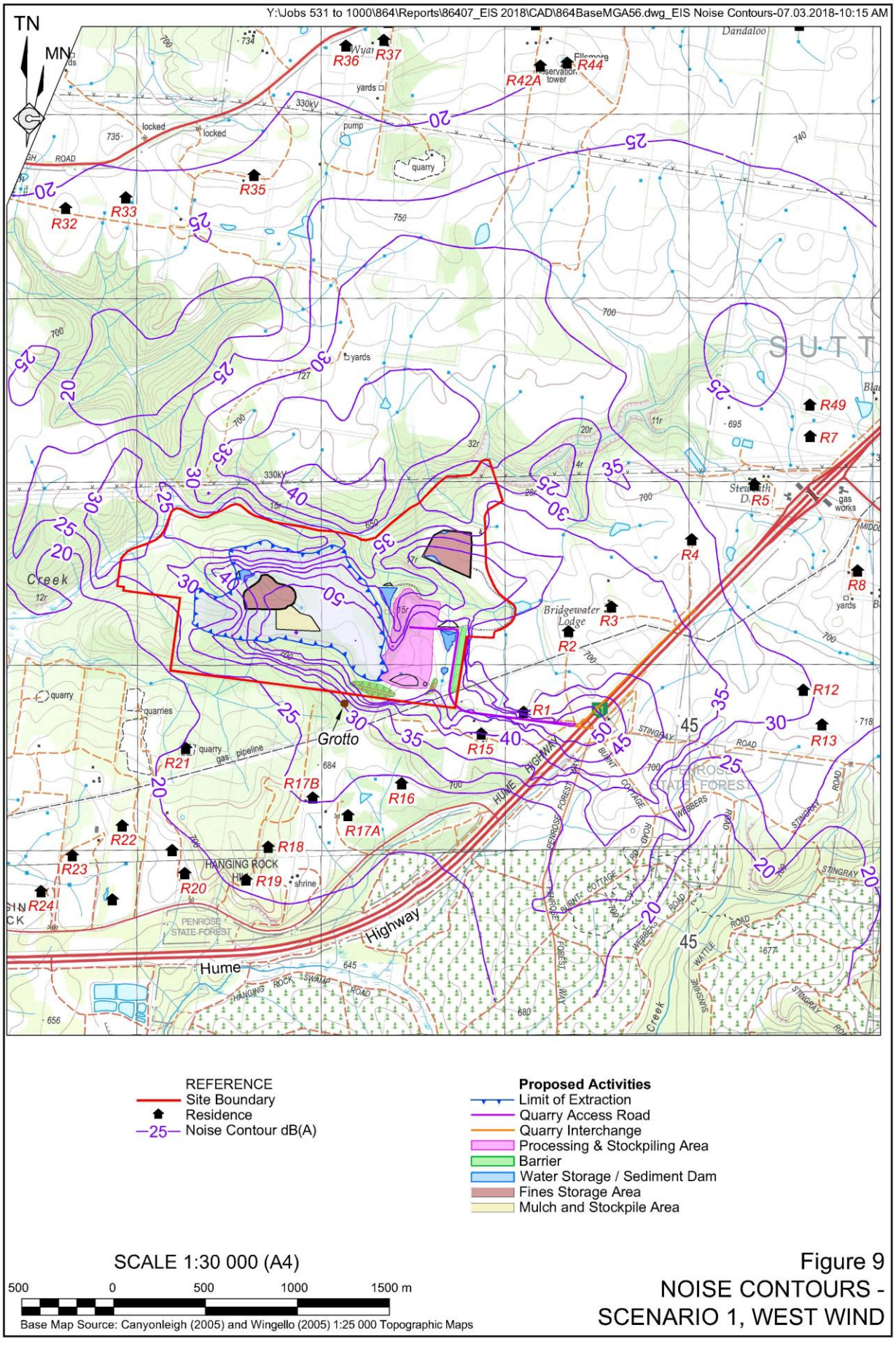


Figure 9
NOISE CONTOURS -
SCENARIO 1, WEST WIND

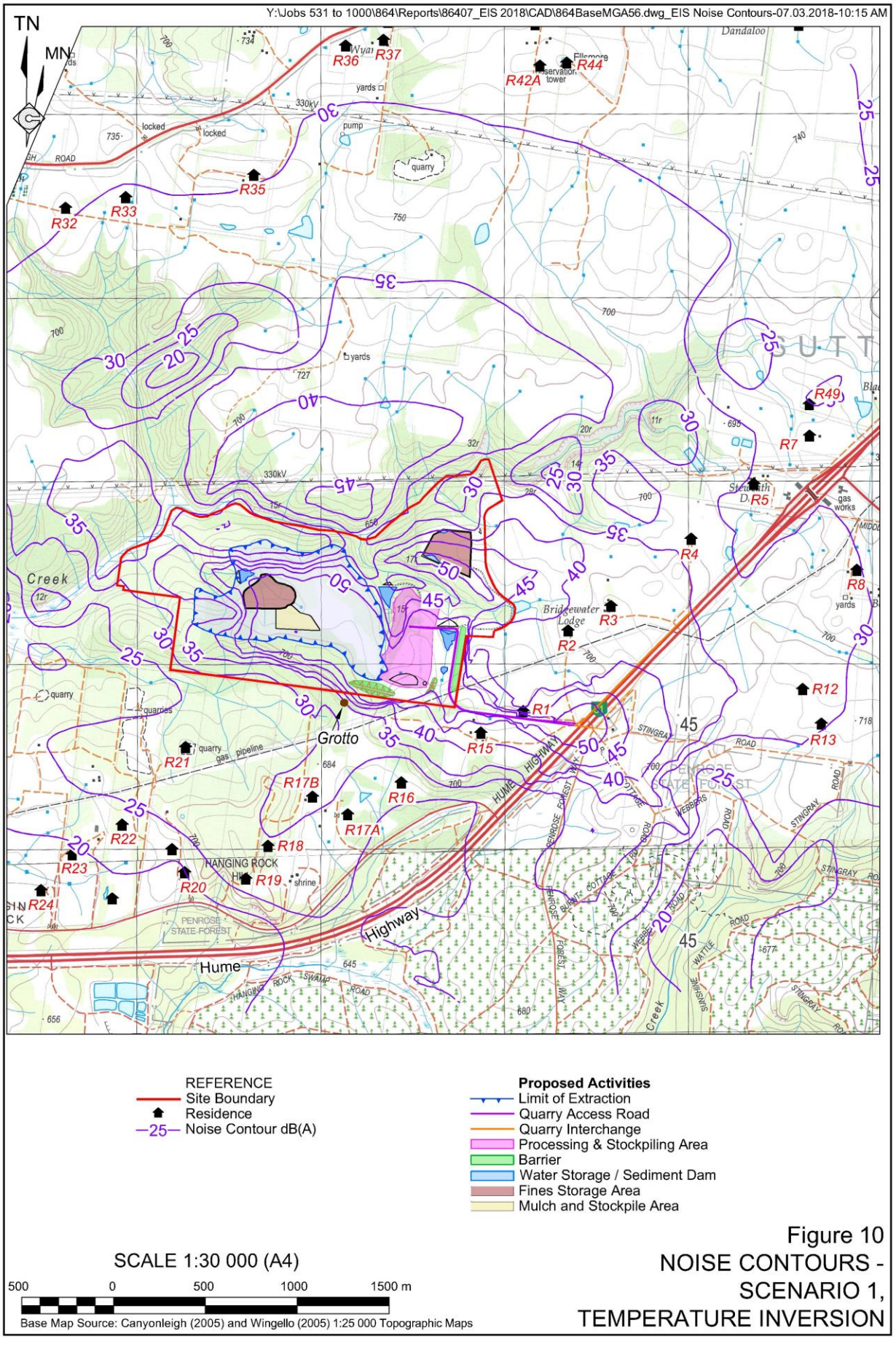


Figure 10
NOISE CONTOURS - SCENARIO 1, TEMPERATURE INVERSION

Table 15
Predicted noise levels, dB(A), $L_{eq(15min)}$ Scenario 2

Receiver*	Noise trigger levels			Meteorological condition			
	Day	Evening	Night	Neutral	Inversion	SE wind	W wind
R2	43	43	39	36	38	35	39
R4	52	52	42	30	35	29	35
R5	52	52	42	25	31	24	30
R8	43	43	39	22	30	21	30
R11	43	43	39	21	29	20	29
R12	43	43	39	25	30	23	30
R13	43	43	39	25	30	23	30
R15	43	43	41	40	38	39	40
R16	41	41	37	25	26	25	25
R17 (Grotto)	40	40	40	30	32	32	30
R17A	41	41	37	24	26	24	24
R17B	41	41	37	25	27	25	25
R18	41	41	37	22	26	23	21
R19	41	41	37	20	25	21	20
R20	41	41	37	<20	20	<20	<20
R21	41	41	37	22	21	25	21
R22	41	41	37	<20	20	20	<20
R23	41	41	37	<20	<20	<20	<20
R24	41	41	37	<20	<20	<20	<20
R25	41	41	37	<20	<20	<20	<20
R26	41	41	37	<20	<20	<20	<20
R27	40	35	35	<20	20	20	<20
R28A	40	35	35	<20	25	26	<20
R28B	40	35	35	20	26	28	<20
R28C	40	35	35	20	26	28	<20
R30	40	35	35	23	29	30	22
R31	40	35	35	22	29	30	21
R33	40	35	35	24	31	33	23
R35	40	35	35	25	30	31	24

* See Figure 8.

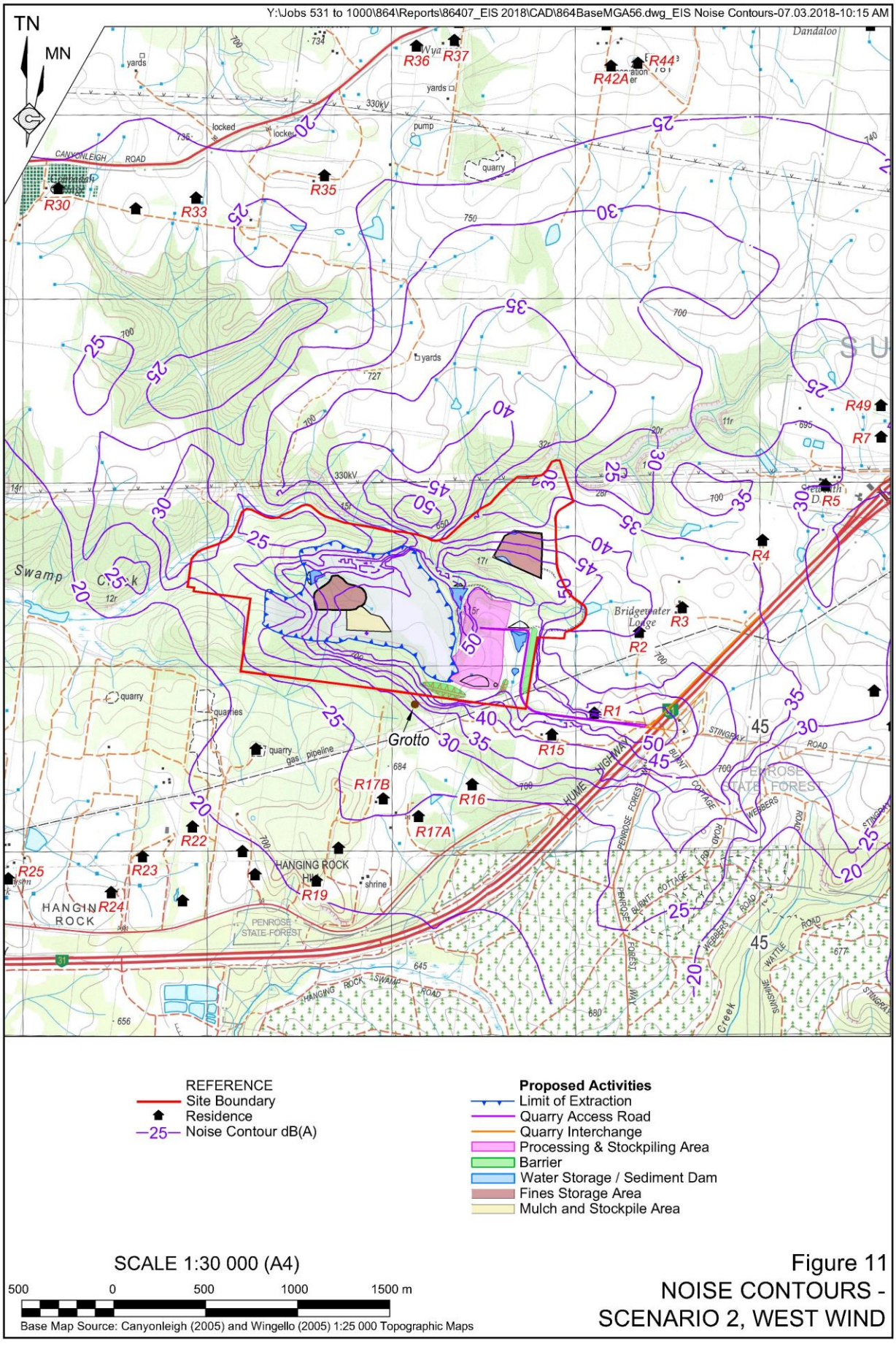


Figure 11
NOISE CONTOURS -
SCENARIO 2, WEST WIND

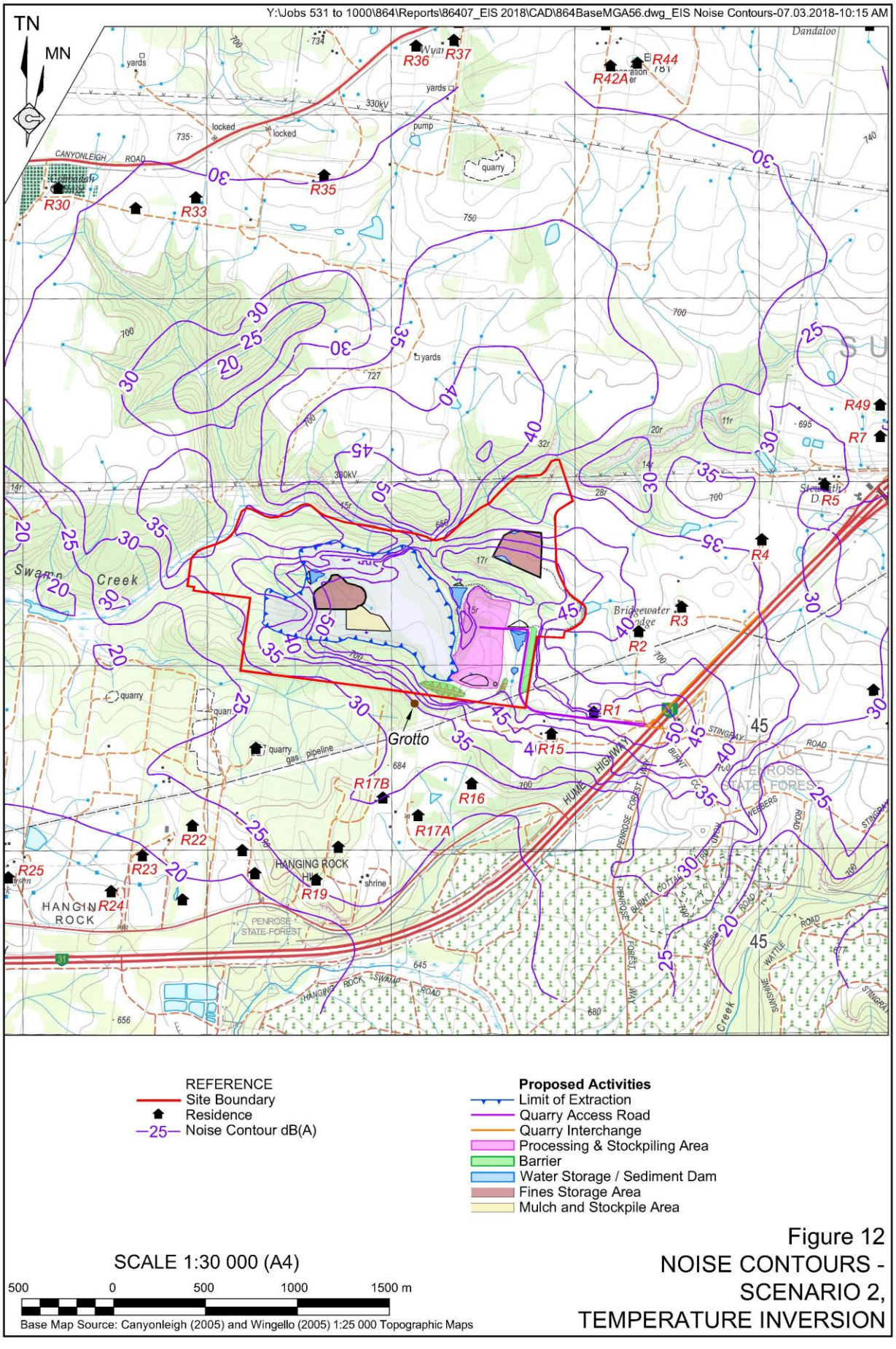


Figure 12
NOISE CONTOURS - SCENARIO 2, TEMPERATURE INVERSION

Table 16
Predicted noise levels, dB(A), $L_{eq(15min)}$ Scenario 3

Receiver*	Noise trigger levels			Meteorological condition			
	Day	Evening	Night	Neutral	Inversion	SE wind	W wind
R2	43	43	39	35	39	34	39
R4	52	52	42	30	36	26	36
R5	52	52	42	25	31	23	34
R8	43	43	39	22	29	20	31
R11	43	43	39	21	28	<20	30
R12	43	43	39	24	30	20	32
R13	43	43	39	24	30	20	31
R15	43	43	41	40	38	39	40
R16	41	41	37	25	26	23	25
R17 (Grotto)	40	40	40	29	34	32	33
R17A	41	41	37	24	26	23	24
R17B	41	41	37	25	27	25	25
R18	41	41	37	22	26	24	21
R19	41	41	37	20	25	21	20
R20	41	41	37	<20	20	<20	<20
R21	41	41	37	22	21	26	21
R22	41	41	37	<20	20	20	<20
R23	41	41	37	<20	<20	<20	<20
R24	41	41	37	<20	<20	<20	<20
R25	41	41	37	<20	<20	<20	<20
R26	41	41	37	<20	<20	<20	<20
R27	40	35	35	<20	20	21	<20
R28A	40	35	35	<20	25	29	<20
R28B	40	35	35	20	26	28	<20
R28C	40	35	35	20	26	28	<20
R30	40	35	35	23	28	30	21
R31	40	35	35	22	29	31	20
R33	40	35	35	23	31	32	21
R35	40	35	35	22	30	31	21

* See Figure 8.

The results in **Tables 14** to **16** predict noise levels equal to or below the project noise trigger levels for all assessed receivers during all time periods under all assessed conditions.

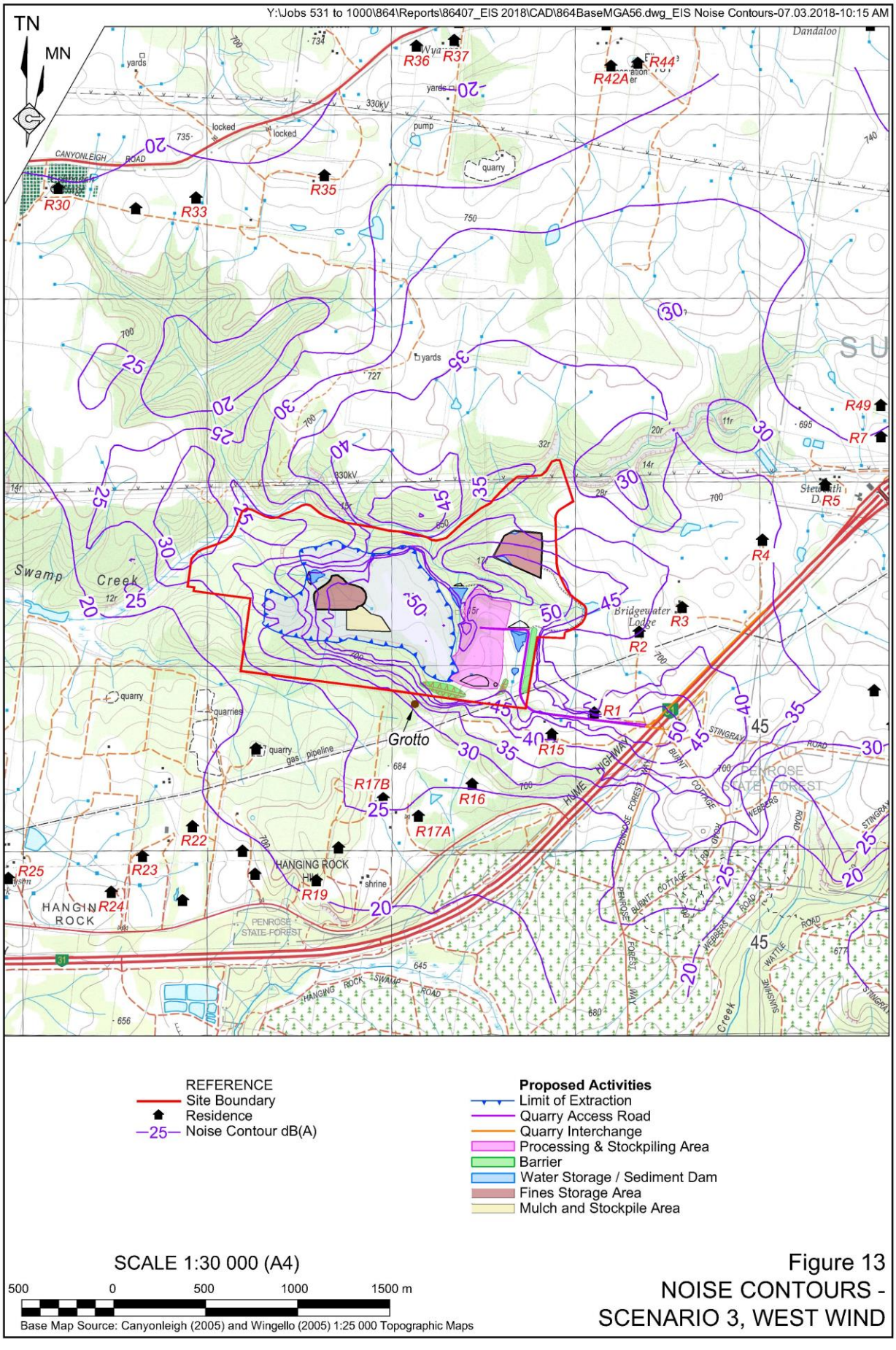


Figure 13
NOISE CONTOURS -
SCENARIO 3, WEST WIND

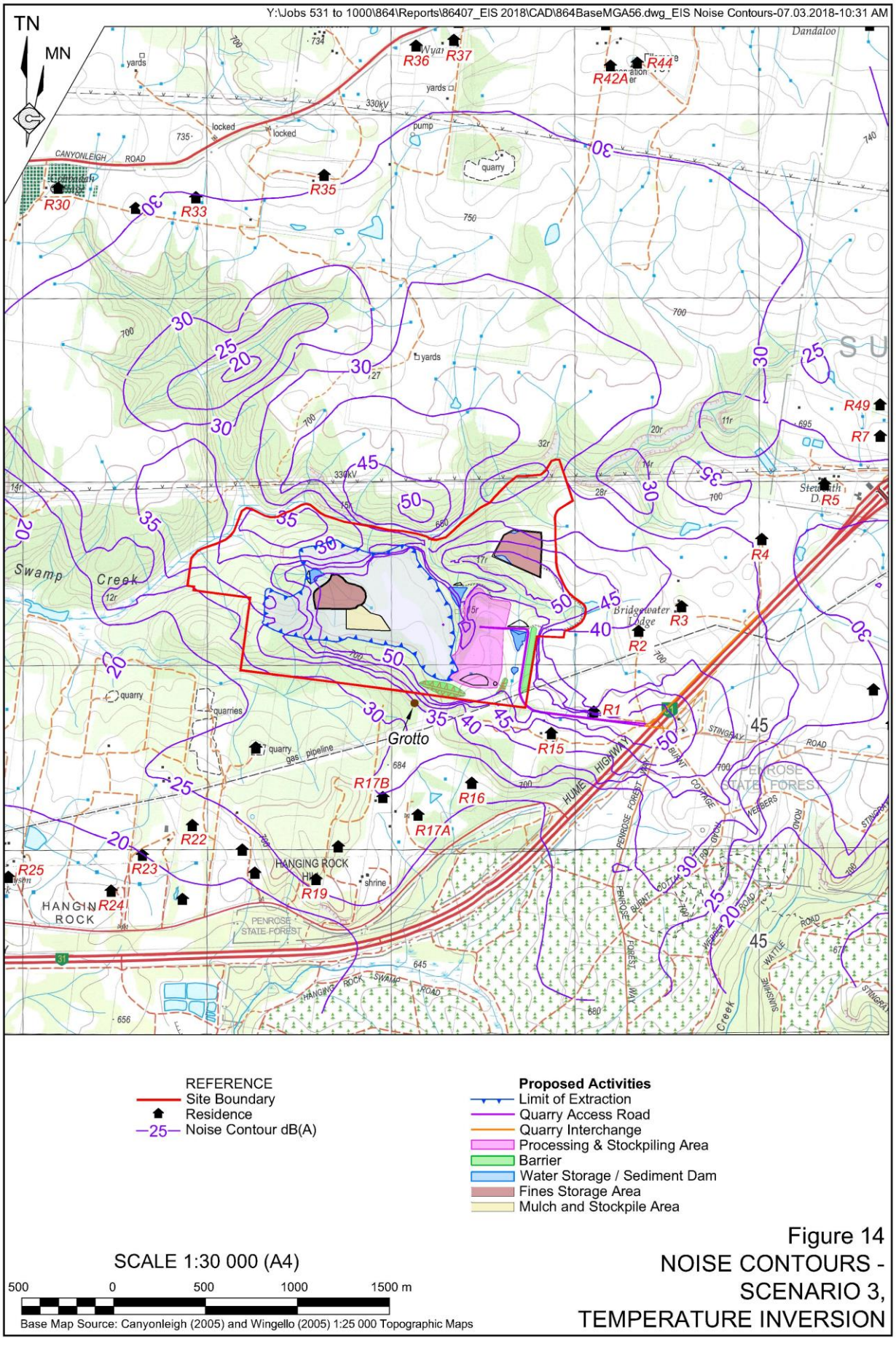


Figure 14
NOISE CONTOURS - SCENARIO 3, TEMPERATURE INVERSION

6.2 VOLUNTARY LAND ACQUISITION AND MITIGATION POLICY CONSIDERATIONS

There are five (5) different levels of noise impact and recommended actions in the NSW Government's *Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extraction Industry Development* (VLAMP). These impact levels are shown in **Table 17**.

Table 17
VLAMP Noise Categories and Recommended Actions

Noise Category	Project Noise Levels	Recommended action
1. Negligible	0-2 dB(A) above PNTL	Not a discernible noise impact – no action required
2. Marginal	3-5 dB(A) above PNTL and project contributes less than 1 dB at residence	Mechanical ventilation and air conditioning
3. Moderate	3-5 dB(A) above PNTL and project contributes more than 1 dB at residence	Mechanical ventilation, air conditioning and facade upgrade
4. Significant	More than 5 dB(A) above PSNL at residence	Mechanical ventilation, air conditioning and facade upgrade or property acquisition
5. Significant	More than 5 dB(A) above amenity limit over 25% of land area	Property acquisition

The project noise trigger levels (PNTLs) would not be exceeded at any assessed receiver. The night time amenity limit at Receiver 2 is 40 dB(A),Leq(night) considering this a rural or suburban receiver in accordance with Table 2.2 of the NPI and associated notes. The operational noise emission calculation in this assessment LAeq(15minute) values and the NPI recommended a +3 dB correction from the amenity level to give LAeq(15minute) levels. The night time amenity limit therefore corresponds to 43 dB(A),Leq(15minute).

The VLAMP Noise Category 5 would be applicable at Receiver 2 if a level of 48 dB(A),Leq(15minute) was exceeded over 25% or more of the land area. Reference to the worst case noise contours for this receiver in **Figure 14** confirms that the 45 dB(A) contour does enclose a small area of the property to the north of the residence, but there is no part of the property that is impacts by a level of 48 dB(A). The provisions of the VLAMP are therefore not applicable and there are no noise mitigation requirements.

6.3 OFF-SITE ROAD TRAFFIC NOISE

Based on the maximum annual product despatch rate of 860 000t, the Proposal would generate up to 50 movements per hour.

Product despatch is proposed to occur on a 24 hour basis and the most stringent traffic noise criterion is 55 dB(A),Leq(9hour). Based on a speed of 110 km/h and in the absence of noise barriers, it has been calculated that the criterion would be achieved at distances greater than 30m from the road. All residences within the noise study area are at distances greater than 250m from the Hume Highway and compliance with the RNP traffic noise criterion would be achieved. Outside the noise study area there is a property called "Black Horse Farm" with a residence 30m from the Hume Highway. The predicted traffic noise level does not exceed the

traffic noise criterion at this receiver. Roads and Maritime Services (RMS) traffic count stations at nearby locations on the Hume Highway indicate approximately 240 heavy vehicles per hour pass the Site, compared to a maximum of 50 heavy vehicles per hour from the Proposal. The calculated increase in traffic noise level from the Proposal is less than 1 dB which is less than the allowable 2 dB increase under the NSW RNP for which mitigation is not required.

6.4 MAXIMUM NOISE LEVELS

Predicted maximum noise levels based on L_{max} values in **Table 11**, as modelled using the ENM software, are shown in **Table 18**. Values represent the worst case over all modelled scenarios when night time activities would occur.

Table 18
Predicted Maximum Noise Levels, dB(A),L_{max}

Receiver*	Meteorological condition				Criteria
	Neutral	Inversion	SE wind	W wind	
R2	39	42	38	43	52
R4	34	<40	<40	<40	56
R5	<30	<40	<40	<40	56
R8	<30	<35	<30	<35	52
R11	<30	<35	<30	<35	52
R12	<30	<35	<30	<35	52
R13	<30	<35	<30	<35	52
R15	47	46	45	46	52
R16	30	33	32	<30	52
R17A	<30	<35	<35	<30	52
R17B	<30	<35	<35	<30	52
R19	<30	<30	<30	<30	52
R22	<30	<30	<30	<30	52
R23	<30	<30	<30	<30	52
R24	<30	<30	<30	<30	52
R25	<30	<30	<30	<30	52
R26	<30	<30	<30	<30	52
R27	<30	<30	<30	<30	52
R28A	<30	<35	<35	<30	52
R28B	<30	<35	<35	<30	52
R28C	<30	<35	<35	<30	52
R30	<30	<35	<35	<30	52
R31	<30	<35	<35	<30	52
R33	<30	<35	<35	<30	52
R35	<30	<35	<35	<30	52
* See Figure 10					

Predicted maximum noise levels in **Table 18** are well below the maximum noise level criteria at all receivers. Therefore, a detailed maximum noise level assessment is not required. It is a feature of extractive industries that the LAmax levels from individual sources exceed the LAeq levels, as indicated in **Table 11**. The LAeq emission is, however, the geometric sum of all the noise sources, whereas impact and Lmax events are generally of short duration and are not

cumulative. Individual LAmax events may be generally audible but not at levels that significantly exceed the LAeq noise emissions from the Site. The exceptions in the current study are Receivers 15, and to a lesser extent Receivers 2 and 16, where the dominant source is the passage of heavy vehicles on the Quarry Access Road and noise level fluctuate accordingly.

6.5 BLASTING AND VIBRATION ASSESSMENT

6.5.1 Blasting Impacts

Predicted blast overpressure and ground vibration levels at the representative residential and non-residential receivers are shown in **Table 19**. Calculations are based on charge weights (Maximum Instantaneous Charge weight, MIC) of a nominal 50 kg and a likely maximum value of 200 kg for a 10m bench height.

Table 19
Predicted Blast Impacts

Receiver	Distance (m)[a]	Criterion		MIC = 50 kg		MIC = 200 kg	
		PPV[b]	OP[c]	PPV	OP	PPV	OP
R33	2000	5	115	0.1	96	0.2	99
R17B	720	5	115	0.3	107	1.0	110
R2	585	5	115	0.4	109	1.2	111
R17 (Grotto) nearest point	500	25	115	0.6	110	1.4	112
R17 (Grotto) furthest point	800	25	115	0.2	106	0.9	109
Rock shelter	100	50	--	7.2	--	21.9	--
Gas/water pipelines	250	20	--	1.7	--	5.0	--

[a] Distance from receiver to closest point of extraction area.
[b] Peak vertical ground vibration, mm/s.
[c] Blast overpressure, dB.

The results in **Table 19** confirm that blast vibration and overpressure levels will be well below the criteria at the most impacted residential receivers. In areas of softer material, the sandstone would be ripped by dozer rather than being blasted. Ground vibration levels from ripping would be significantly lower than vibration levels from blasting.

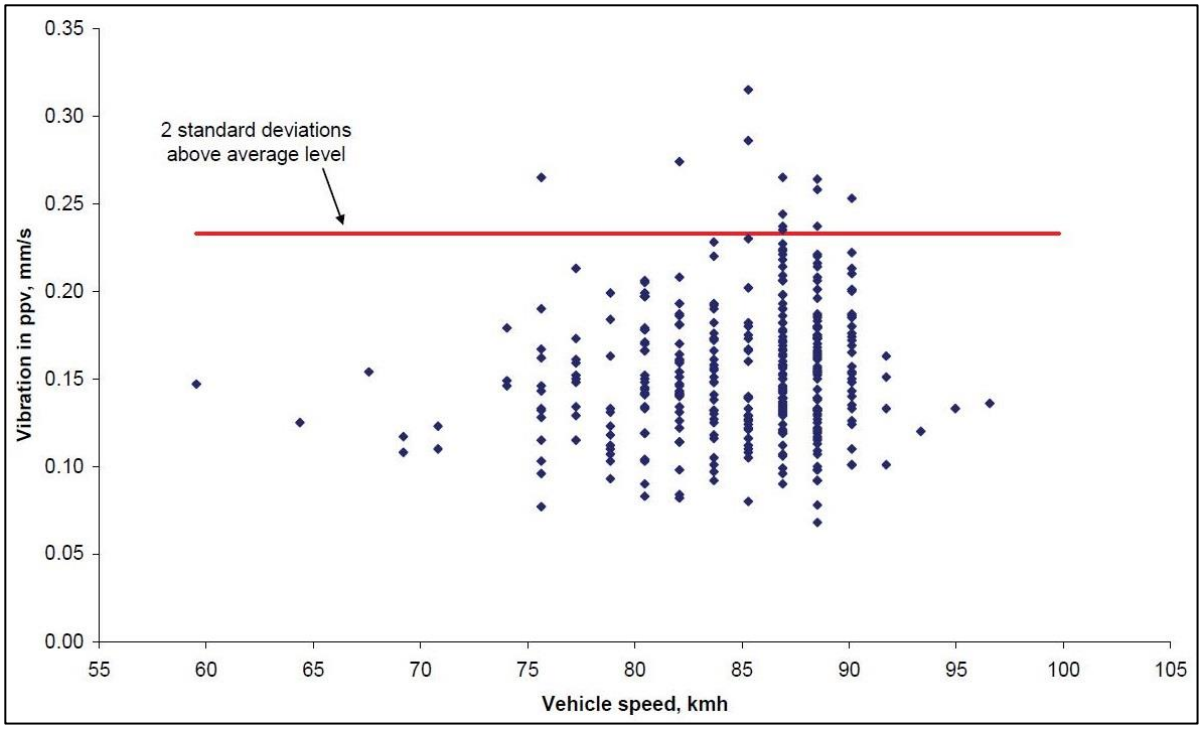
Ground vibration levels from blasting are predicted to be well below the criterion for all assessed receivers including the Aboriginal rock shelter site (54-4-0323), outdoor shrines at “Penrose Park” and the gas and water pipelines assessed for realistic charge weights. Overpressure levels are predicted to be below the human comfort criterion at the Grotto where blasting occurs at the nearest point 500m from the Grotto. It is noted that blasting would not occur for at least five years after project commencement. The Applicant would maintain communication with the Pauline Fathers to ensure that all planned blasting events within the Site are discussed prior to final planning for each blast.

6.5.2 Vehicle Vibration

Noise and vibration measurements of a large number of passing vehicles were conducted in 2008 by G R Watts and R E Stait (TRL Limited, UK) with results documented in a report titled "Characteristics of vehicles producing excessive noise and ground-borne vibration – Phase 1". **Figure 15** is a reproduction of Watts and Stait's Figure 3.15. The vibration sensor was at a distance of 8m from the centre of the traffic lane and a site was chosen where there was a defect in the road, in the form of a crack perpendicular to the direction of travel.

Watts and Stait found that there was little variation in vibration levels with vehicle speed and that the 95th percentile (2 standard deviations) level was approximately 0.23 mm/s. Even considering that the road had a defect in it, the recorded levels were approximately one tenth of the minimum human comfort criterion in **Table 11** for intermittent events during night time. The levels are also well below the "barely noticeable" perception level in **Table 12.** It is therefore considered that there would be negligible potential vibration impacts at the nearest receiver to the Quarry Access Road (Residence 15).

Figure 15 Maximum peak particle velocity for Category 3 (heavy vehicles) (from Watts and Stait, 2008)



6.6 CUMULATIVE IMPACTS

The Proposal has potential to cumulatively impact on receivers southwest of the Site with noise from the Penrose Sand Quarry and Green Valley Sand Quarry, both of which are south of the Hume Highway. Receivers 26 and 24 have the greatest potential to be cumulatively impacted with respect to noise emission from the three quarries.

Worst case impacts are expected under neutral conditions when noise from all three quarries may be received at these receivers. Prevailing winds, although not required to be considered in this assessment, are such that they would reduce noise levels from one or more of the three quarries.

Based on the results in this assessment and the cumulative impact assessment conducted for the Green Valley Sand Quarry project by Spectrum Acoustics, **Table 20** shows cumulative noise impacts at the two nominated receivers.

Table 20
Cumulative Noise Impacts, dB(A),$L_{eq(15minute)}$

Receiver	Contributing Quarry			Total
	Green Valley	Penrose	Sutton Forest	
R26	21	35	<20	35
R24	<20	35	<20	35

Both EPA and DPE prefer cumulative industrial noise levels to be below an 'amenity' criterion of 40 dB(A),$L_{eq(period)}$ during the night time at rural residences. **Table 20** demonstrates that cumulative levels are well below this level at the potentially worst impacted receivers.

7. MONITORING

7.1 NOISE

It is recommended that noise monitoring should be conducted on a quarterly basis for at least the first two years of operation, commencing from initial site establishment works, to determine compliance with the noise criteria and to inform any further noise mitigation works, should the need arise. Monitoring locations would include the "Penrose Park" property and residential receivers R2 and R15 to monitor operational noise from extraction and processing activities and heavy vehicles on the Quarry Access Road.

7.2 BLASTING

Each blast event would be monitored at the Grotto and other location(s) as may be required by the EPA with monitoring protocols established in an approved Blast Management Plan.

8. SUMMARY

A noise and vibration impact assessment of the proposed construction and operation of the Sutton Forest Sand Quarry has been conducted. The study has found the following.

- Operations would comply with the project noise trigger levels at all residences given a range of design and operational noise control measures.
- No exceedance of off-site traffic noise criteria at any receiver.
- No exceedance of cumulative noise criteria at any receiver.
- No exceedance of ground vibration criteria at the assessed locations.
- Overpressure levels are predicted to be below the human comfort criterion at the Grotto when blasting occurs at the nearest point 500m from the Grotto. The Applicant would maintain communication with the Pauline Fathers to ensure that all planned blasting events within the Site are discussed prior to final planning for each blast.

We therefore advise that the Proposal can operate within the EPA project noise trigger levels at all receivers, with the modelled noise barriers in place, and recommend approval of the Proposal, as far as acoustic issues are concerned.

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Appendices

(Total No. of pages including blank pages = 26)

Appendix 1 Coverage of Director-General's Requirements

Appendix 2* Noise Logger Data

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Appendix 1

Coverage of Director-General's Requirements and Issues Raised by other Government Agencies

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Table A1
Coverage of Noise, Vibration and Blasting-related Agency Requirements

Organisation	Paraphrased Requirement/Issue	Relevant Section(s)
DIRECTOR-GENERAL'S REQUIREMENTS		
The EIS must include and quantitative assessment of the potential: • construction, operational and transport noise impacts;		All
• off-site road noise impact;		5.2
• reasonable and feasible mitigation measures, including evidence that there are no such measures available other than those proposed; and		5.5
• monitoring and management measures.		5.5
ISSUES RAISED BY OTHER GOVERNMENT AGENCIES		
NOISE AND VIBRATION		
EPA (21/01/14)	Assess the predicted noise impacts associated with the project in accordance with the EPA's *Interim Construction Noise Guidelines* and *Industrial Noise Policy* [since replaced by the *Noise Policy for Industry*] The assessment should include*:* • Identification and assessment of all potential noise sources associated with the development	4.2
	• Identify the locations of all sensitive receptors	1.2
	• The proposed hours of construction and operation of the quarry and associated activities	3.3
	• An assessment of compliance with the project specific noise levels	5.1
	• An assessment of the potential impacts of any transport noise	5.2
	Any proposed noise mitigation, monitoring and management measures	5.5
	Include an assessment of any predicted vibration impacts associated with the project	6.5
	Consider the cumulative noise impacts with reference to the Penrose Quarry and the Green Valley Sand Quarry	5.4
DTIRIS – DRE (07/02/14)	Assess noise and vibration impacts, and proposed measures to minimise these impacts.	All

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Appendix 2

Noise Logger Data

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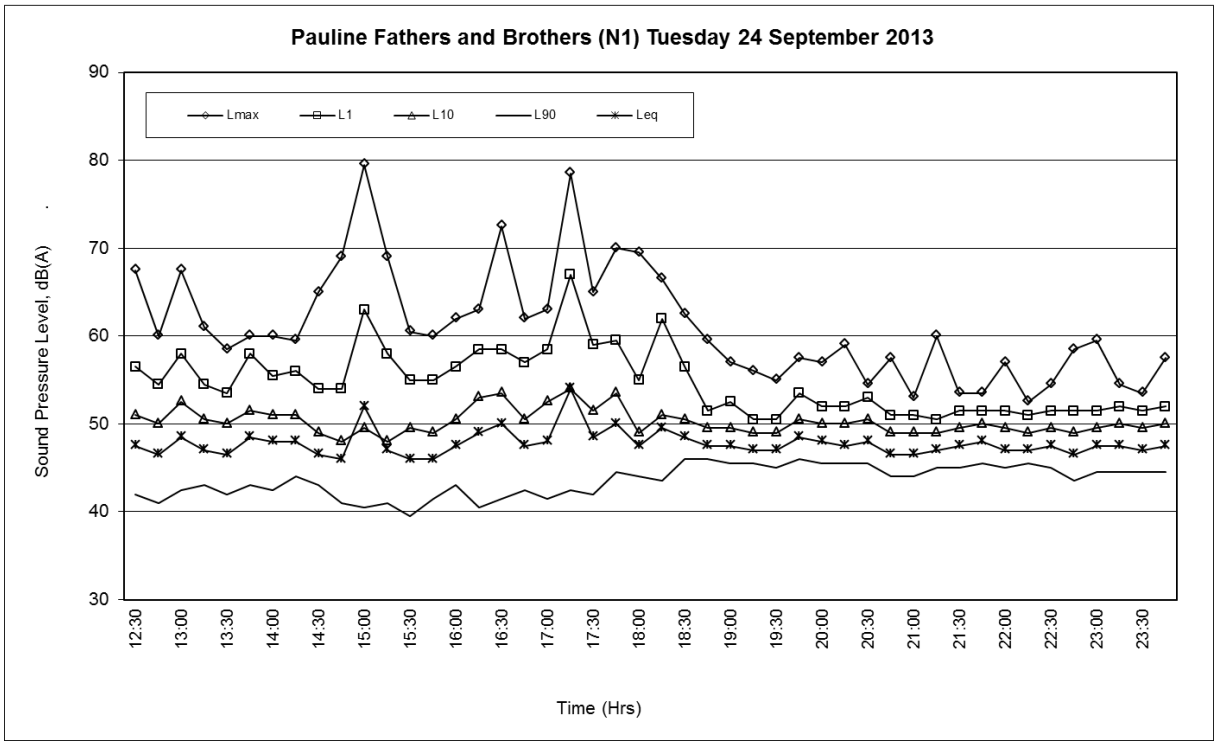
Pauline Fathers and Brothers (N1) Tuesday 24 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
90
80
70
60
50
40
30
12:30
13:00
13:30
14:00
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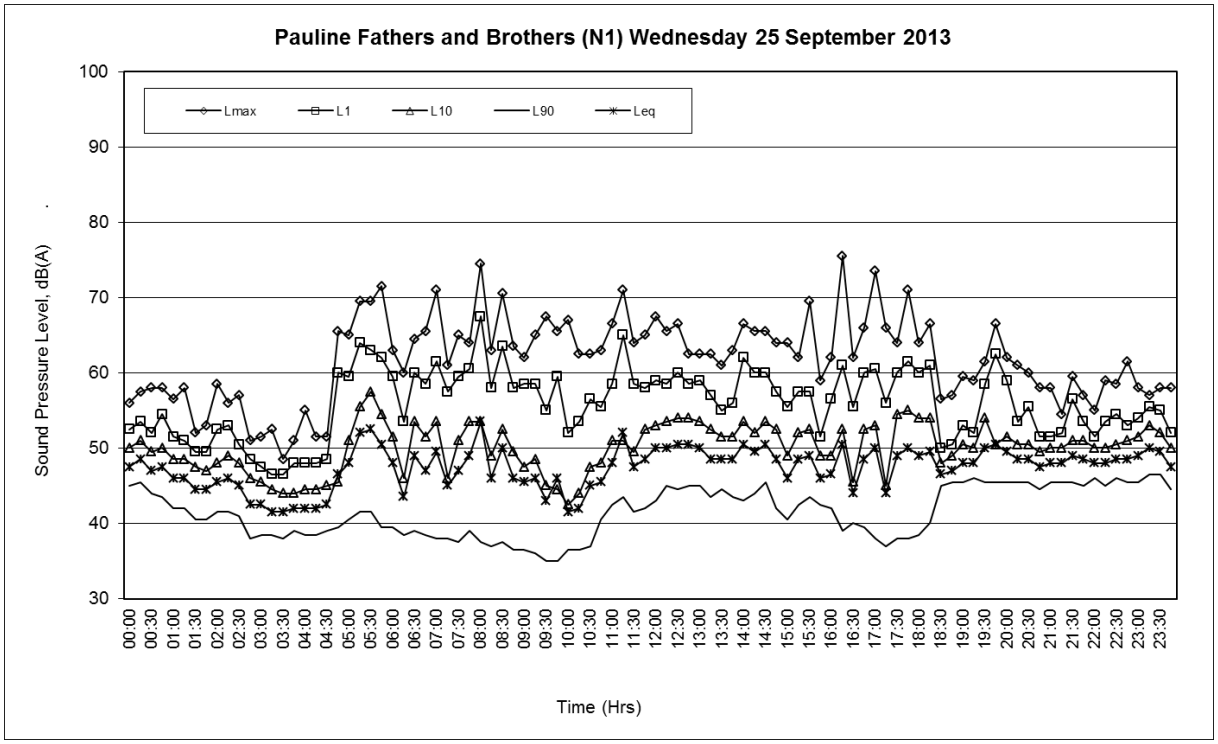
Time (Hrs)


Pauline Fathers and Brothers (N1) Wednesday 25 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
100
90
80
70
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50
40
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00:00
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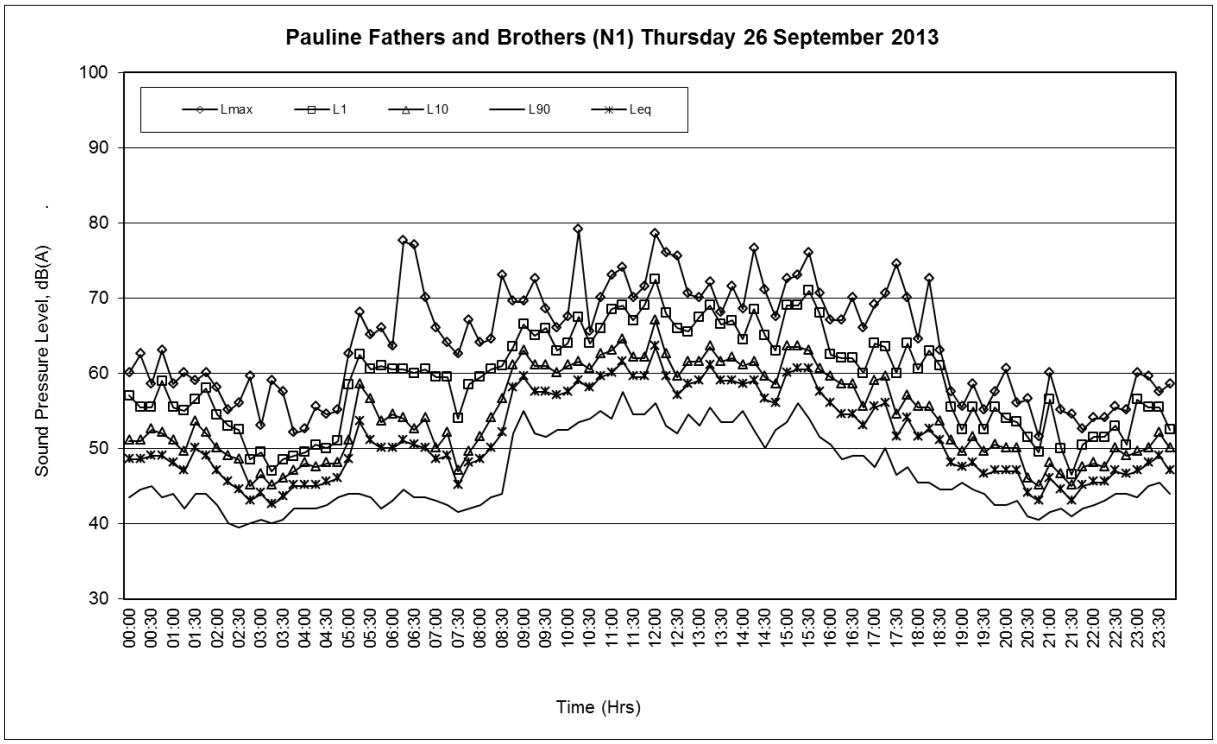
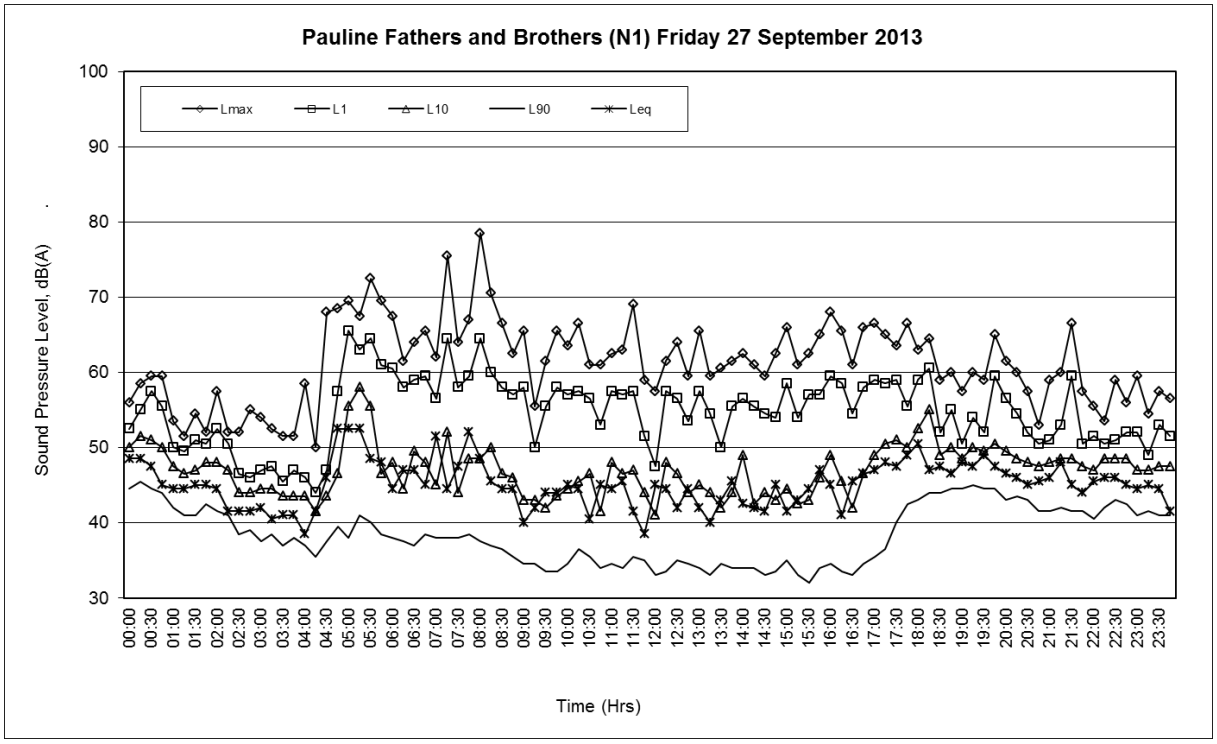
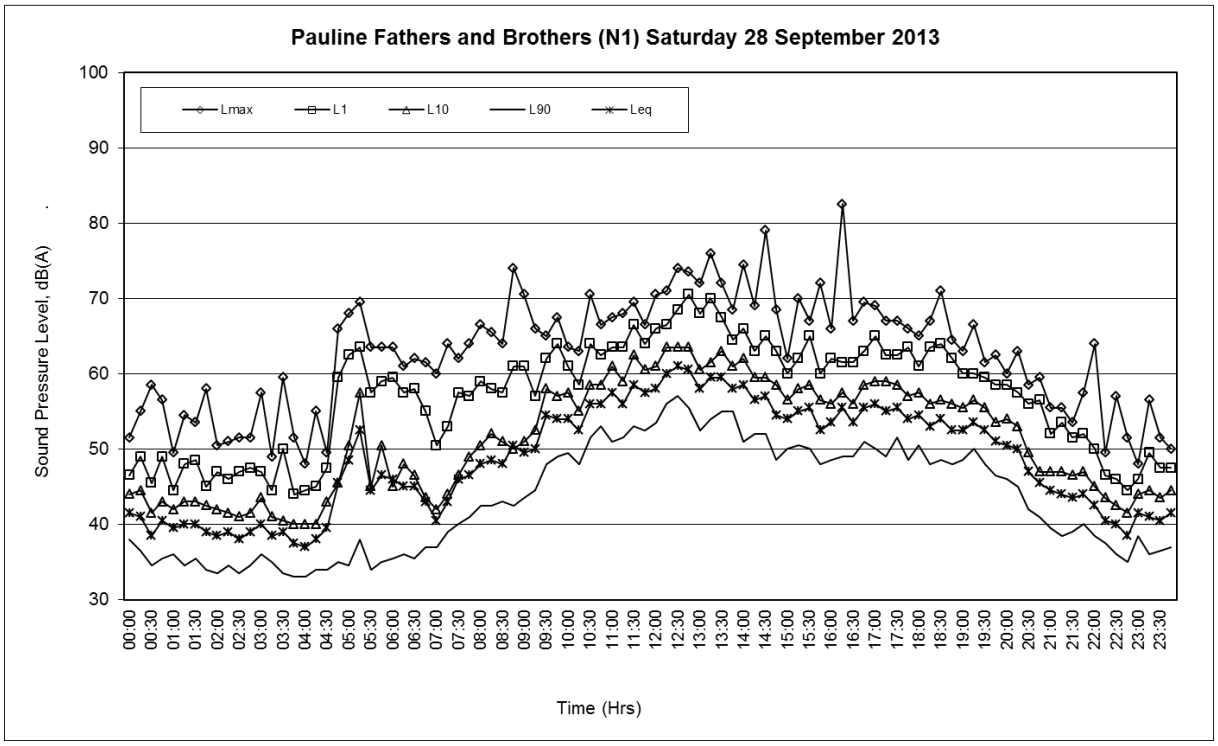
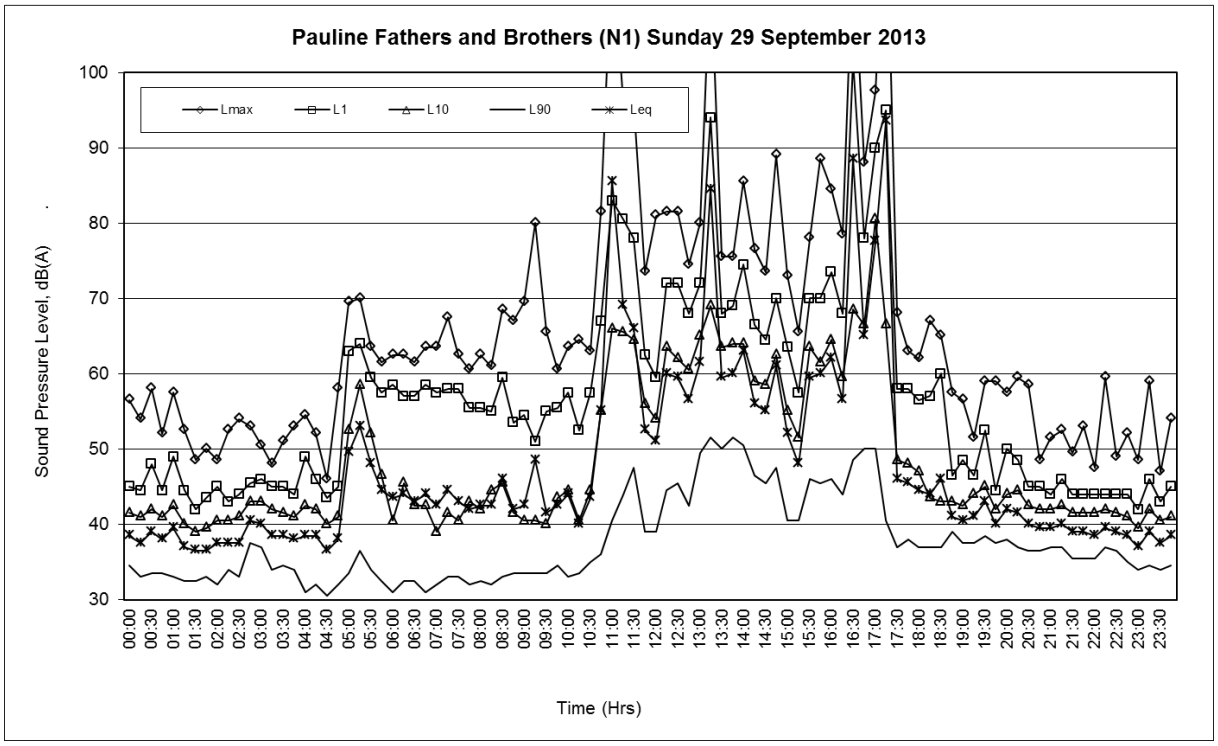
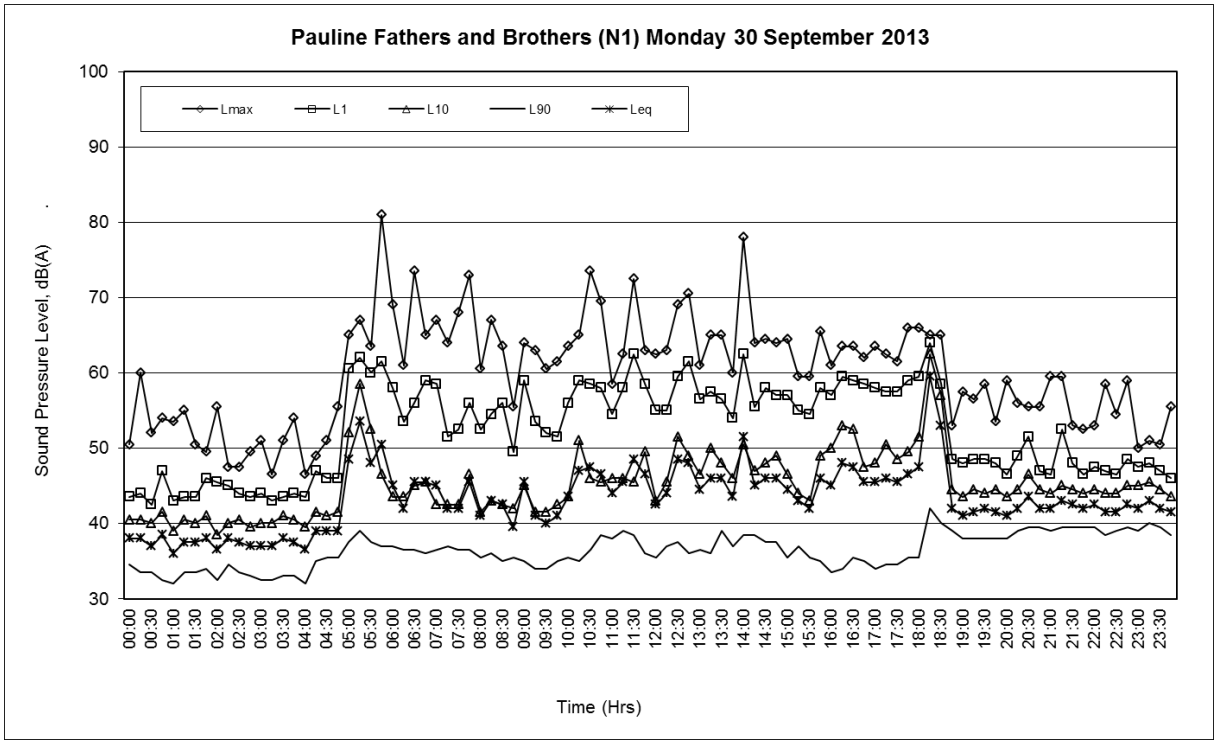
Time (Hrs)

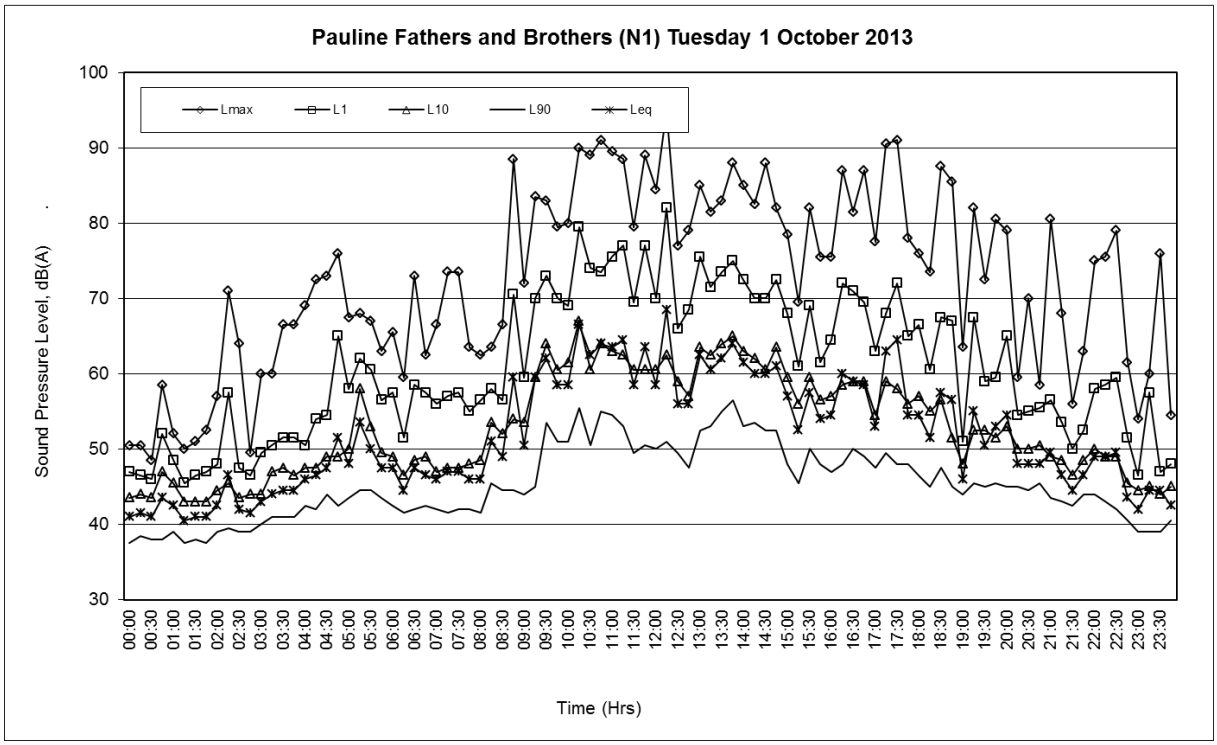

Pauline Fathers and Brothers (N1) Thursday 26 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)

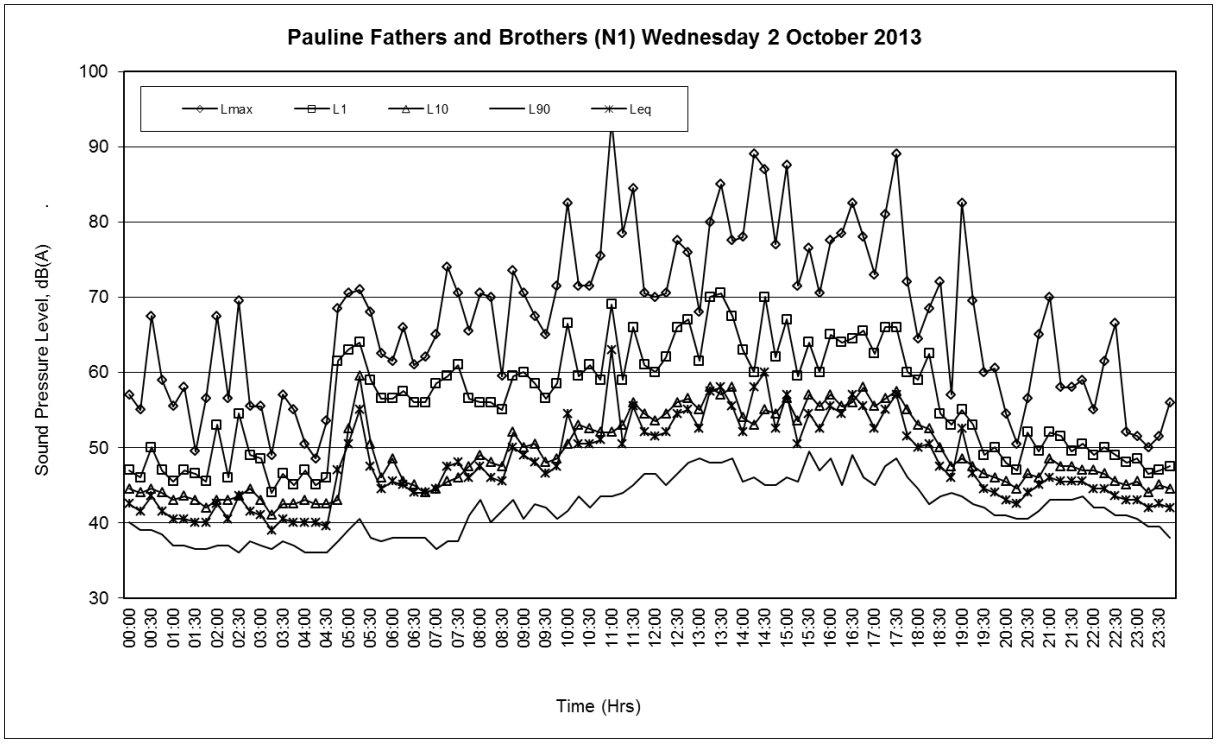

Pauline Fathers and Brothers (N1) Friday 27 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)

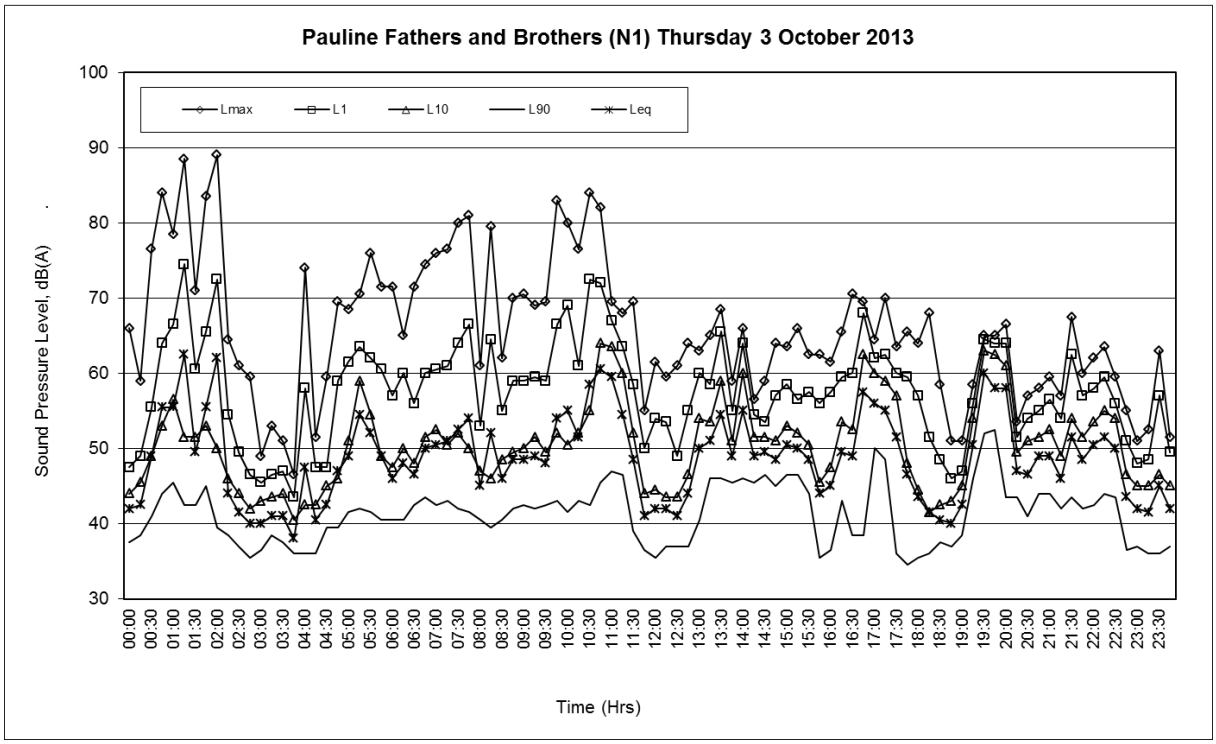

Pauline Fathers and Brothers (N1) Saturday 28 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)

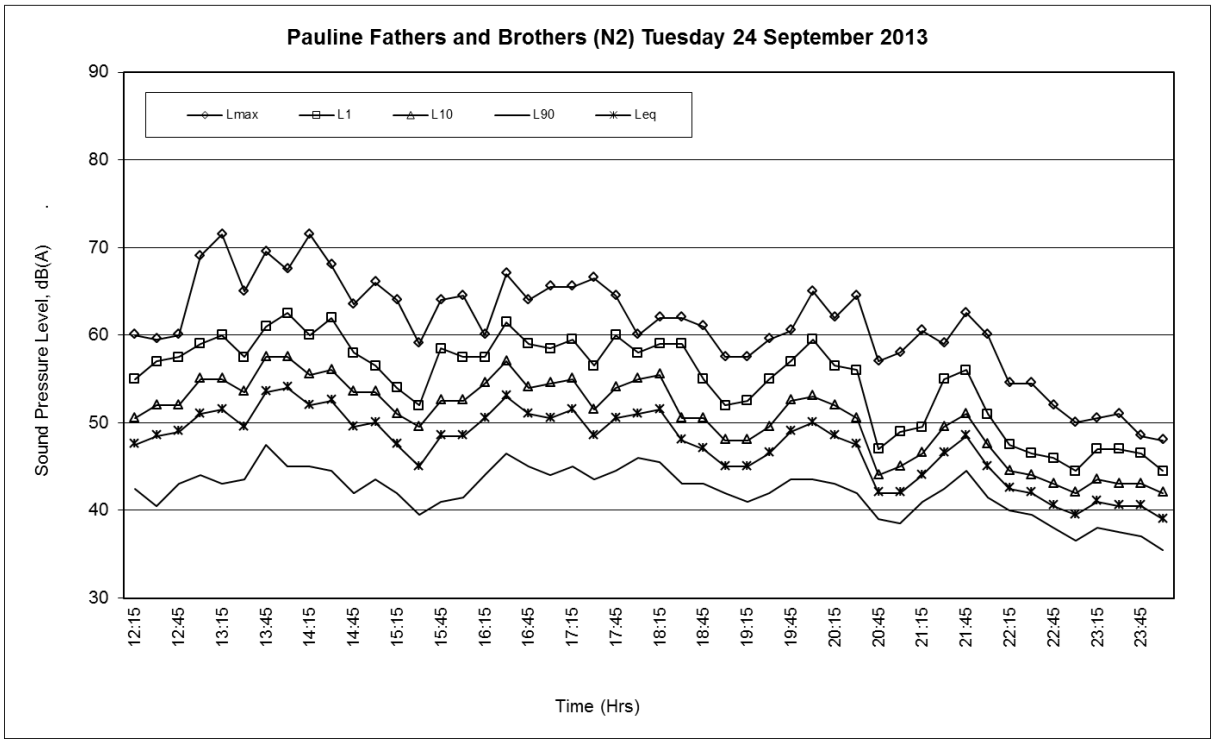

Pauline Fathers and Brothers (N1) Sunday 29 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


Pauline Fathers and Brothers (N1) Monday 30 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


Pauline Fathers and Brothers (N1) Tuesday 1 October 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


Pauline Fathers and Brothers (N1) Wednesday 2 October 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


Pauline Fathers and Brothers (N1) Thursday 3 October 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


Pauline Fathers and Brothers (N2) Tuesday 24 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
90
80
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12:15
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13:45
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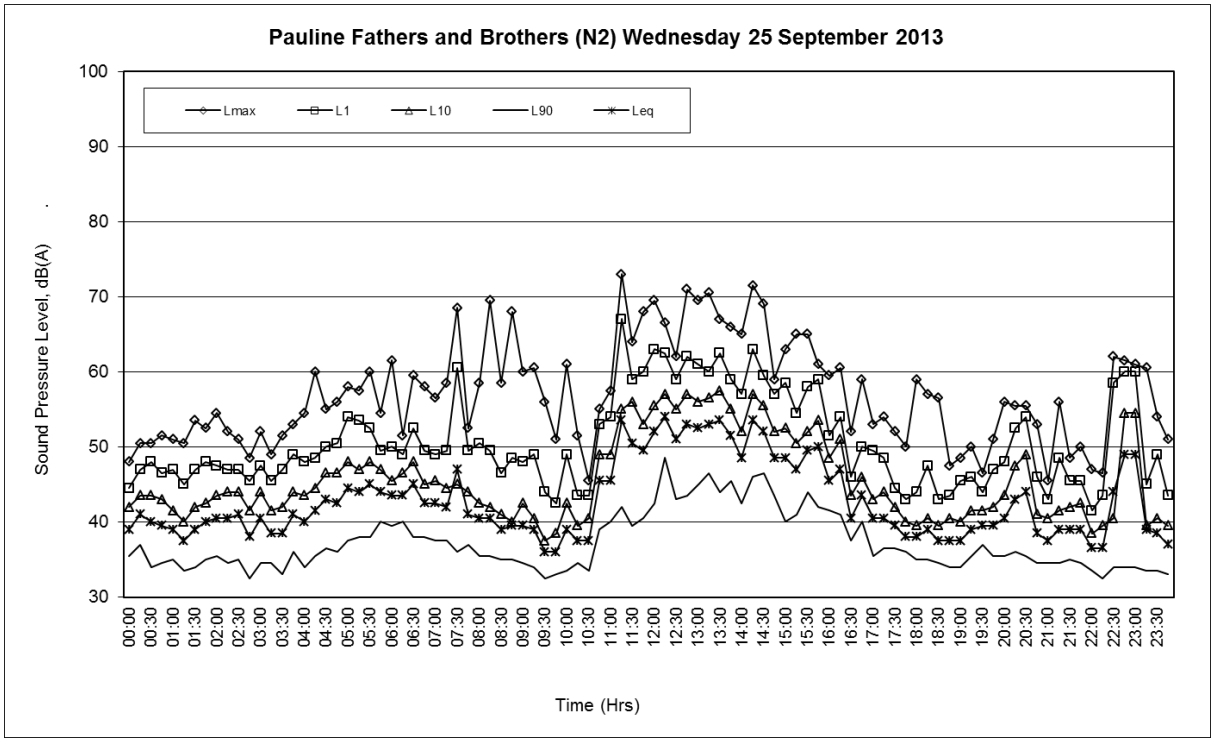
22:45
23:15
23:45
Time (Hrs)


Pauline Fathers and Brothers (N2) Wednesday 25 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
100
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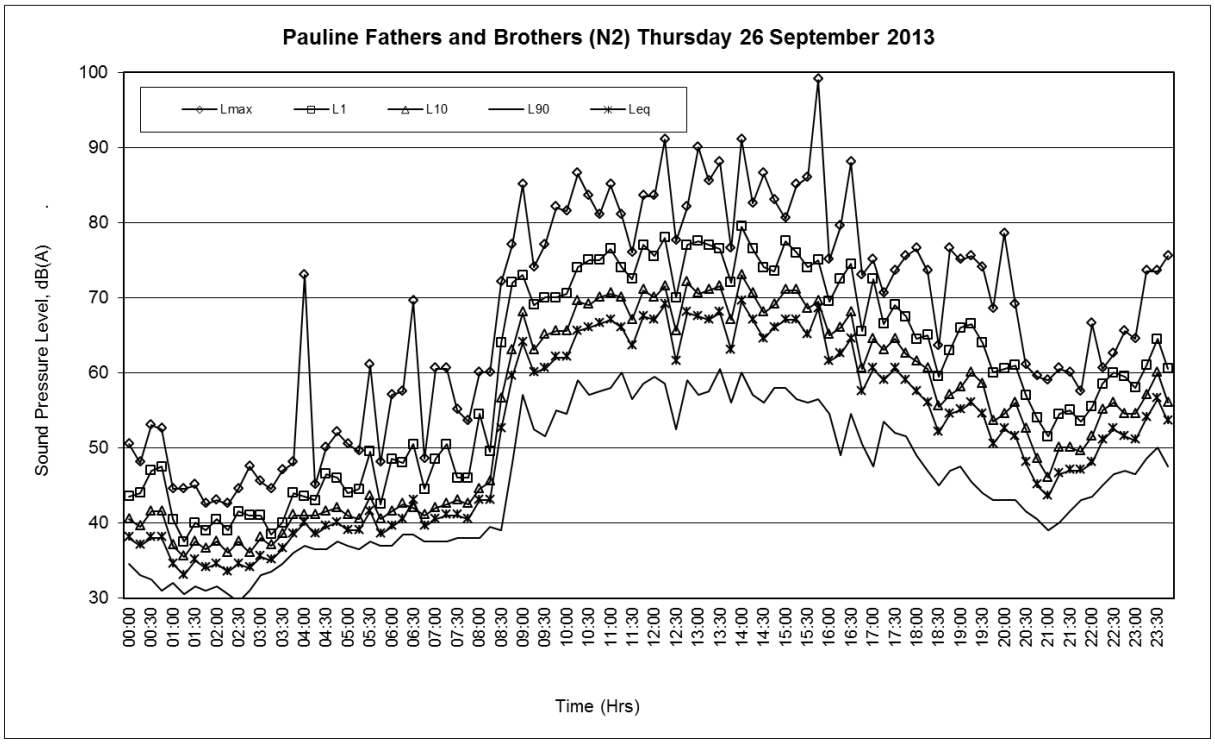
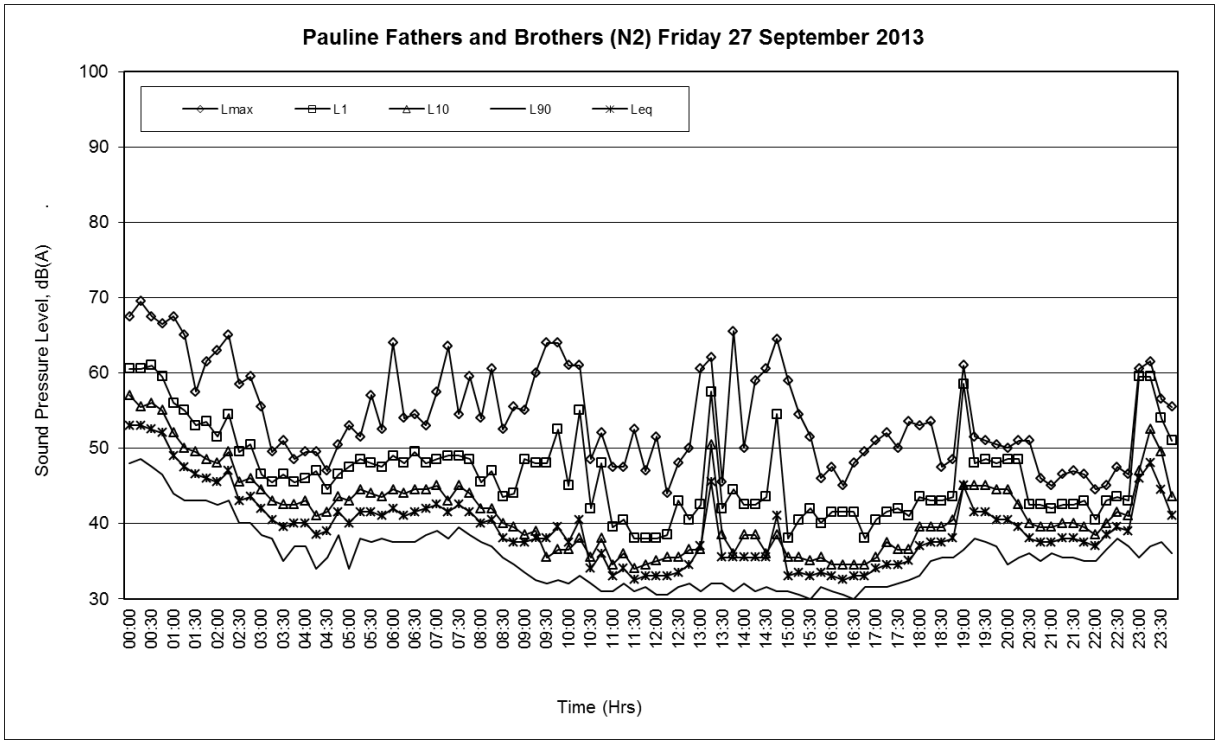
Time (Hrs)


Pauline Fathers and Brothers (N2) Thursday 26 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


Pauline Fathers and Brothers (N2) Friday 27 September 2013
Lmax
L1
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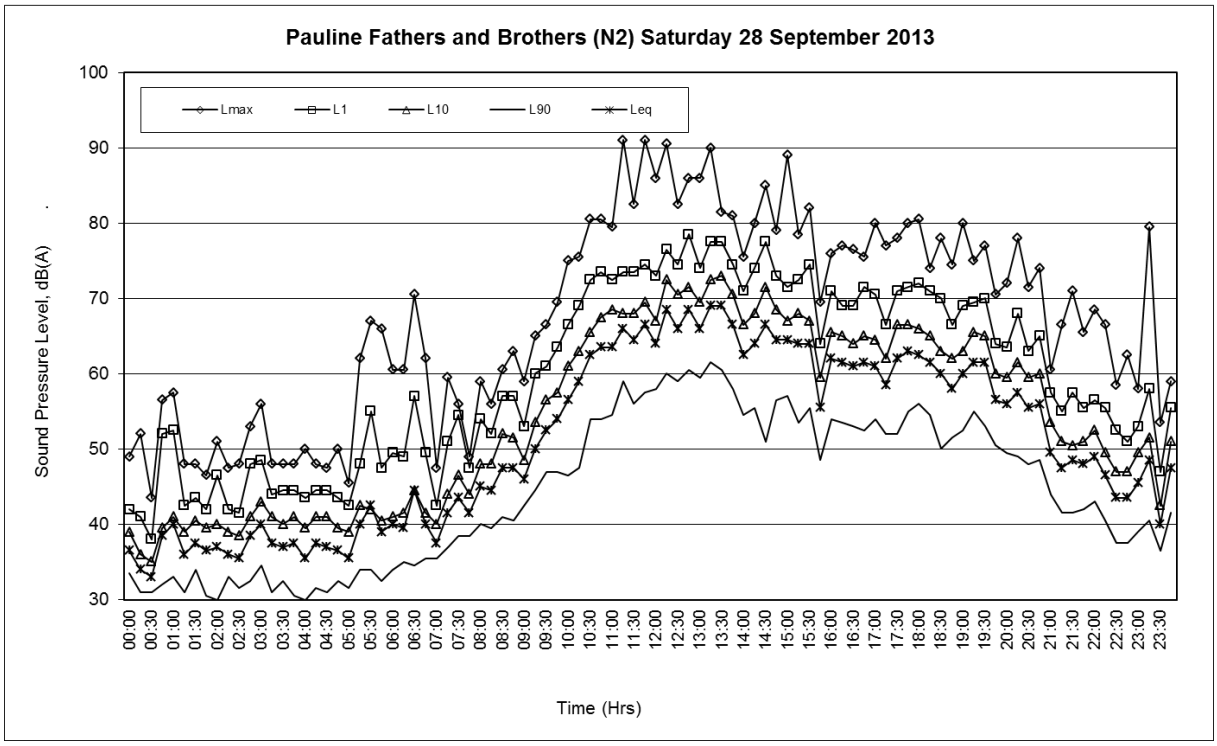
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


Pauline Fathers and Brothers (N2) Saturday 28 September 2013
Lmax
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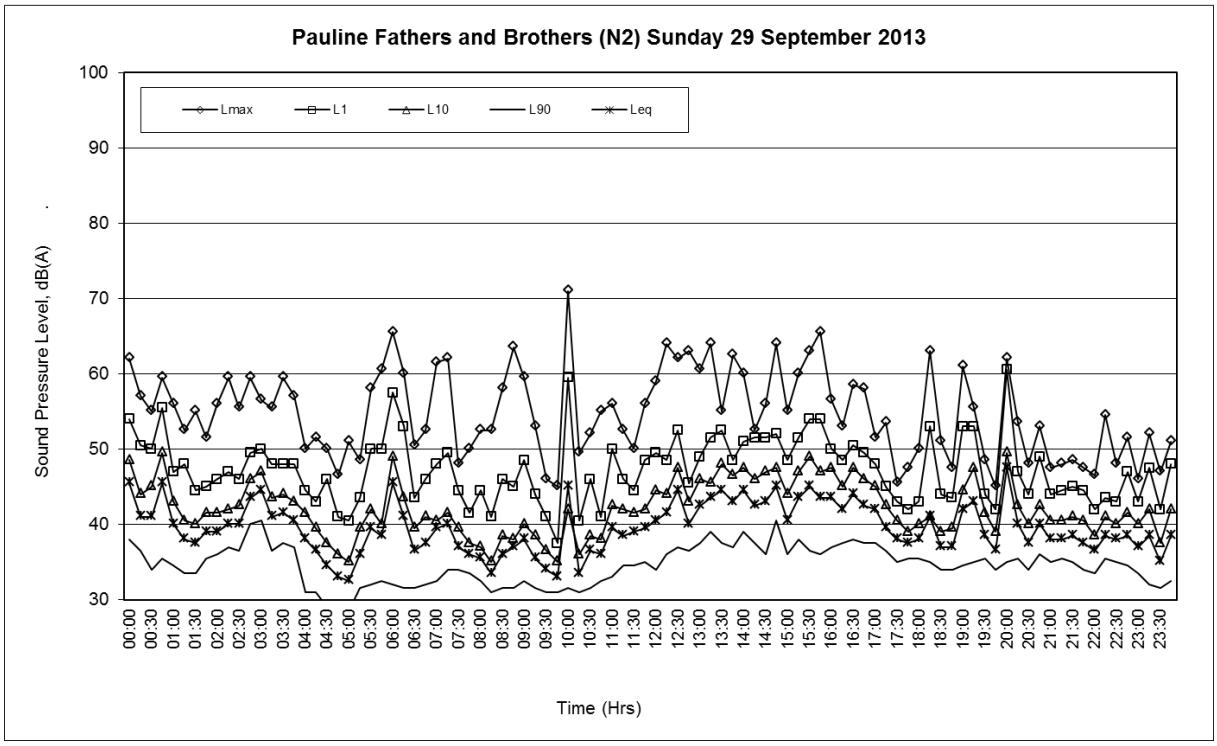
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


Pauline Fathers and Brothers (N2) Sunday 29 September 2013
Lmax
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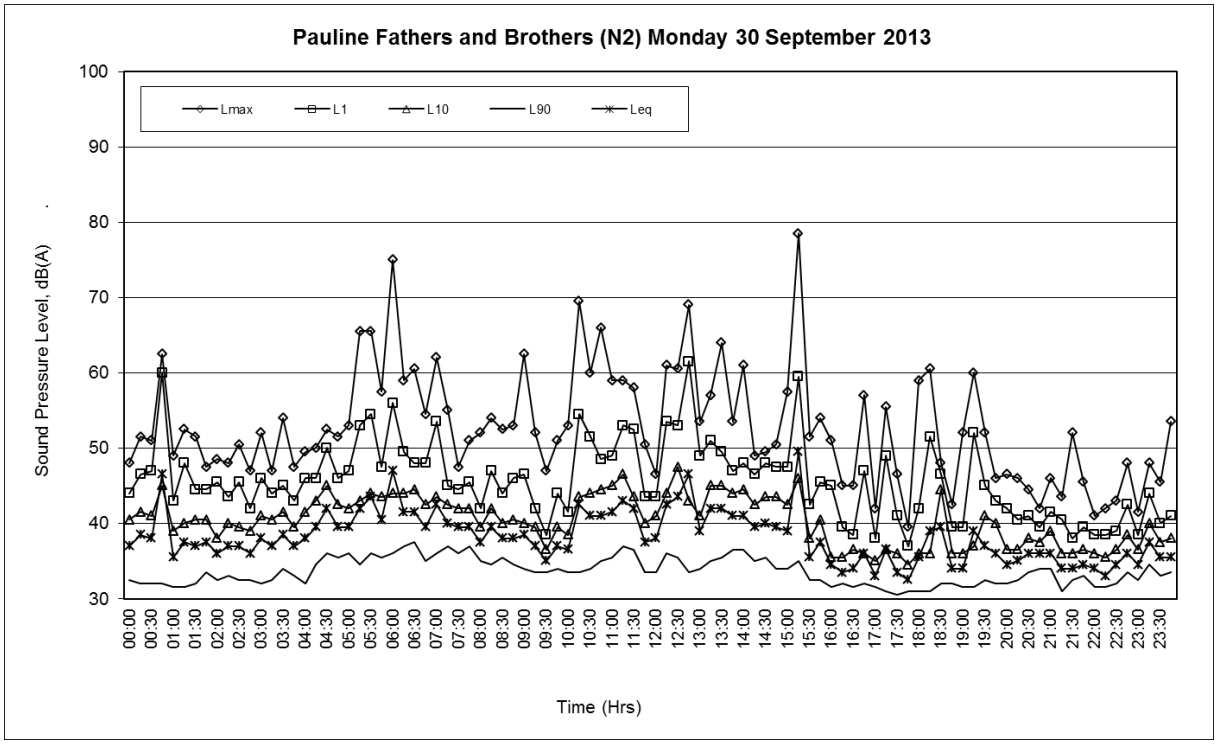
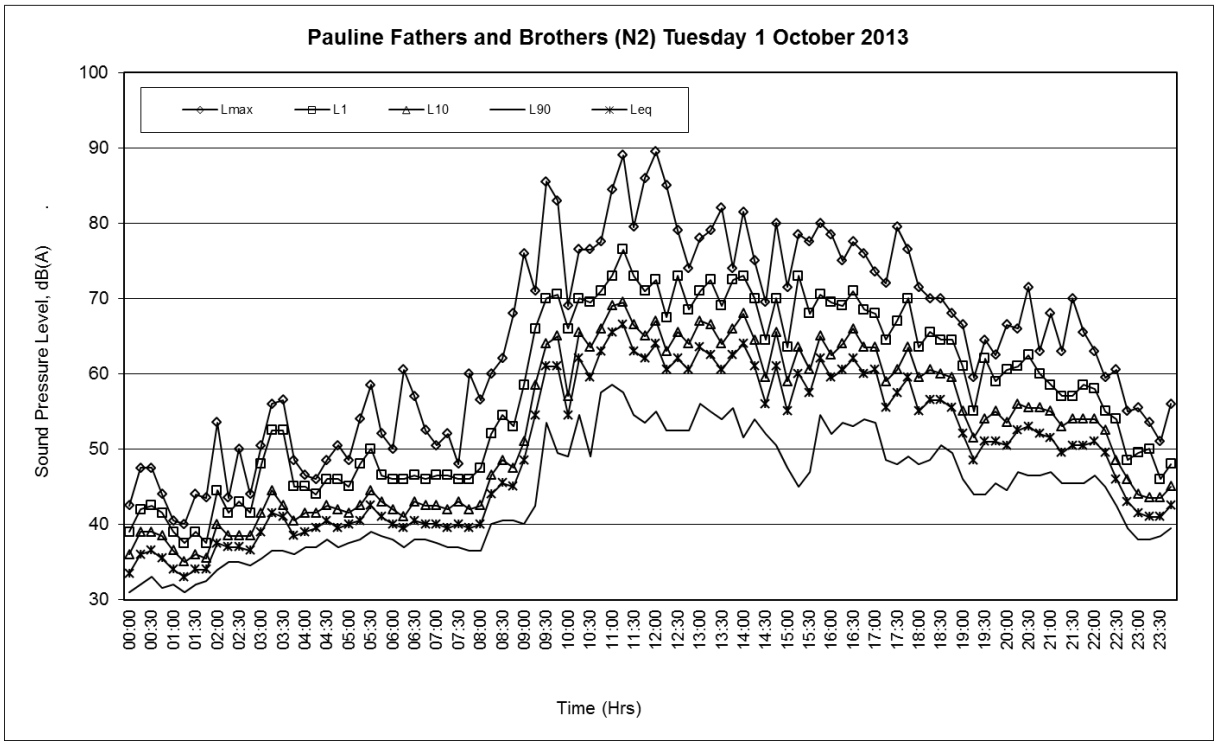
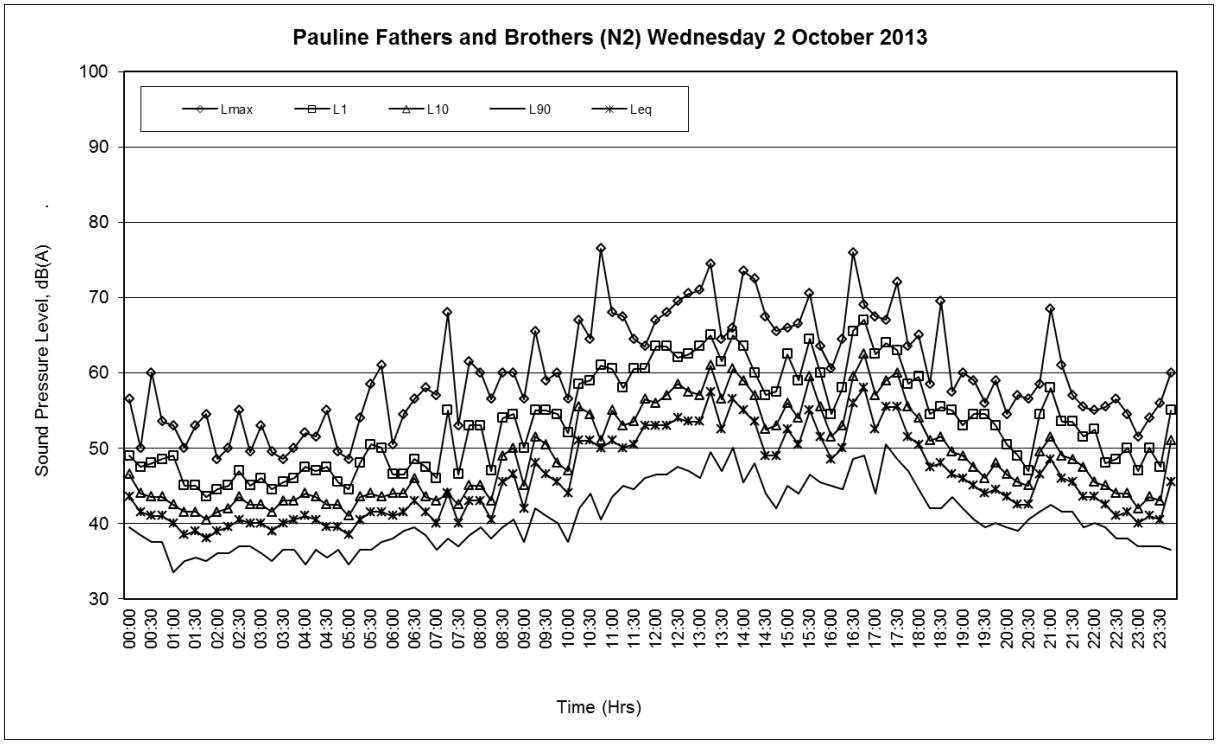
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


Pauline Fathers and Brothers (N2) Monday 30 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


Pauline Fathers and Brothers (N2) Tuesday 1 October 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


Pauline Fathers and Brothers (N2) Wednesday 2 October 2013
Lmax
L1
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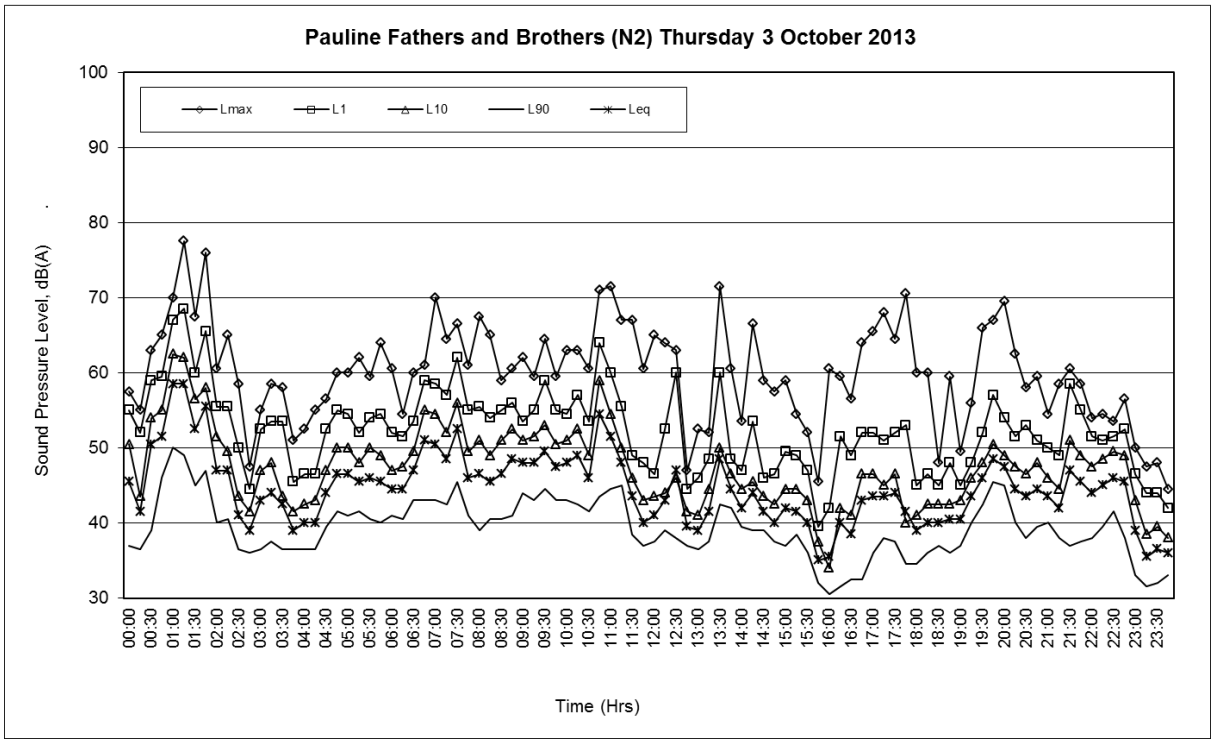
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


Pauline Fathers and Brothers (N2) Thursday 3 October 2013
Lmax
L1
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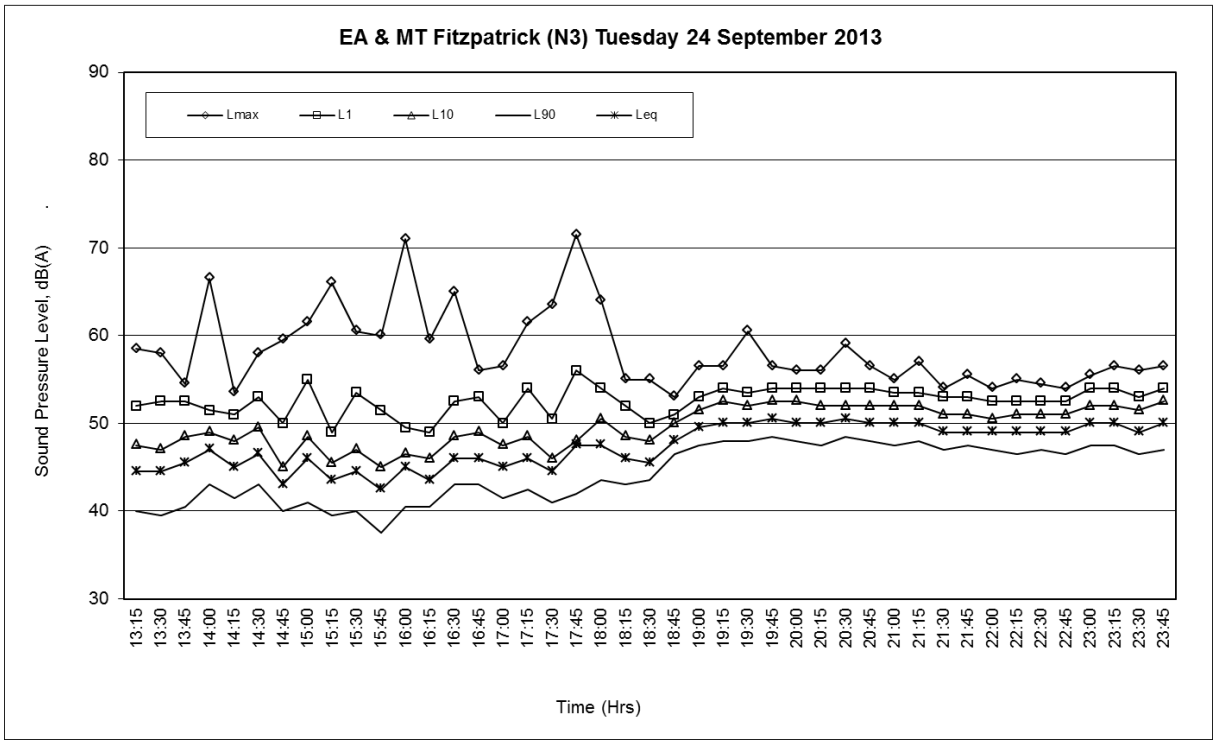
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


EA & MT Fitzpatrick (N3) Tuesday 24 September 2013
Lmax
L1
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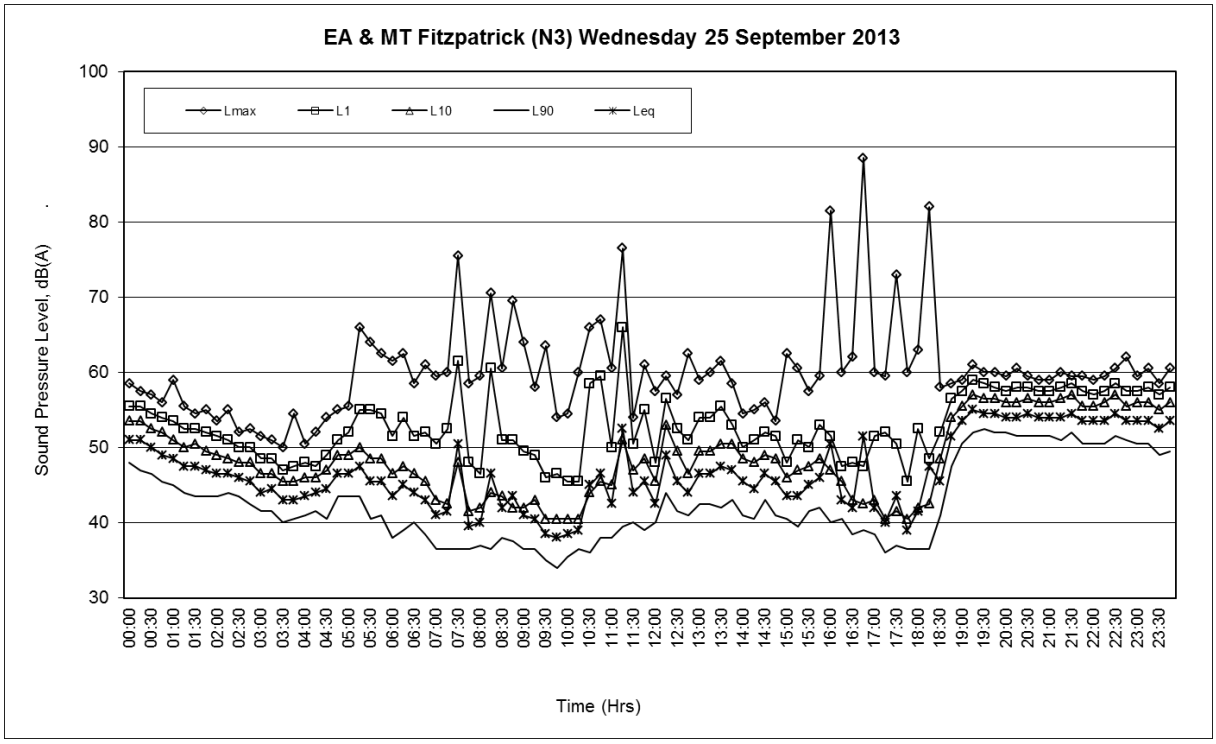
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


EA & MT Fitzpatrick (N3) Wednesday 25 September 2013
Lmax
L1
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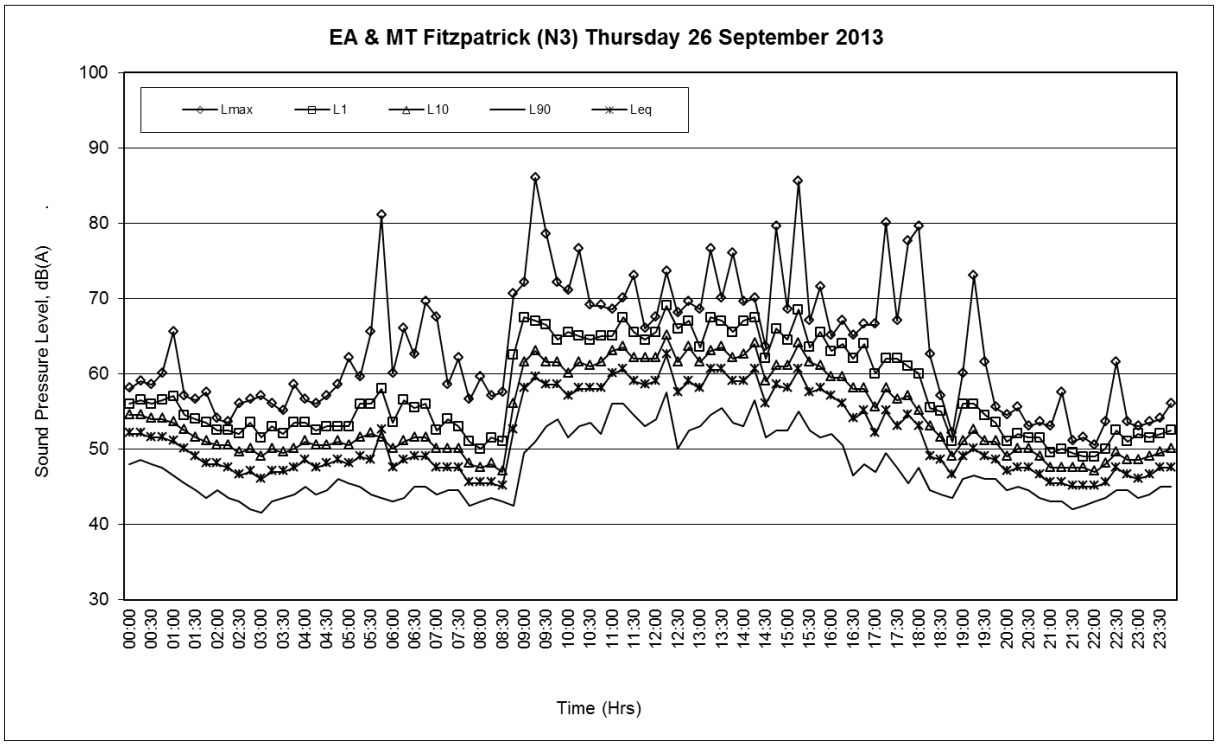
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


EA & MT Fitzpatrick (N3) Thursday 26 September 2013
Lmax
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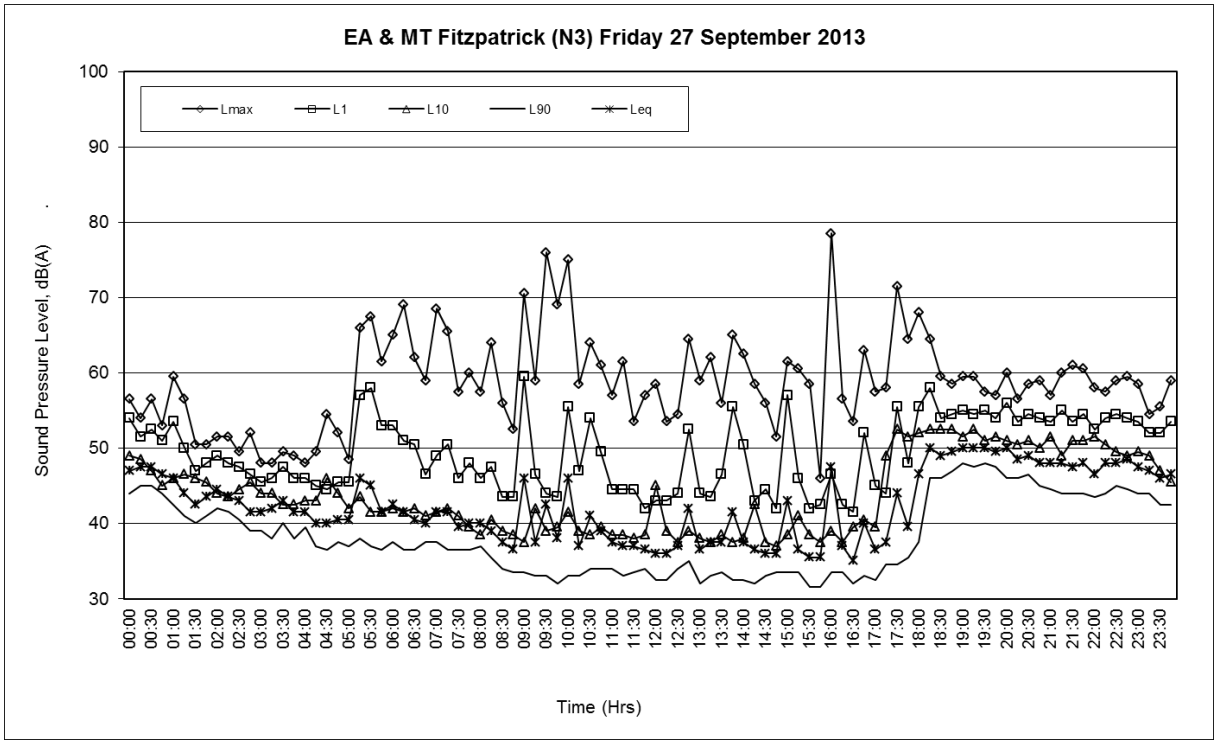
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


EA & MT Fitzpatrick (N3) Friday 27 September 2013
Lmax
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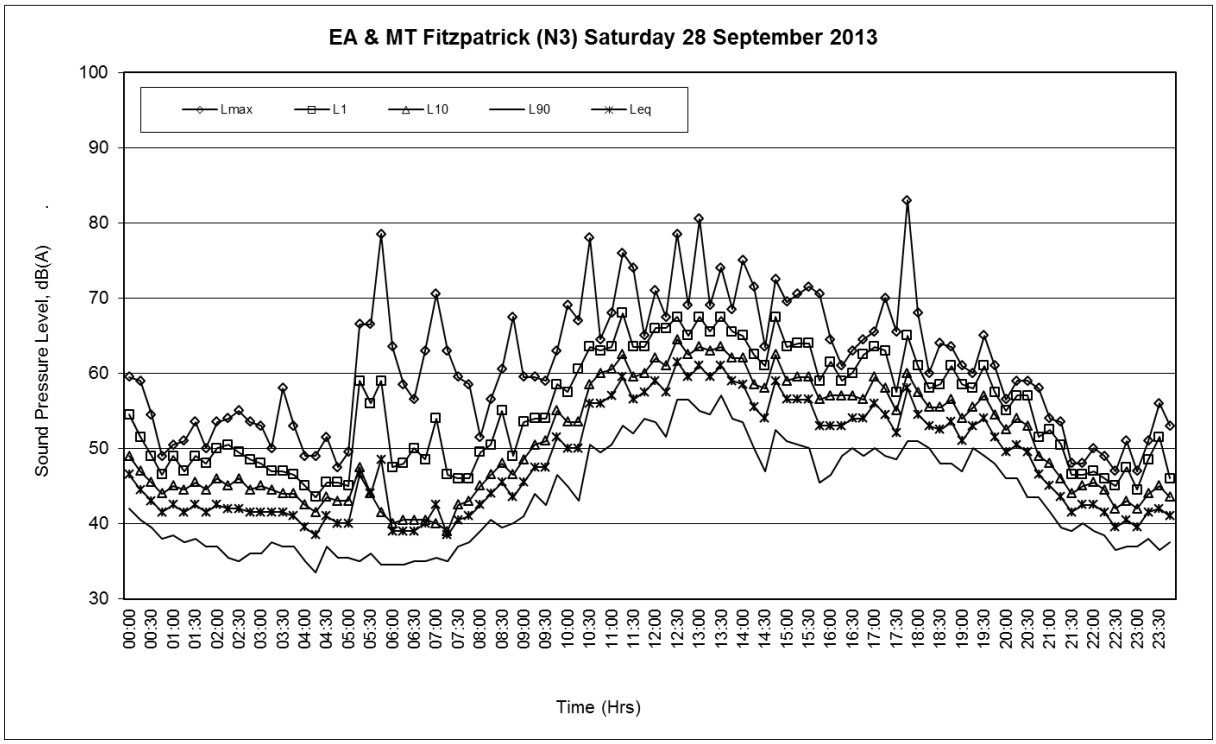
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


EA & MT Fitzpatrick (N3) Saturday 28 September 2013
Lmax
L1
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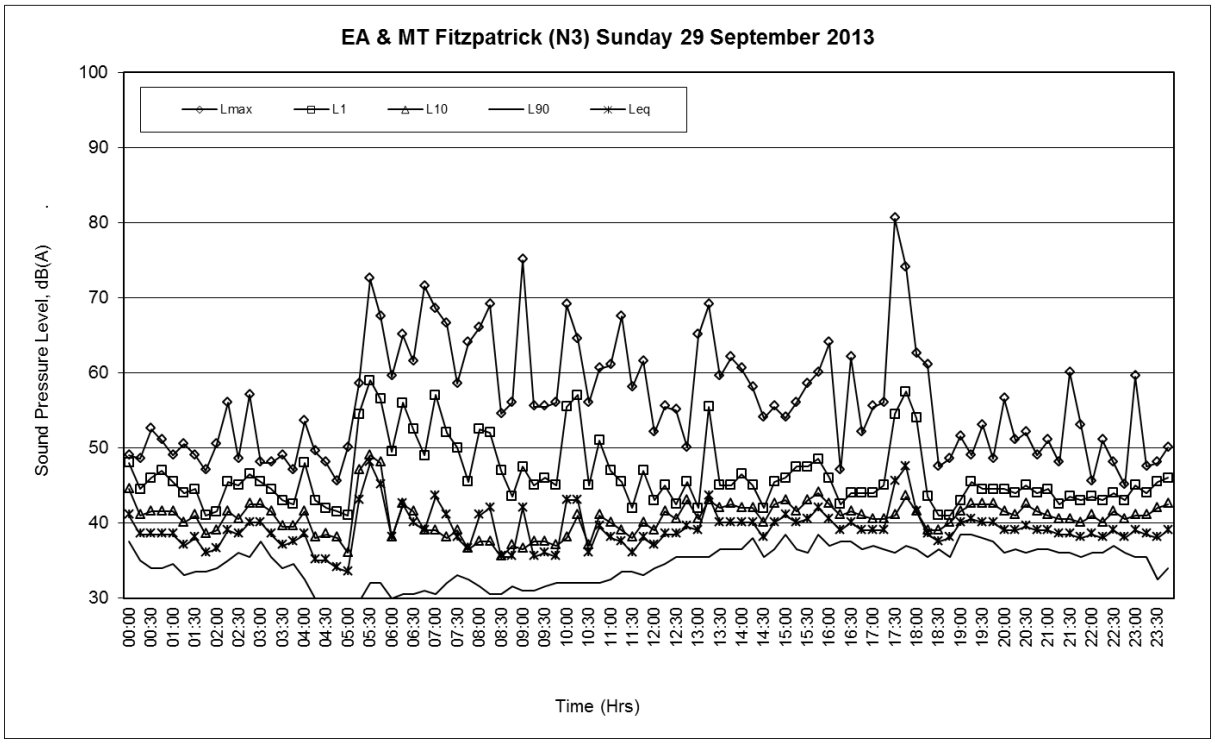
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


EA & MT Fitzpatrick (N3) Sunday 29 September 2013
Lmax
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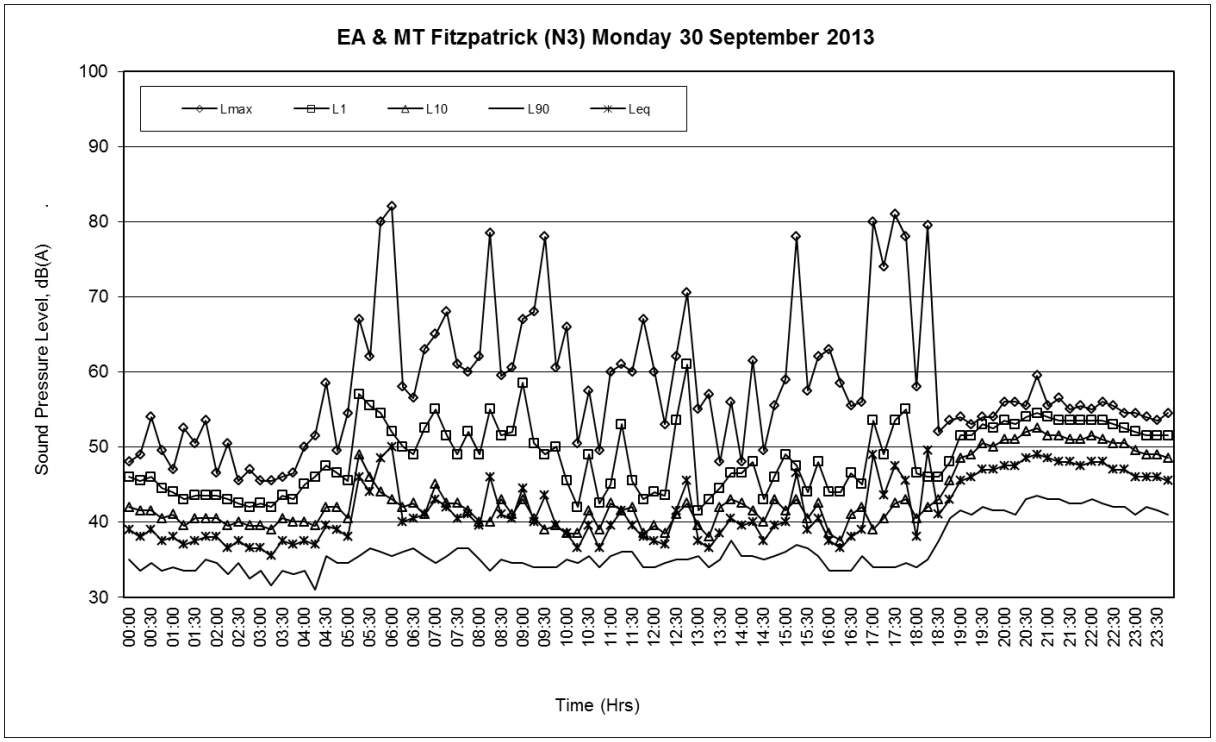
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


EA & MT Fitzpatrick (N3) Monday 30 September 2013
Lmax
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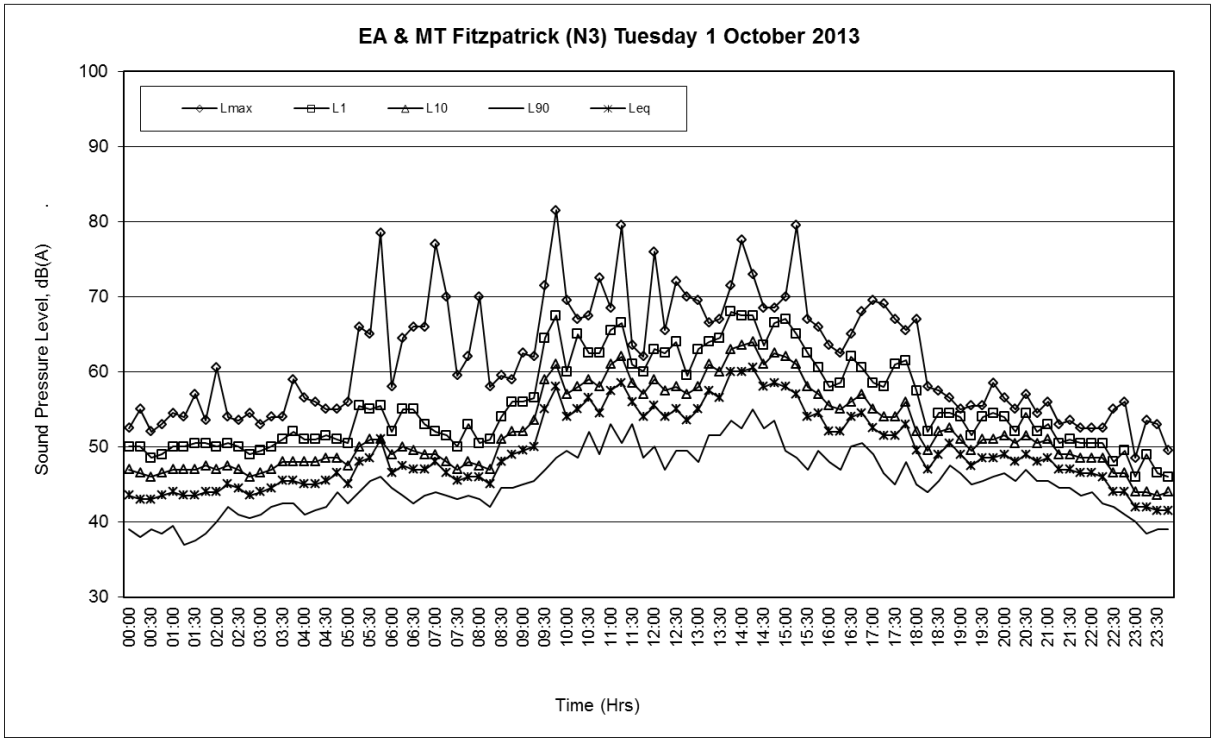
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


EA & MT Fitzpatrick (N3) Tuesday 1 October 2013
Lmax
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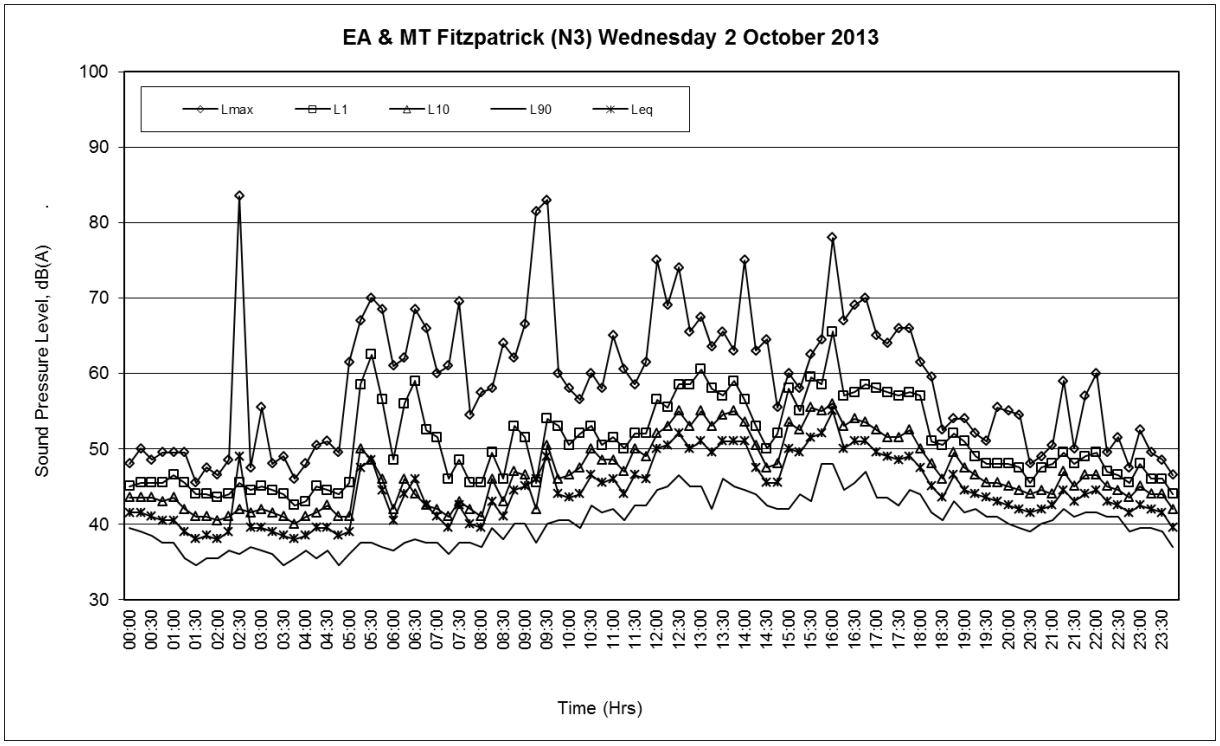
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


EA & MT Fitzpatrick (N3) Wednesday 2 October 2013
Lmax
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Leq
Sound Pressure Level, dB(A)
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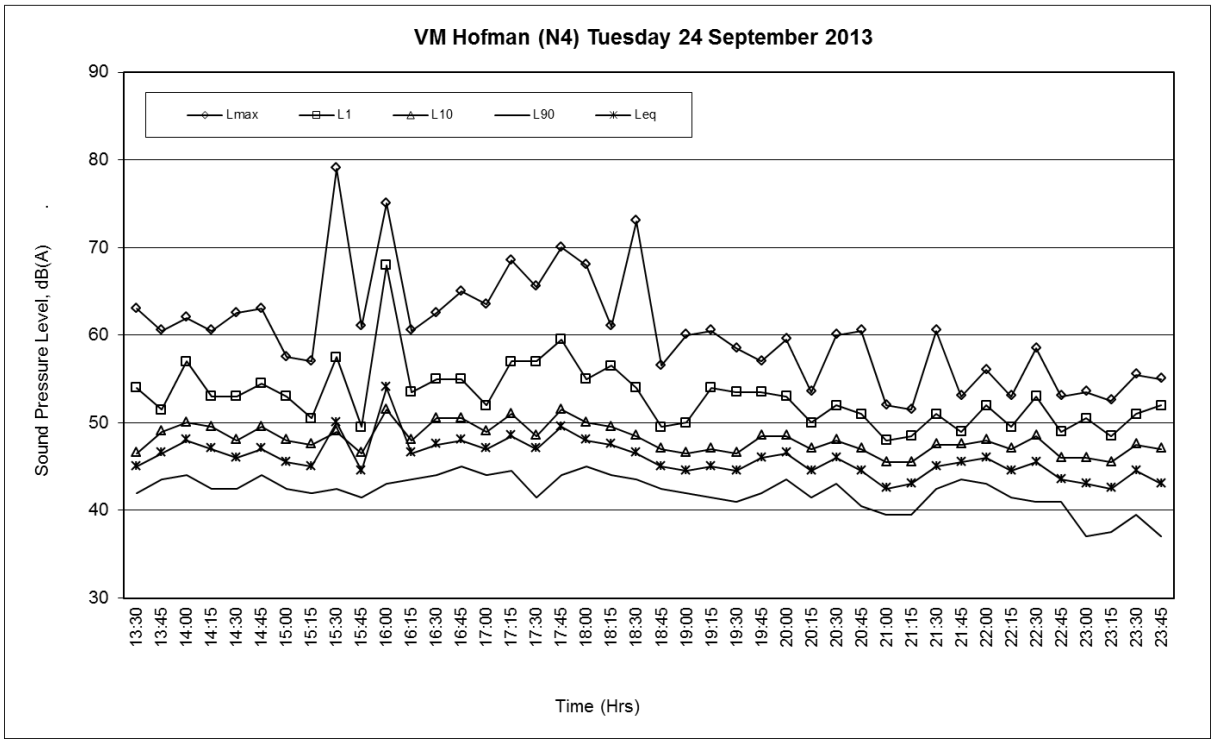
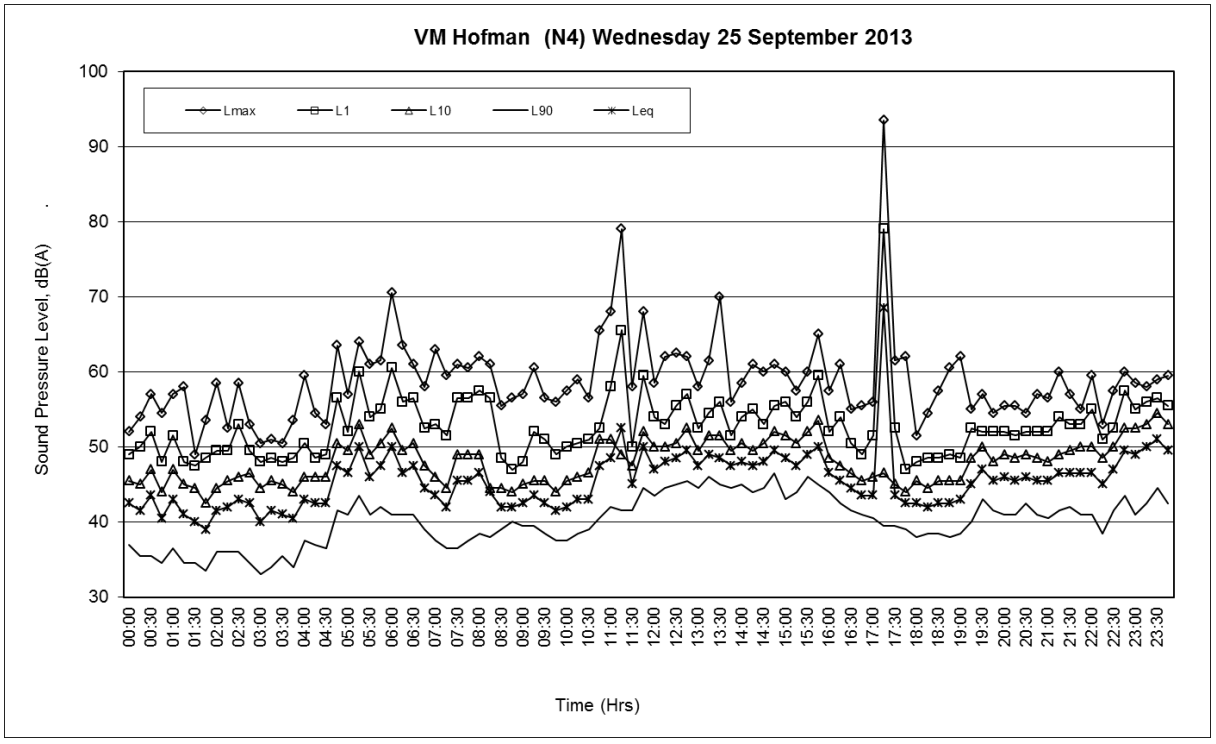
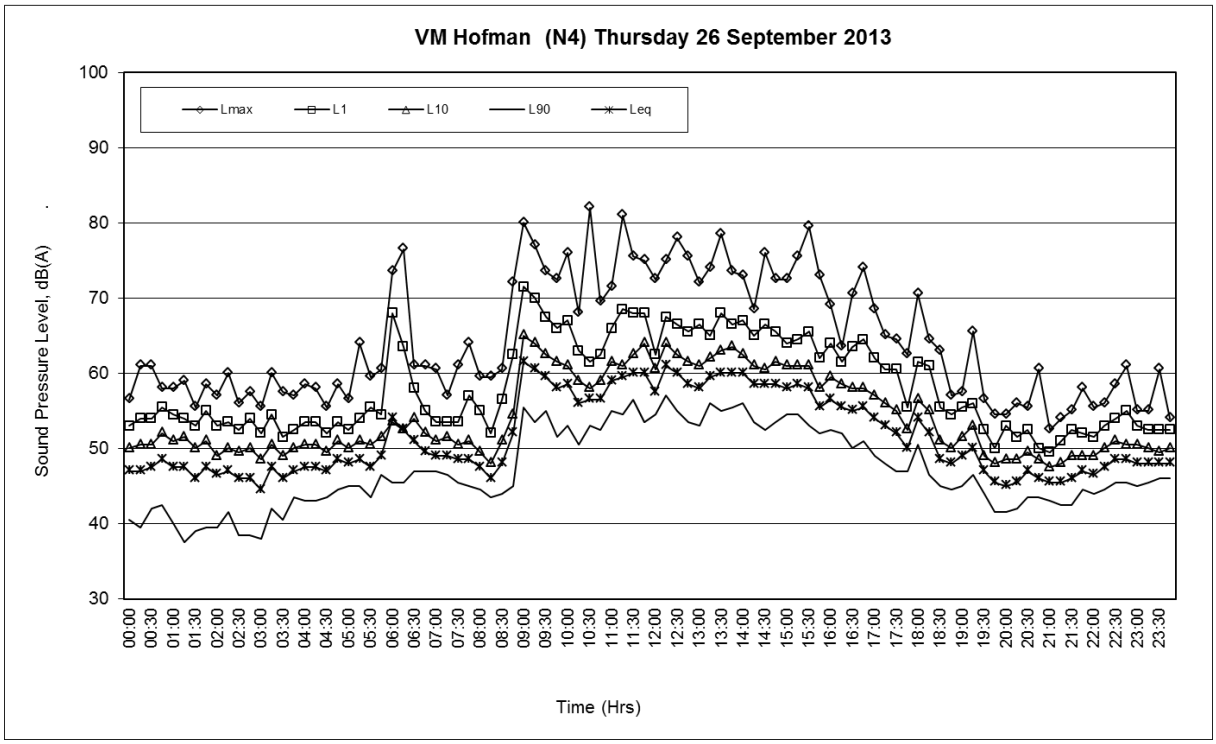
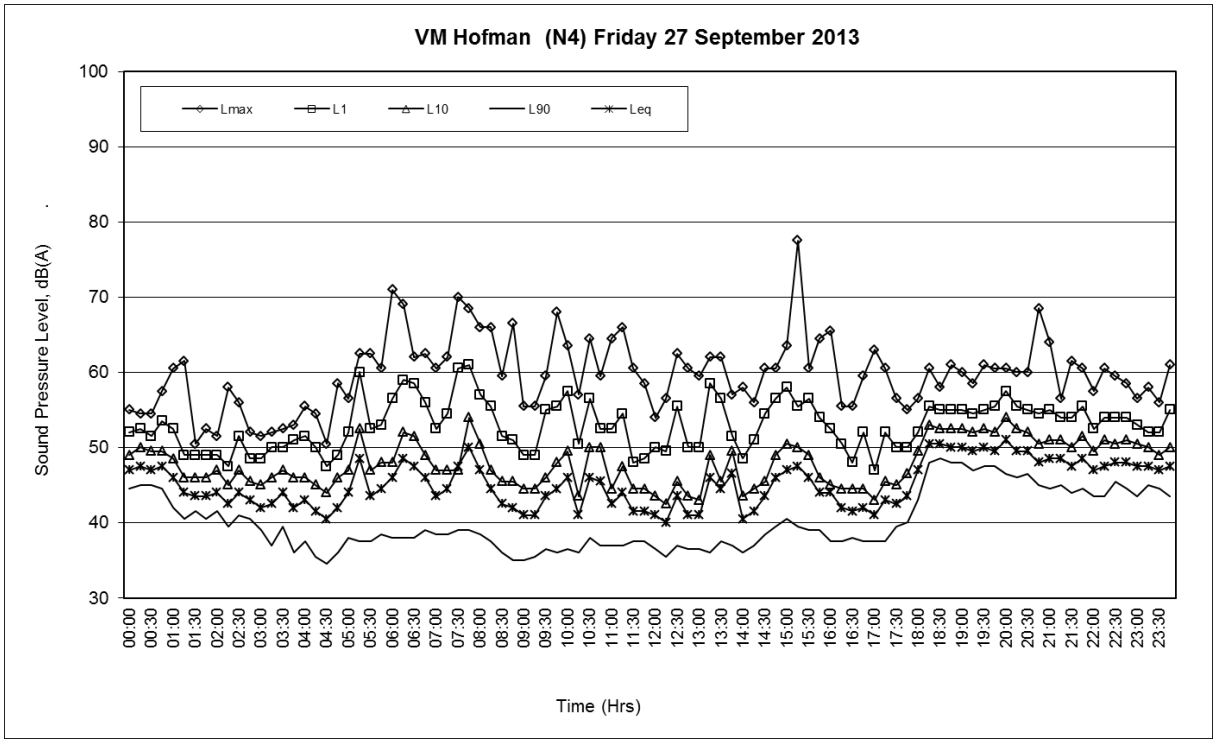
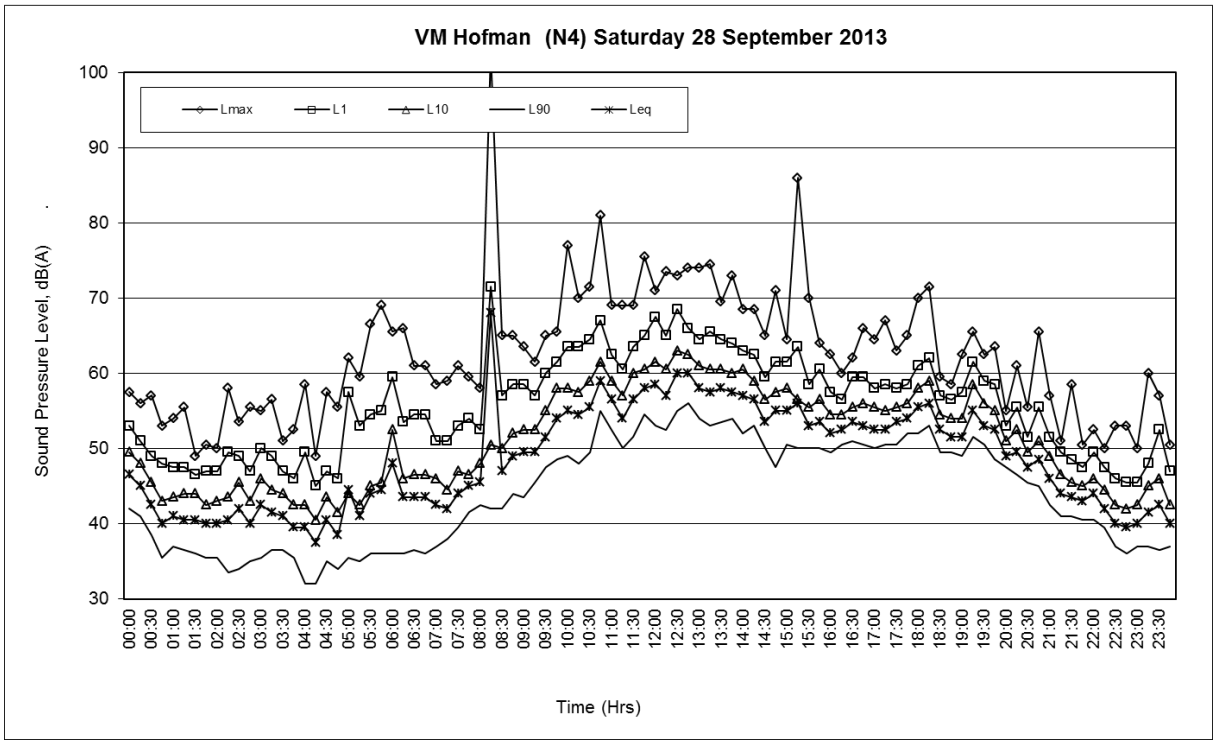
Time (Hrs)

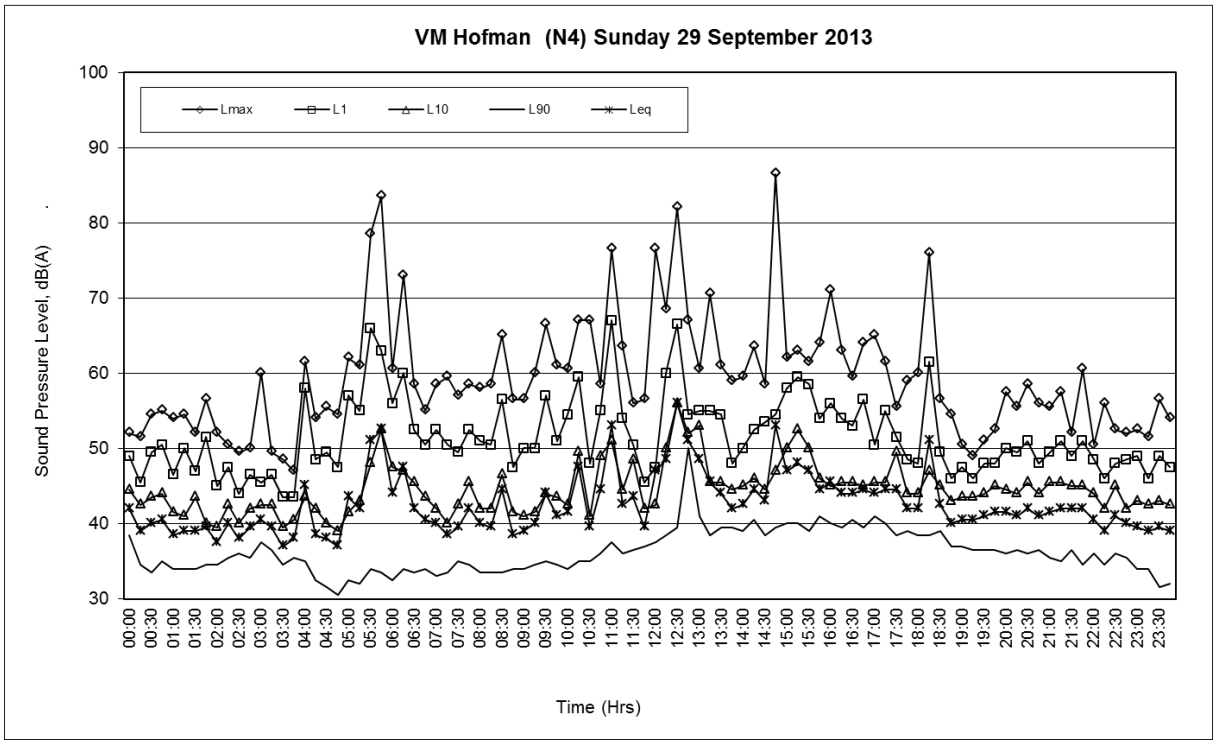

VM Hofman (N4) Tuesday 24 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)

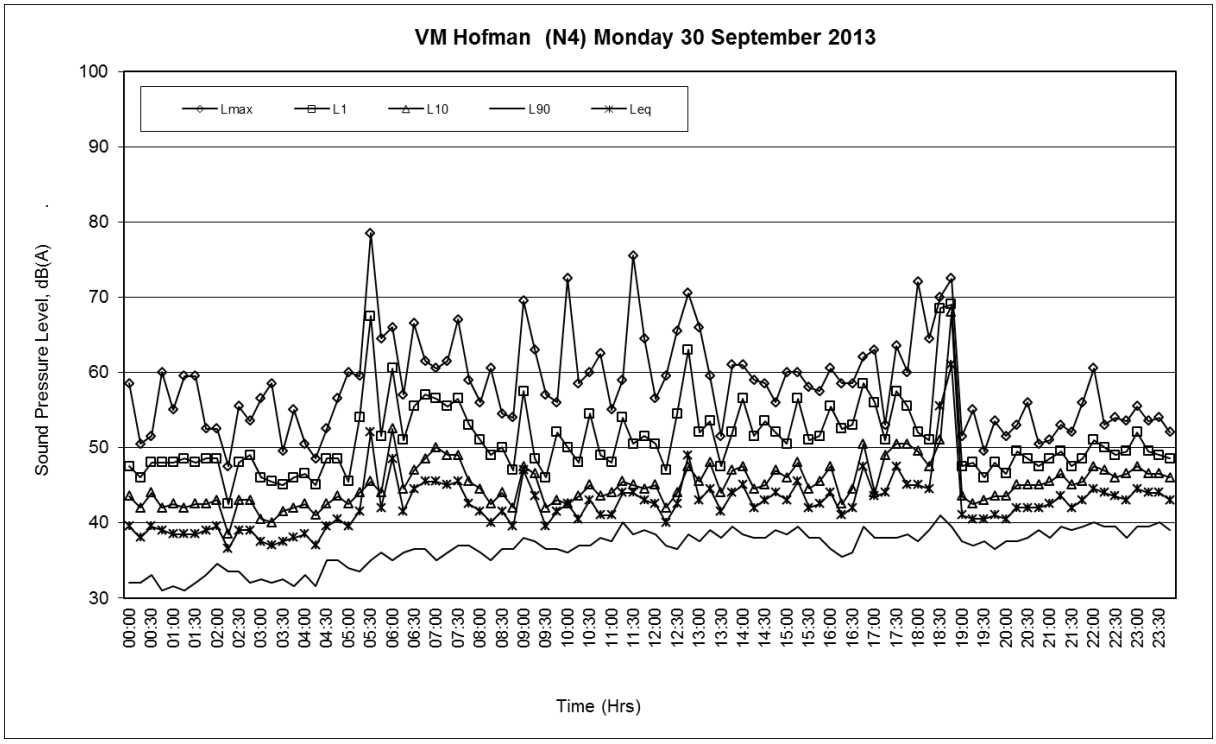

VM Hofman (N4) Wednesday 25 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)

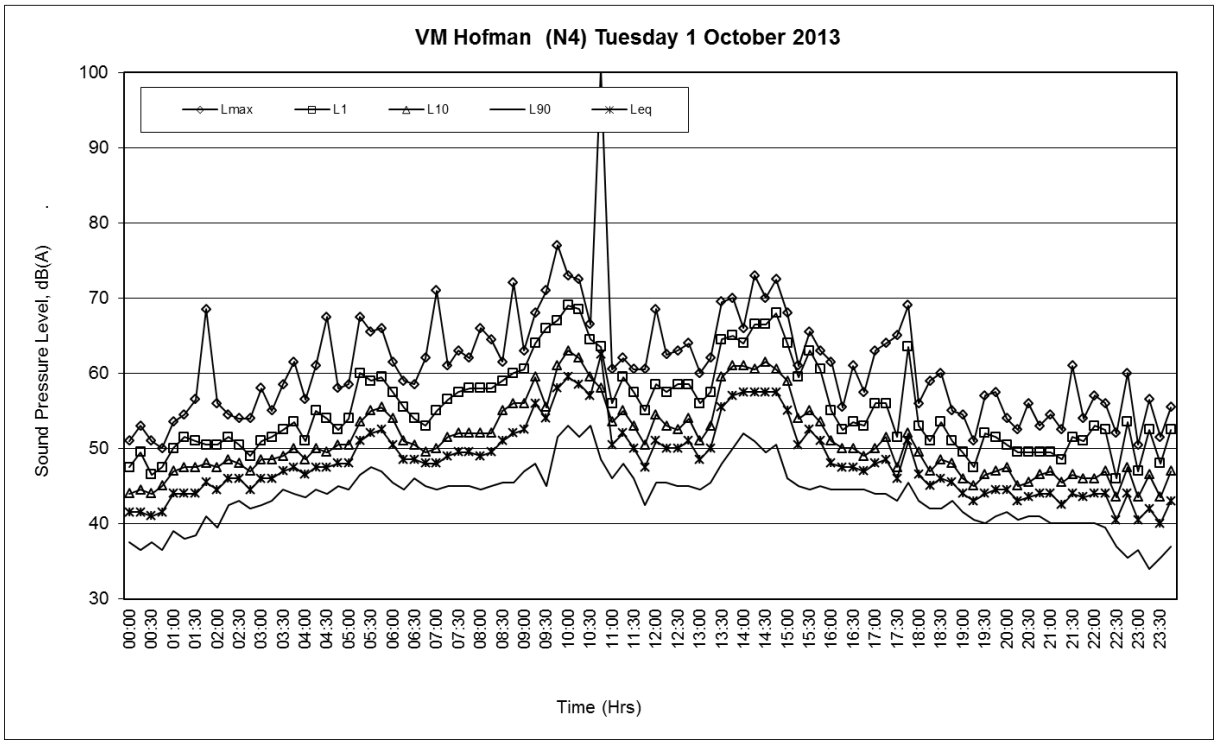

VM Hofman (N4) Thursday 26 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)

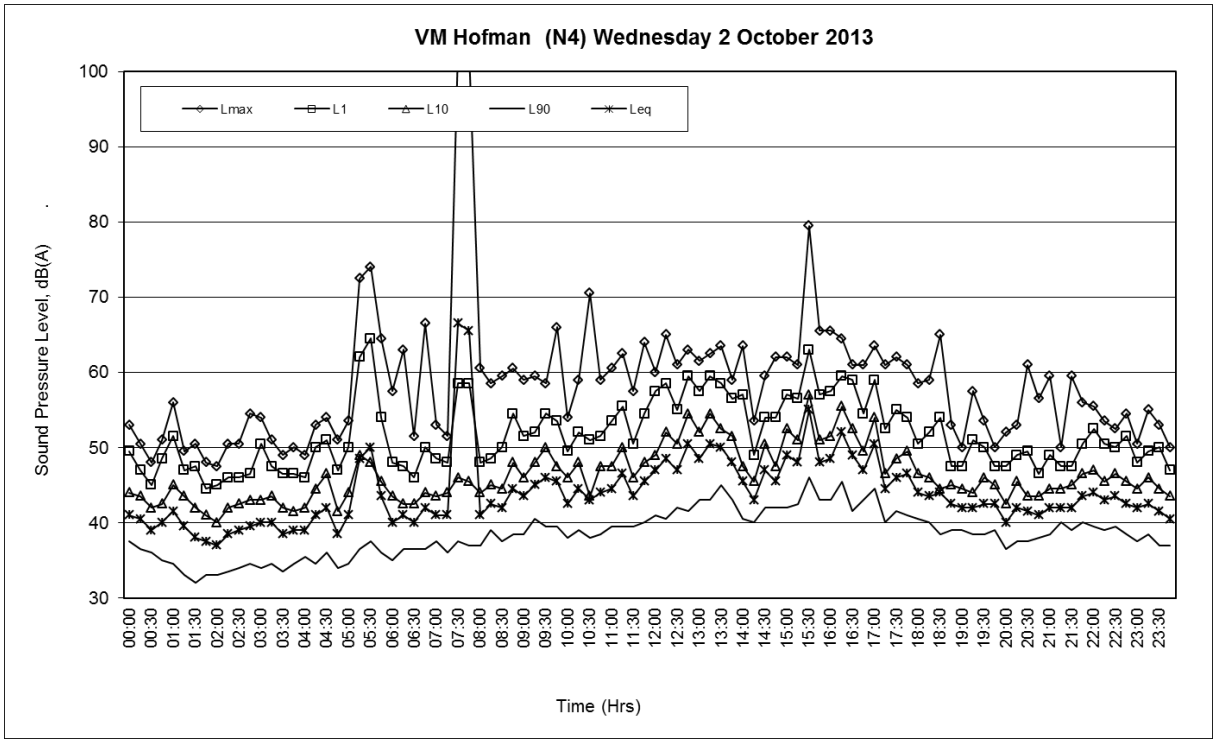

VM Hofman (N4) Friday 27 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)

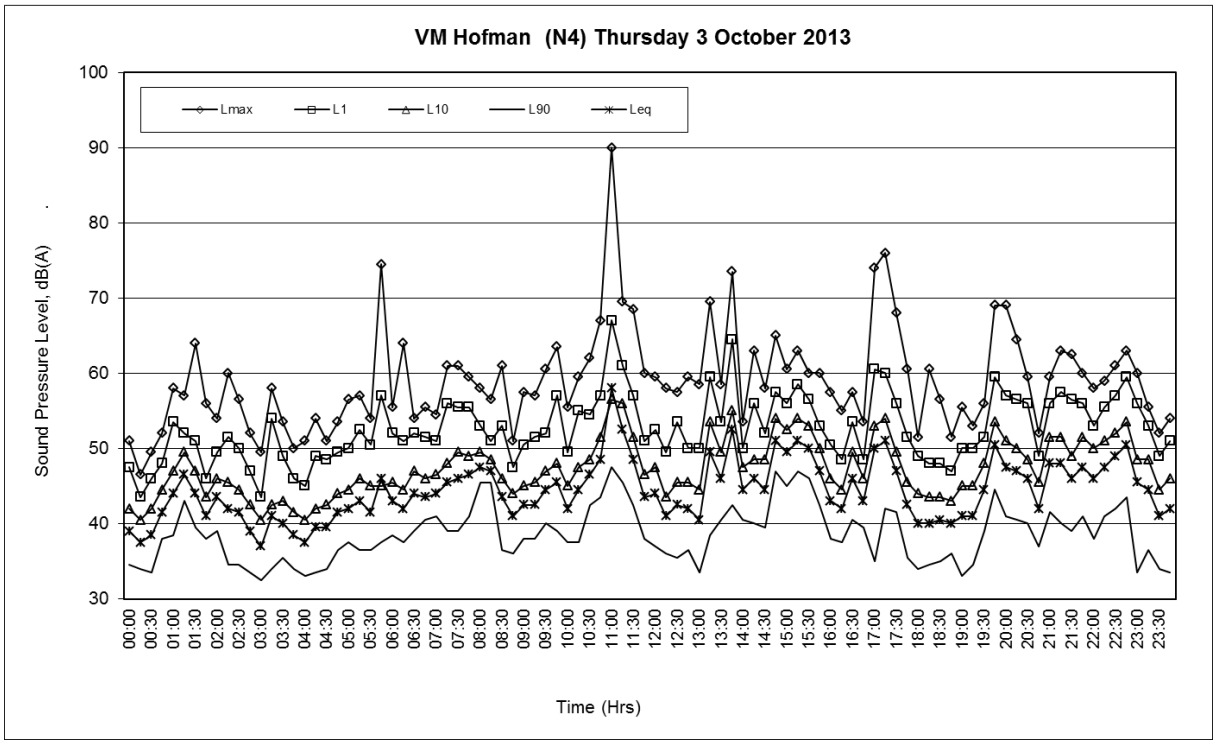

VM Hofman (N4) Saturday 28 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


VM Hofman (N4) Sunday 29 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


VM Hofman (N4) Monday 30 September 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


VM Hofman (N4) Tuesday 1 October 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


VM Hofman (N4) Wednesday 2 October 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


VM Hofman (N4) Thursday 3 October 2013
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)