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Duralie Coal Mine
Quarterly Compliance Noise Monitoring
September 2016

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Table of Contents

1	INTRODUCTION	5
1.1	Acoustic Terminology	5
2	DCM NOISE LIMITS	6
2.1	EPL Noise Limits	6
2.2	Project Approval Noise Limits	6
2.3	Rail Noise Limits	8
3	OPERATIONAL NOISE MONITORING METHODOLOGY	8
3.1	General Requirements	8
3.2	Methodology - Operator Attended Noise Monitoring Locations	9
4	RESULTS	11
4.1	Operator Attended Monitoring – DCM Operational Activity	11
4.1.1	Operator Attended Noise Survey Results – Monitoring Location NM1	11
4.1.2	Operator Attended Noise Survey Results – Monitoring Location NM2	13
4.1.3	Operator Attended Noise Survey Results – Monitoring Location NM3	14
4.1.4	Operator Attended Noise Survey Results – Monitoring Location NM4	16
4.1.5	Operator Attended Noise Survey Results – Monitoring Location Wards River	17
4.2	Operator Attended Monitoring – Rail Noise Survey	18
5	PERFORMANCE ASSESSMENT	19
5.1	Operations	19
5.2	Assessment of Compliance – Day period	19
5.3	Assessment of Compliance – Evening period	19
5.4	Assessment of Compliance – Night period	19
5.5	Sleep Disturbance	19
5.6	Low Frequency Noise	20
6	CONCLUSION	20

TABLES

Table 1	EPL Noise Limits for the nominated attended noise monitoring locations [dBA re 20 µPa]	6
Table 2	Noise Monitoring Locations	9
Table 3	Rail Noise Monitoring Locations	9
Table 4	Operator Attended Noise Survey Results – NM1	12
Table 5	Attended Noise Survey Results – NM2	13
Table 6	Attended Noise Survey Results – NM3	14
Table 7	Attended Noise Survey Results – NM4	16
Table 8	Attended Noise Survey Results – Wards River	17
Table 9	Performance Assessment – Operations	19
Table 10	Performance Assessment – Sleep Disturbance	19

FIGURES

Figure 1	Duralie Coal Mine Attended Noise Monitoring Locations	10
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Table of Contents

APPENDICES

Appendix A Acoustic Terminology

Appendix B Measured Ambient Noise Levels

1 INTRODUCTION

Duralie Coal Pty Limited (DCPL), a wholly owned subsidiary of Yancoal Australia Limited (Yancoal), has commissioned SLR Consulting Australia Pty Ltd (SLR) to conduct quarterly noise monitoring for the Duralie Coal Mine (DCM) operations guided by the requirements of the *Duralie Coal Mine Noise Management Plan* (NMP), Document No. NMP-R04-A, dated June 2015. This report presents the results and findings from the operator-attended noise surveys conducted between 16 September and 17 September 2016.

Coal production commenced at Duralie in 2003 using conventional open cut mining methods, operating 24 hours a day. The Duralie Extension Project (DEP) was approved under Project Approval (08_0203) on 10 November 2011, with a maximum Run-of-Mine (ROM) coal mining rate of 3 million tonnes per annum (Mtpa). Sized Duralie ROM coal is loaded and railed to the Stratford Coal Mine (SCM) for coal washing before being transported on the North Coast Railway to the port of Newcastle.

The original Noise Management Plan was prepared by DCPL in accordance with Condition 7, Schedule 3 of Project Approval (08_0203). The current version of the NMP was prepared by DCPL to consider:

- The outcomes of the Annual Review (2014) for the Duralie Coal Mine, submitted August 2014, in accordance with the requirements of Condition 4, Schedule 5 of the Project Approval.
- The recommendations from the Department of Planning & Environment (DP&E) Independent Environmental Compliance Audit completed on 6 December 2014 and the recommendations of the Duralie Coal Mine Rail Haulage Noise Audit (Wilkinson Murray, 2013) as well as a subsequent review following the granting of the Duralie Open Pit Modification 2.

The objectives of the noise monitoring programme for this operating period were as follows:

- Conduct three rounds of external operator-attended noise measurements at the five nominated locations listed in Project Approval, representative of receivers located in the north, west and south directions from the DCM. The monitoring locations are NM1, NM2, NM4, NM5 and the additional monitoring location in Wards River Village (hill on Wards Street).
The three rounds comprise a single round within each of the day, evening and night-time periods as defined in the NSW Industrial Noise Policy (EPA 2000).
- Rail Noise Monitoring – Perform one round of external operator-attended noise measurements at the three nominated locations listed in Section 7.6 of the NMP, being: TN1 (Craven), TN2 (Wards River Village North) and TN3 (Wards River Village South).
- Quantify all sources of noise within each of the attended noise surveys, including measured and/or estimated contribution and maximum level of individual noise sources.
- Assess the noise emissions from the DCM and determine compliance with respect to the limits contained in the NMP.

1.1 Acoustic Terminology

The following report uses specialist acoustic terminology. An explanation of common terms is provided in **Appendix A**.

2 DCM NOISE LIMITS

2.1 EPL Noise Limits

The site specific noise limits of sub-section L4.1 of Section L4 *Noise Limits* of the EPA's Environment Protection Licence (EPL), EPL 11701 dated 20 August 2014, for the five nominated attended noise monitoring locations, are summarised in **Table 1**.

Table 1 EPL Noise Limits for the nominated attended noise monitoring locations [dBA re 20 µPa]

Locality	LAeq(15 min) Criteria			LA1(1minute) Criterion
	Day	Evening	Night	Night
NM1 Woodley	35	35	35	45
NM2 Zulmovski North	35	35	35	45
NM3 Mahony	35	35	35	45
NM4 Fisher-Webster	35	35	37	45
Wards River (Additional Monitoring Location)	35	35	35	45

Additional conditions relating to the noise monitoring location and applicable meteorological conditions are outlined in sub-sections L4.2 (a) and L4.8 of EPL 11701 and are summarised below.

L4.2 (a) with the L_{eq} (15-minute) noise limits in condition 4.1, the noise measurement equipment must be located:

Approximately on the property boundary, where any dwelling is situated 30 metres or less from the property boundary closest to the premises; or

Within 30 metres of a dwelling façade, but not closer than 3 m, where any dwelling on the property is situated more than 30 metres from the boundary closest to the premises.

Noise from the premises is to be measured at a distance within 30 metres of the locations identified in L4.1 to determine compliance with this condition.

L4.8 The noise limits set out in condition in L4.1 apply under all meteorological conditions except for the following:

- a) wind speeds greater than 3 metres/second at 10 metres above ground level; or*
- b) Temperature Inversion conditions up to 3 degrees Celsius/100m and wind speeds greater than 2 metres/second at 10 metres above the ground level; or*
- c) Temperature inversion conditions greater than 3 degrees Celsius/100m.*

2.2 Project Approval Noise Limits

The Project Approval conditions relating to the noise limits are as follows:

NOISE

Noise Criteria

2. Except for the land referred to in Table 1, the Proponent shall ensure that the noise generated by the project does not exceed the criteria in Table 2 at any residence on privately-owned land or on more than 25 percent of any privately-owned land.

Table 2: Noise criteria dB(A)

Location	Day	Evening	Night	
	$L_{Aeq}(15 \text{ minute})$	$L_{Aeq}(15 \text{ minute})$	$L_{Aeq}(15 \text{ minute})$	$L_{A1}(1 \text{ minute})$
172 - Lyall	35	39	40	45
126 – Hamann Pixalu PL	35	35	39	45
123 – Oleksiuk & Carmody				
173 – Trigg & Holland	35	36	37	45
116 - Weismantel				
127 – Fisher-Webster	35	35	37	45
131(1) - Relton				
180 (1) - Thompson	35	36	36	45
95 - Smith & Ransley	35	35	36	45
144 - Wielgosinski				
169 - Williams	35	36	35	45
177 - Thompson				
All other privately-owned land	35	35	35	45

Notes:

- To identify the locations referred to in Table 2, see the figure in Appendix 3; and
- Noise generated by the project is to be measured in accordance with the relevant procedures and exemptions (including certain meteorological conditions) of the NSW Industrial Noise Policy.

However, these criteria do not apply if the Proponent has a written agreement with the relevant landowner to exceed the criteria, and the Proponent has advised the Department in writing of the terms of this agreement.

Noise Acquisition Criteria

3. If the noise generated by the project exceeds the criteria in Table 3 at any residence on privately-owned land or on more than 25 percent of any privately-owned land, then upon receiving a written request for acquisition from the landowner, the Proponent shall acquire the land in accordance with the procedures in Conditions 5 - 6 of Schedule 4.

Table 3: Noise acquisition criteria dB(A) $L_{Aeq}(15min)$

Location	Day	Evening	Night
All privately-owned land	40	40	40

Notes:

- Noise generated by the project is to be measured in accordance with the relevant procedures and exemptions (including certain meteorological conditions) of the NSW Industrial Noise Policy; and
- For this condition to apply, the exceedences of the criteria must be systemic.

Rail Noise

5. By the end of December 2011, or as otherwise agreed by the Director-General, the Proponent shall only use locomotives that are approved to operate on the NSW rail network in accordance with the noise limits in the ARTC's EPL (No. 3142).

Operating Conditions

6. The Proponent shall:
 - (a) implement best practice noise management, including all reasonable and feasible noise mitigation measures to minimise the operational, low frequency and rail noise generated by the project; and
 - (b) regularly assess the real-time noise monitoring and meteorological forecasting data and relocate, modify, and/or stop operations on site to ensure compliance with the relevant conditions of this approval, to the satisfaction of the Director-General.

2.3 Rail Noise Limits

The site specific rail noise limits of Clause L2.2 of the DCM NMP Section 4.2.2 are:

It is the objective of this license to progressively reduce noise levels to the goals of 65dB(A)Leq , (daytime from 7am – 10pm), 60dB(A)Leq (night-time from 10pm – 7am) and 85dB(A) (24hr) max pass-by noise, at one metre from the façade of affected residential properties through the implementation of the Pollution Reduction Programs.

Additionally, Section 7.6 of the DCM NMP specifies:

Rail Noise monitoring and reporting against the other rail noise performance criteria described in Section 4 will be undertaken for general information purposes only (i.e. they are not DCM compliance requirements).

Furthermore, Schedule 3 Condition 4(e) of the DCPL Extension Project Approval states:

On privately owned land between the Stratford and Duralie mines where the maximum pass-by rail traffic noise from the Project exceeds 85dB(A), the Proponent shall implement additional noise mitigation measures (such as double glazing, insulation, and/or air conditioning) at the residence in consultation with the owner. These measures must be reasonable and feasible.

3 OPERATIONAL NOISE MONITORING METHODOLOGY

3.1 General Requirements

All acoustic instrumentation employed throughout the monitoring programme has been designed to comply with the requirements of AS IEC 61672.1 – 2004 *Electroacoustics—Sound level meters – Specifications*, AS IEC 61672.2-2004, AS IEC 61672.3-2004 and carried current NATA or manufacturer calibration certificates. Instrument calibration was checked before and after each measurement survey, with the variation in calibrated levels not exceeding ± 0.5 dBA.

3.2 Methodology - Operator Attended Noise Monitoring Locations

Noise monitoring was conducted guided by the requirements of the NMP.

Operator attended noise measurements were conducted during the day, evening and night-time periods for a minimum of 15 minutes per period at each of the five nominated noise monitoring locations. The details of the operator-attended mine noise monitoring locations are contained within **Table 2** and shown in **Figure 1**. During the operator attended noise measurements, the character and relative contribution of ambient noise sources and colliery contributions were determined.

Table 2 Noise Monitoring Locations

Monitoring Location	Receiver Type	Resident / Owner	Monitoring Location - MGA Zone 56	
			Easting (m)	Northing (m)
NM1	Residence	Woodley ¹	400644	6421907
NM2 ²	Residence	Zulumovski North	399042	6430384
NM3 ³	Residence	Mahony	400198	6431032
NM4	Residence	Fisher-Webster	396790	6428961
RTNM1	Residence	Wards River Village	399765	6430622

Note:

1. Woodley property has recently been purchased by the Thompson family but will retain the title of 'Woodley' until a License revision.
2. Yancoal owned property.
3. Property under private agreement.

The details of the operator-attended rail noise monitoring locations are contained within **Table 3** and shown in **Figure 1**.

Table 3 Rail Noise Monitoring Locations

Monitoring Location	Receiver Type	Address	Monitoring Location - MGA Zone 56	
			Easting (m)	Northing (m)
TN1	Residence	Craven	400252	6441916
TN2	Residence	Wards River Village North	399914	6434771
NM3	Residence	Wards River Village South	399765	6434421

The objective of the operator attended noise monitoring was to measure the maximum (L_{Amax}) and the L_{Aeq}(15minute) noise level contributions at the nearest potentially affected receptors to determine the noise contribution of mining activities associated with Duralie Coal Mine operations over a 15 minute measurement period. In addition, the operator quantifies and characterises the overall levels of ambient noise in the area (i.e. L_{Amax}, LA1, LA10, LA90, and L_{Aeq}) over the 15 minute measurement interval.

Operator attended noise measurements were conducted using a one-third octave integrating Brüel & Kjær Type 2250L sound level meter (s/n 3004635).

Figure 1 Duralie Coal Mine Attended Noise Monitoring Locations



4 RESULTS

4.1 Operator Attended Monitoring – DCM Operational Activity

Operator attended noise measurements were conducted during day, evening and night periods on Friday 16 September 2016. Results of the operator attended noise surveys at NM1 through NM4 and at the additional monitoring location in Wards River Village (Wards Street) are provided in **Table 4** to **Table 8**, respectively.

A summary of the results for the attended noise monitoring are displayed graphically in Appendix B. Charts of the noise surveys show L_{Amax}, L_{Aeq}, and L_{Aeq}(12.5Hz-1.25kHz) and where required, shaded bands represent periods containing the audible DCM noise contribution.

Ambient noise levels presented include all noise sources such as transport (roads and aircraft), fauna (insects, frogs, birds, and bats), the natural environment (wind in trees), domestic noises, other industrial operations as well as Duralie Coal Mine noise emissions.

Weather data during the monitoring period has been obtained from the weather station located on the Duralie Coal Mine site. Where this data was not available meteorological conditions have been estimated based on observed conditions during the monitoring period.

The tables provide the following information:

- Date and start time, operator and equipment details.
- Monitoring location.
- Wind velocity (m/s) and temperature (°C) at the measurement location.
- Typical maximum (L_{Amax}) and contributed L_{Aeq}(15minute) noise levels.

4.1.1 Operator Attended Noise Survey Results – Monitoring Location NM1

Results of the operator attended noise surveys at NM1 are provided in **Table 4** Monitoring Location NM1 represents residential receptors located to the south of the site.

Table 4 Operator Attended Noise Survey Results – NM1

Period	Date/Start Time/ Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emissions and Typical Maximum Noise Levels (dBA)
		L _{Amax}	L _{A1}	L _{A10}	L _{A90}	L _{Aeq}	
Day	16/9/2016 15:41 19°C 5.0 - 5.9 m/s West	70	65	47	34	50	<i>Site related noise events:</i> Duralie Coal Mine: Inaudible <i>Other noise events:</i> Sheep 43 to 70 Wind gust 42 to 62 Wind (breeze) 35 to 39 Aircraft 34 to 49 Bird calls 41 to 66 Farmstead noise 35 Farm voices 37 to 48 Farm impacts 47 to 48 Road traffic noise 38
Evening	16/9/2016 18:33 17°C 0.8 - 1.6 m/s NW to WNW	51	49	44	40	43	<i>Site related noise events:</i> Duralie Coal Mine: Inaudible <i>Other noise events:</i> Road Traffic noise 40 to 42 Road traffic noise (distant) < 35 Insects/Frogs 40 to 49 Poultry farm 25 to 30 Train 44 to 51
Night	17/9/2016 1:37 9°C 0.3 - 0.5 m/s S - SE	38	35	32	26	30	<i>Site related noise events:</i> Duralie Coal Mine: Intermittently audible low frequency noise from mobile plant (Haul trucks) Calculated contribution L_{Aeq}(15minute) <20 dBA L_{A1}(1minute) 28 dBA Haul truck (<500 Hz) 19 to 28 <i>Other noise events:</i> Insects/Frogs 26 to 38 Poultry farm 11 to 12 Industrial noise (Urban) 29 to 35 Birds 32 to 34

DCM operations were inaudible during the day and evening period noise surveys at this location. DCM operations were intermittently audible during the night period operator attended noise survey at this location.

The ambient noise environment at the monitoring location during the day period was dominated by wind gusts, sheep and aircraft flyover noise. Other contributory noise sources included farm noises (voices, impacts), birds and distant road traffic noise.

The ambient noise environment at the monitoring location during the evening period was dominated insects and frog noise as well as a train passby. Other contributory noise sources included farm noises (mechanical plant) and distant road traffic noise.

The ambient noise environment at the monitoring location during the night period was dominated by insects and frog noise. Other contributory noise sources included urban town centre industrial noise, birds and poultry farm noise (mechanical plant).

The DCM LAeq(15minute) noise contribution was estimated to be less than 20 dBA during the night-time period. The major site noise contributor identified during the survey were haul truck activity.

During the night-time noise monitoring survey an on-site haul truck resulted in a LA1(1minute) noise level of 28 dBA.

4.1.2 Operator Attended Noise Survey Results – Monitoring Location NM2

Results of the operator attended noise surveys at NM2 are provided in **Table 5**. Monitoring location NM2 represents residential receptors located to the north of the site.

Table 5 Attended Noise Survey Results – NM2

Period	Date/Start Time/ Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emissions and Typical Maximum Noise Levels (dBA)
		L _{Amax}	L _{A1}	L _{A10}	L _{A90}	L _{Aeq}	
Day	16/9/2016 16:45 19°C 0.0 - 2.9 m/s West	63	56	49	33	46	<i>Site related noise events:</i> Duralie Coal Mine: Inaudible <i>Other noise events:</i> Road Traffic (Bucketts Way) 33 to 56 Bird calls 30 to 63 Cow 45 Dogs barking 36 to 39 Train horn 36
Evening	16/9/2016 20:19 17°C 2.8 – 3.3 m/s West	63	52	46	36	44	<i>Site related noise events:</i> Duralie Coal Mine: Audible intermittent mobile plant (Haul trucks) Calculated contribution LAeq(15minute) 19 dBA Haul truck (<500 Hz) 20 to 39 <i>Other noise events:</i> Insects/Frogs 37 to 44 Dogs barking 43 to 50 Road Traffic (Bucketts Way) 41 to 52 Road Traffic (Adjacent road) 43 to 63 Aircraft 21 to 30 Bird 40 Cows 38 to 47
Night	16/9/2016 23:19 13°C 1.6-1.9 m/s SSE	49	44	41	33	38	<i>Site related noise events:</i> Duralie Coal Mine: Audible low frequency continuum and intermittent mobile plant (Haul trucks) Calculated contribution LAeq(15minute) 32 dBA LA1(1minute) 45 dBA Haul truck (<500 Hz) 28 to 45 Continuum ≤ 800 Hz 29 to 33 <i>Other noise events:</i> Insects/Frogs 29 to 41 Road Traffic (Bucketts Way) 30 to 48 Birds 37 to 40 Dogs 30 to 37 Cows 34 to 44

DCM operations were inaudible during the day period noise survey at this location. DCM operations were audible during both the evening and night period operator attended noise surveys at this location.

The ambient noise environment at the monitoring location during the day period was dominated by road traffic noise from The Bucketts Way roadway and birds. Other contributory noise sources included farm animals (cows and dogs) and a train horn.

The ambient noise environment at the monitoring location during the evening period was dominated road traffic noise, insects dogs. Other contributory noise sources included the DCM noise contribution, birds, cows and aircraft flyover noise.

The ambient noise environment at the monitoring location during the night period was dominated by road traffic noise from The Bucketts Way roadway, insects and the DCM noise contribution. Other contributory noise sources included cows, birds and dogs barking.

The DCM LAeq(15minute) noise contribution was estimated to be 32 dBA during the night-time period. The major site noise contributors identified during the survey were haul truck activity and operational low frequency continuum.

During the night-time noise monitoring survey an on-site haul truck resulted in a LA1(1minute) noise level of 45 dBA.

4.1.3 Operator Attended Noise Survey Results – Monitoring Location NM3

Results of the operator attended noise surveys at NM3 are provided in **Table 6**. Monitoring location NM3 represents residential receptors located to the west of the site.

Table 6 Attended Noise Survey Results – NM3

Period	Date/Start Time/ Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emissions and Typical Maximum Noise Levels (dBA)
		LAmx	LA1	LA10	LA90	LAeq	
Day	16/9/2016 16:19 19°C 4.2 – 4.8 m/s WNW	62	59	56	49	54	<i>Site related noise events:</i> Duralie Coal Mine: Inaudible <i>Other noise events:</i> Ride-on-mower 49 to 62 Road Traffic (Bucketts Way) 44 to 59 Road Traffic (Monkerai Rd) 55 Wind gust 55 to 57 Bird calls 40 to 53
Evening	16/9/2016 19:12 17°C 2.4 – 2.8 m/s WNW - W	62	58	51	41	48	<i>Site related noise events:</i> Duralie Coal Mine: Inaudible <i>Other noise events:</i> Insects / Frogs 41 to 45 Homestead generator 42 to 44 Road Traffic (Bucketts Way) 30 to 52 Road Traffic (Monkerai Rd) 48 to 62 Aircraft 31 to 35 Wind 41 to 48 Bird calls 44 to 45 Dogs barking 44 to 46

Period	Date/Start Time/ Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emissions and Typical Maximum Noise Levels (dBA)
		L _{Amax}	L _{A1}	L _{A10}	L _{A90}	L _{Aeq}	
Night	17/9/2016 00:57 10°C 0.7-0.8 m/s ENE - SSW	62	55	44	36	43	<p><i>Site related noise events:</i></p> <p>Duralie Coal Mine: Audible low frequency continuum and intermittent mobile plant (Haul trucks, excavator, dozer), activity noise</p> <p>Calculated contribution L_{Aeq}(15minute) <20 dBA L_{A1}(1minute) 27 dBA</p> <p>Haul truck (<500 Hz) 20 to 26 Engine exhaust fans/continuum (<800 Hz) 9 to 27 Track Dozer 21 to 27</p> <p><i>Other noise events:</i> Road Traffic (Bucketts Way) 45 to 51 Road Traffic (Monkerai Rd) 46 to 62 Insects/Frogs 36 to 43 Cows 42 to 44</p>

DCM operations were inaudible during both the day and evening period noise surveys at this location. Between lulls in road traffic noise, DCM operations were intermittently audible during the night period operator attended noise survey at this location.

The ambient noise environment at the monitoring location during the day period was dominated by use of a ride-on mower at the property, road traffic noise (both Monkerai Road and The Bucketts Way). Other contributory noise sources included intermittent birds and wind noise.

The ambient noise environment at the monitoring location during the evening period was dominated insects and frog noise as well as road traffic noise (both Monkerai Road and The Bucketts Way). Other contributory noise sources included the homestead generator (mechanical plant), aircraft noise, birds and dogs.

The ambient noise environment at the monitoring location during the night period was dominated insects and frog noise as well as road traffic noise (both Monkerai Road and The Bucketts Way). Other contributory noise sources included the DCM noise contribution and cows.

The DCM L_{Aeq}(15minute) noise contribution was estimated to be less than 20 dBA during the night-time period. The major site noise contribution sources identified during the survey were haul truck activity, dozer activity and excavator noise.

During the night-time noise monitoring survey an on-site haul truck resulted in a L_{A1}(1minute) noise level of 27 dBA.

4.1.4 Operator Attended Noise Survey Results – Monitoring Location NM4

Results of the operator attended noise surveys at NM4 are provided in **Table 7**. NM4 represents residential receptors located to the north of the site.

Table 7 Attended Noise Survey Results – NM4

Period	Date/Start Time/ Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emissions and Typical Maximum Noise Levels (dBA)
		L _{Amax}	L _{A1}	L _{A10}	L _{A90}	L _{Aeq}	
Day	16/9/2016 17:14 19°C 0.0 – 2.9 m/s West	70	52	43	32	42	<i>Site related noise events:</i> Duralie Coal Mine: Inaudible <i>Other noise events:</i> People's voices and activity 32 to 70 Cows 41 to 51 Dogs barking 43 to 49 Birds 36 to 51 Road traffic 40
Evening	16/9/2016 19:45 17°C 2.4 – 2.9 m/s West	71	63	56	40	52	<i>Site related noise events:</i> Duralie Coal Mine: Barely audible intermittent mobile plant and impacts Calculated contribution L_{Aeq}(15minute) 18 dBA Haul truck (<500 Hz) 24 to 51 Impact (low frequency) 25 <i>Other noise events:</i> Insects/Frogs 38 to 39 Dogs barking 52 to 71 Road Traffic (Bucketts Way) 43 to 60 Aircraft 22 to 51
Night	16/9/2016 23:50 12°C 1.1 – 1.4 m/s N	67	60	54	34	49	<i>Site related noise events:</i> Duralie Coal Mine: Audible low frequency continuum and intermittent mobile plant (Haul trucks, excavator, dozer), activity noise Calculated contribution L_{Aeq}(15minute) 29 dBA L_{A1}(1minute) 33 dBA Haul truck (<500 Hz) 27 to 35 Engine exhaust fans/continuum (<800 Hz) 27 to 35 Track Dozer 27 to 35 Low frequency impacts 24 to 34 <i>Other noise events:</i> Insects/Frogs 29 to 43 Dogs 34 to 67 Cows 38 to 60 Bulls 47 to 48 Road Traffic Noise 44 to 55

DCM operations were inaudible during the day period noise survey at this location. DCM operations were barely audible during the evening period and audible during the night period operator attended noise surveys at this location.

The ambient noise environment at the monitoring location during the day period was dominated by farm activity (people's voices and activity); other contributory noise sources included birds, dogs barking, cows and road traffic noise.

The ambient noise environment at the monitoring location during the evening period was dominated by dogs barking. Other contributory noise sources included insects and frogs, aircraft noise, road traffic noise and aircraft flyover noise.

The ambient noise environment at the monitoring location during the night period was dominated by dogs barking. The Bucketts Way roadway, insects and the DCM haul truck noise contribution. Other contributory noise sources included the DCM contribution, cows/bulls, birds and The Bucketts Way roadway.

The DCM LAeq(15minute) noise contribution was estimated to be 29 dBA during the night-time period. The major site noise contributors identified during the survey were intermittent mobile plant activity (haul trucks, track dozer, excavator noise) and the operational low frequency continuum.

During the night-time noise monitoring survey on-site mobile plant activity resulted in a LA1(1minute) noise level of 33 dBA.

4.1.5 Operator Attended Noise Survey Results – Monitoring Location Wards River

Results of the operator attended noise surveys at Wards River are provided in **Table 8**. Wards River represents residential receptors located in Wards River to the north of the site.

Table 8 Attended Noise Survey Results – Wards River

Period	Date/Start Time/Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emissions and Typical Maximum Noise Levels (dBA)
		LAmx	LA1	LA10	LA90	LAeq	
Day	16/9/2016 17:44 18°C 0.0-2.3 m/s WNW	74	63	45	33	51	<i>Site related noise events:</i> Duralie Coal Mine: Inaudible <i>Other noise events:</i> Local road traffic (Ward St) 41 to 74 Road traffic (Bucketts Way) 37 to 49 Cows 38 to 49 Bats (in trees) 37 to 40 Dogs barking 48 to 56 Birds 30 to 53 Domestic noises 33 to 45 Car doors 49 to 53 Aircraft 27 to 45
Evening	16/9/2016 20:54 18°C 0.0 – 1.8 m/s NW	57	44	40	33	37	<i>Site related noise events:</i> Duralie Coal Mine: Inaudible <i>Other noise events:</i> Insects/Frogs 33 to 37 Road traffic (Bucketts Way) 33 to 57 Cows 42 to 46 Bulls 36 to 47

Period	Date/Start Time/ Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emissions and Typical Maximum Noise Levels (dBA)
		L _{Amax}	L _{A1}	L _{A10}	L _{A90}	L _{Aeq}	
Night	17/11/2016 00:23 11°C 0.1 – 0.4 m/s ENE - WSW	51	43	37	26	34	<p><i>Site related noise events:</i></p> <p>Duralie Coal Mine: Audible to barely audible low frequency continuum and intermittent mobile plant (Haul trucks, excavator)</p> <p>Calculated contribution L_{Aeq}(15minute) <15 dBA L_{A1}(1minute) 39 dBA</p> <p>Haul truck (<500 Hz) 18 to 39 Engine exhaust fans/continuum (<800 Hz) 19 to 31</p> <p><i>Other noise events:</i></p> <p>Road traffic 26 to 51 Insects/Frogs 26 to 37 Cow 29 to 40</p>

DCM operations were inaudible during both the day and evening period noise surveys at this location. DCM operations were audible to barely audible during the night period operator attended noise surveys at this location.

The ambient noise environment at the monitoring location during the day period was dominated by domestic noises from the nearby residences, road traffic noise and fauna noises (dogs, cows, bats). Other sources included aircraft noise.

The ambient noise environment at the monitoring location during the evening period was dominated by The Bucketts Way road traffic noise and continuous insects/frogs noise. Other sources include cows and bulls and general domestic noises.

The ambient noise environment at the monitoring location during the night period was dominated by The Bucketts Way road traffic noise and continuous insects/frogs noise. Other contributory noise sources included the DCM contribution in periods of road traffic lulls.

The DCM L_{Aeq}(15minute) noise contribution was estimated to be less than 15 dBA during the night-time period. The major site noise contributors identified during the survey were intermittent mobile plant activity (haul trucks, track dozer, excavator noise) and the operational low frequency continuum.

During the night-time noise monitoring survey on-site mobile plant activity resulted in a L_{A1}(1minute) noise level of 39 dBA.

4.2 Operator Attended Monitoring – Rail Noise Survey

During the operator attended noise survey period there was no site rail activity. Consequently, no maximum pass-by rail traffic noise measurements were able to be undertaken.

5 PERFORMANCE ASSESSMENT

5.1 Operations

Results of the operator attended noise measurements compared with the relevant noise criteria contained in the Project Approval and EPL 11701 are given in **Table 9**.

Table 9 Performance Assessment – Operations

Location	Estimated DCM LAeq(15minute) Contribution dBA			Noise Criteria LAeq(15minute) dBA			Compliance		
	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night
NM1	I/A ²	I/A	<20	35	35	35	Yes	Yes	Yes
NM2	I/A	19	32	35	35	35	Yes	Yes	Yes
NM3	I/A	I/A	<20	35	35	35	Yes	Yes	Yes
NM4	I/A	18	29	35	35	37	Yes	Yes	Yes
Wards River	I/A	I/A	<15	35	35	35	Yes	Yes	Yes

Note 1: I/A = Inaudible

5.2 Assessment of Compliance – Day period

Results presented in **Table 9** indicate that compliance with the consent conditions was achieved at all attended noise monitoring locations during the day period.

5.3 Assessment of Compliance – Evening period

Results presented in **Table 9** indicate that compliance with the consent conditions was achieved at all attended noise monitoring locations during the evening period.

5.4 Assessment of Compliance – Night period

Results presented in **Table 9** indicate that compliance with the consent conditions was achieved at all attended noise monitoring locations during the night period.

5.5 Sleep Disturbance

Results of the night period sleep disturbance measurements compared with the relevant noise criteria contained in the Project Approval and EPL 11701 are given in **Table 10**.

Table 10 Performance Assessment – Sleep Disturbance

Location	DCM LA1(1minute) Contribution	Noise Criteria LA1(1minute)	Compliance
NM1	28	45	Yes
NM2	45	45	Yes
NM3	27	45	Yes
NM4	33	45	Yes
Wards River	39	45	Yes

Table 10 indicates that compliance with the relevant sleep disturbance noise criteria was achieved at all noise monitoring locations during the night-time noise monitoring period.

5.6 Low Frequency Noise

The Duralie Modification Environmental Assessment included a low frequency analysis of C and A weighted intrusive noise levels in accordance with INP requirements which indicated that there is no dominant low-frequency content relating to noise emissions from Duralie Coal Mine.

6 CONCLUSION

SLR was engaged by *Duralie Coal Pty Limited* (DCPL) to conduct quarterly noise monitoring for the Duralie Coal Mine (DCM) guided by the requirements of the *Duralie Coal Mine Noise Management Plan* (NMP), Document No. NMP-R04-A, dated June 2015.

Operator-attended noise monitoring conducted at five locations between 16 September and 17 September 2016 in order to determine the noise performance of the DCM operations, has resulted in the following per period assessment of compliance:

- Compliance with the relevant noise criteria was achieved at all noise monitoring locations during the day period.
- Compliance with the relevant noise criteria was achieved at all noise monitoring locations during the evening period.
- Compliance with the relevant noise criteria was achieved at all noise monitoring locations during the night period.

Based on the measured DCM noise contribution compliance with the relevant sleep disturbance noise criteria was achieved at all noise monitoring locations during the night-time noise monitoring period.

No reporting against the rail noise performance criteria was possible this round of monitoring as there was no site rail activity during the operator attended noise survey period.

ACOUSTIC TERMINOLOGY

1 Sound Level or Noise Level

The terms “sound” and “noise” are almost interchangeable, except that in common usage “noise” is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2E-5 Pa.

2 “A” Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an “A-weighting” filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People’s hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120 110	Heavy rock concert Grinding on steel	Extremely noisy
100 90	Loud car horn at 3 m Construction site with pneumatic hammering	Very noisy
80 70	Kerbside of busy street Loud radio or television	Loud
60 50	Department store General Office	Moderate to quiet
40 30	Inside private office Inside bedroom	Quiet to very quiet
20	Unoccupied recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A weighting. Sound Levels measured without any weighting are referred to as “linear”, and the units are expressed as dB(lin) or dB.

3 Sound Power Level

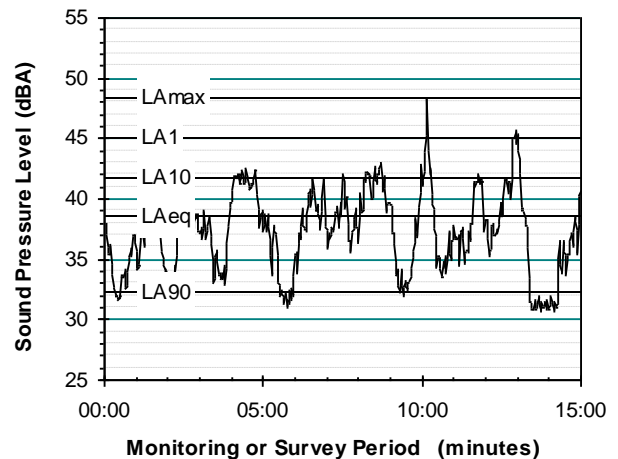
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 1E-12 W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating the statistical indices.



Of particular relevance, are:

- LA1 The noise level exceeded for 1% of the 15 minute interval.
- LA10 The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.
- LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.
- LAeq Is the A-weighted equivalent continuous noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the “repeatable minimum” LA90 noise level over the daytime and night-time measurement periods, as required by the DECCW. In addition the method produces mean or “average” levels representative of the other descriptors (LAeq, LA10 etc).

ACOUSTIC TERMINOLOGY

5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than "broad band" noise.

6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7 Frequency Analysis

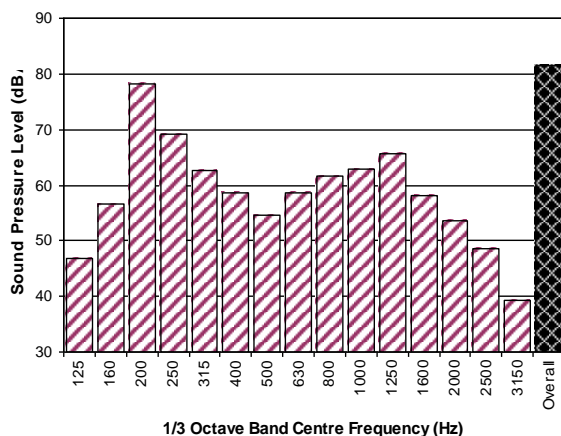
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of "peak" velocity or "rms" velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as "peak particle velocity", or PPV. The latter incorporate "root mean squared" averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V , expressed in mm/s can be converted to decibels by the formula $20 \log (V/V_0)$, where V_0 is the reference level (1E-6 mm/s). Care is required in this regard, as other reference levels are used by some organisations.

9 Human Perception of Vibration

People are able to "feel" vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

10 Overpressure

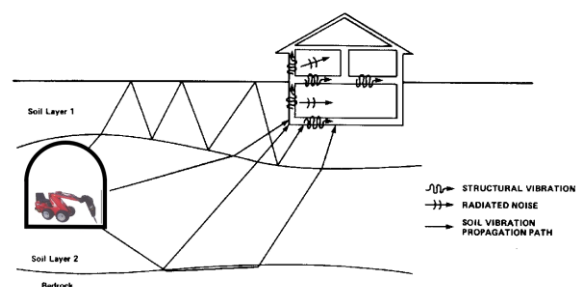
The term "over-pressure" is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

11 Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed "regenerated noise", "structure borne noise", or sometimes "ground-borne noise". Regenerated noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of regenerated noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents the various paths by which vibration and regenerated noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term "regenerated noise" is also used to describe other types of noise that are emitted from the primary source as a different form of energy. One example would be a fan with a silencer, where the fan is the energy source and primary noise source. The silencer may effectively reduce the fan noise, but some additional noise may be created by the aerodynamic effect of the silencer in the airstream. This "secondary" noise may be referred to as regenerated noise.

MEASURED AMBIENT NOISE LEVELS

Figure B1 – Day Period – NM1 Operator Attended Noise Survey Results

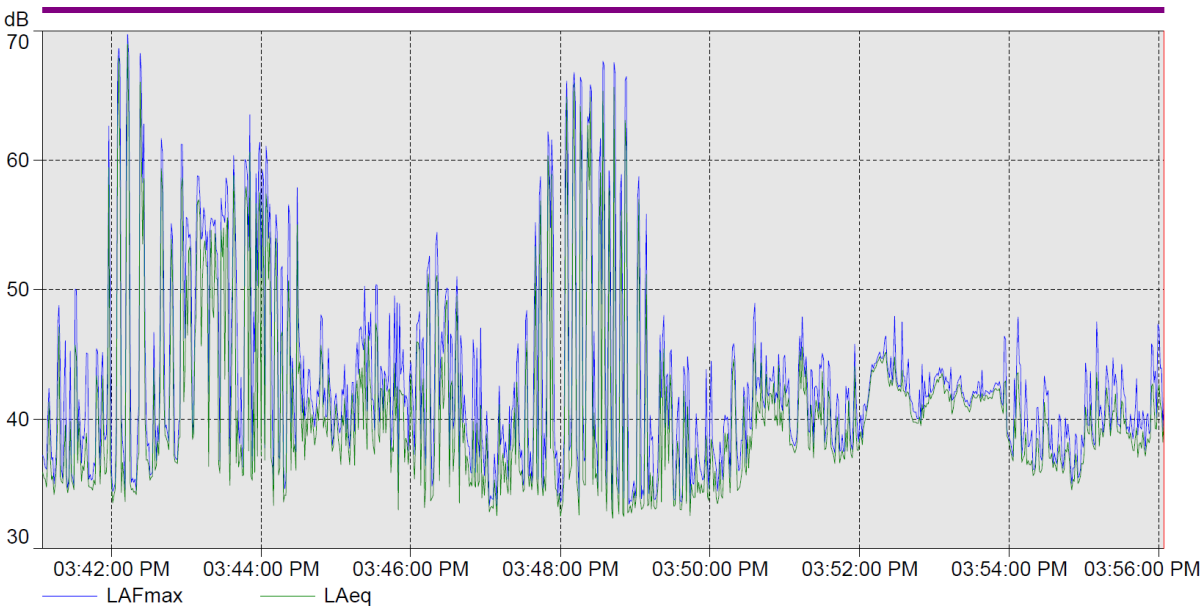
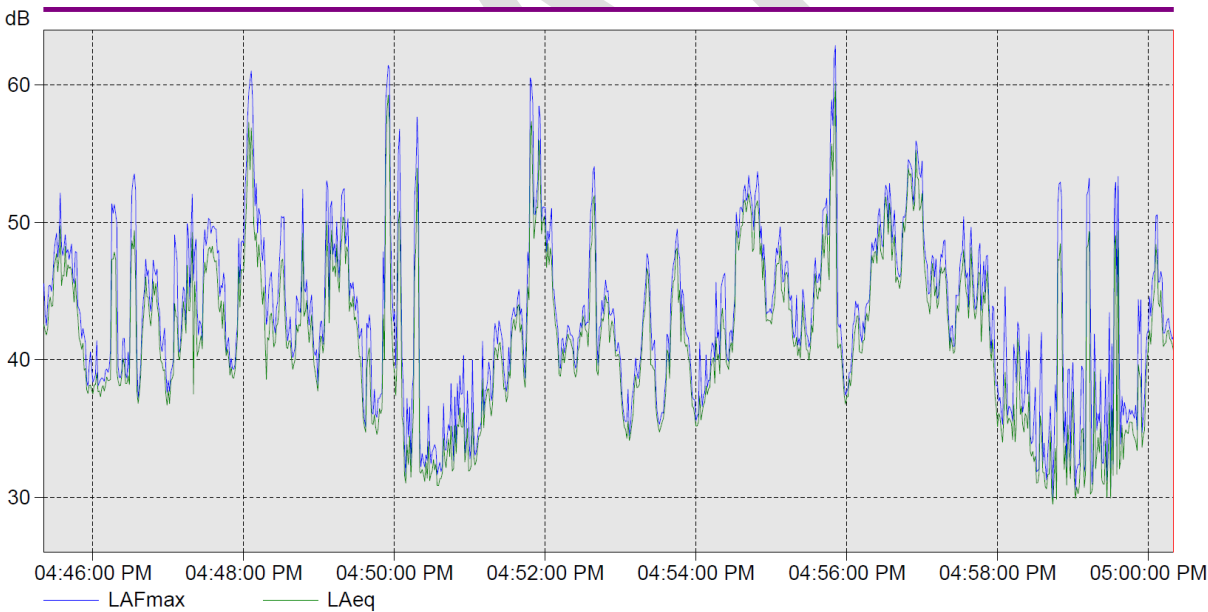


Figure B2 – Day Period – NM2 Operator Attended Noise Survey Results



MEASURED AMBIENT NOISE LEVELS

Figure B3 – Day Period – NM3 Operator Attended Noise Survey Results

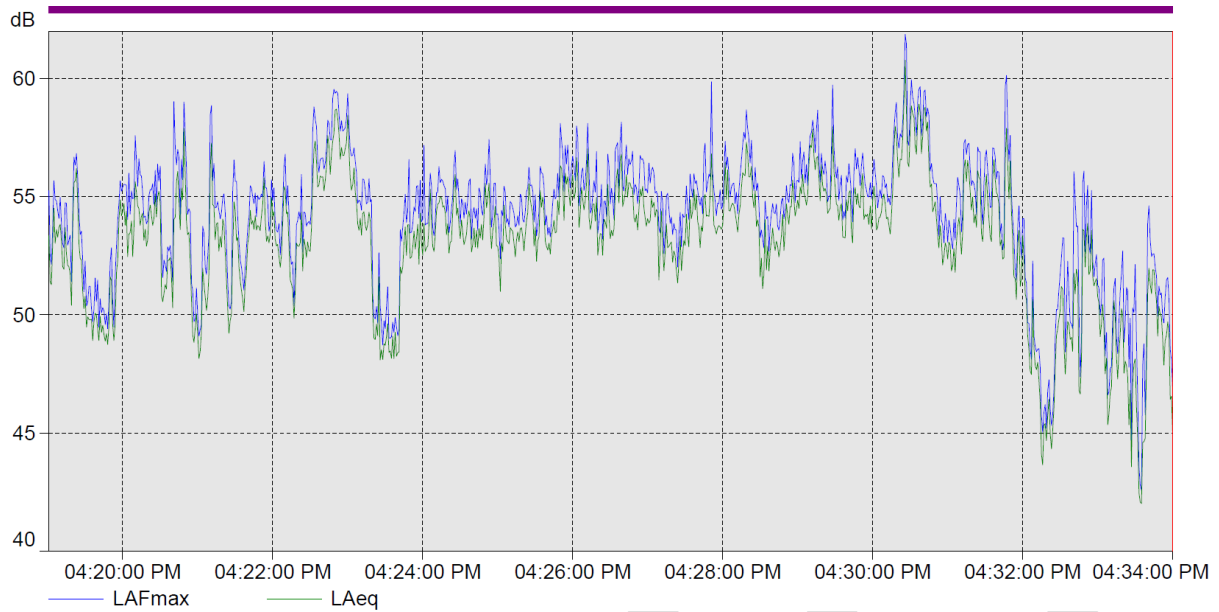
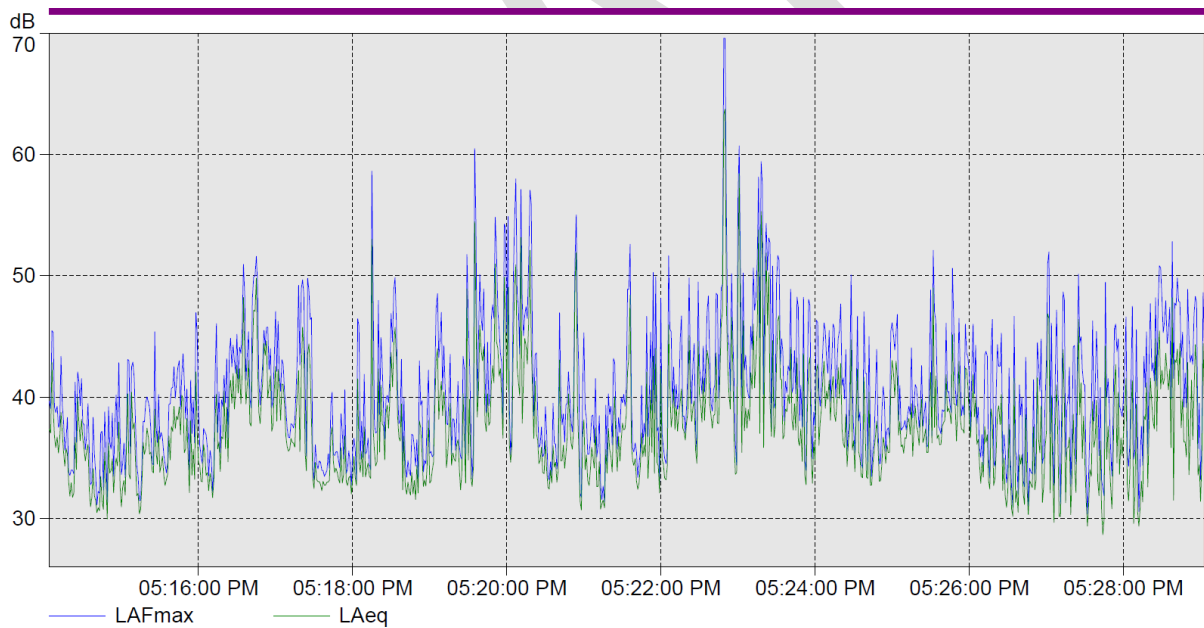


Figure B4 – Day Period – NM4 Operator Attended Noise Survey Results



MEASURED AMBIENT NOISE LEVELS

Figure B5 – Day Period – Wards River Operator Attended Noise Survey Results

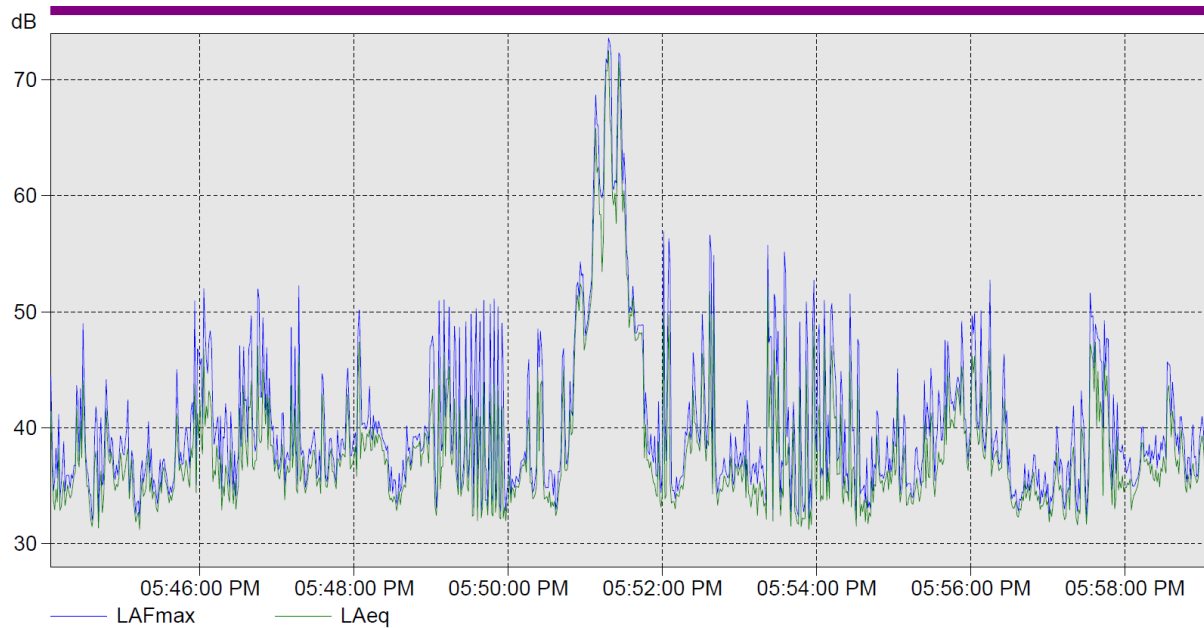
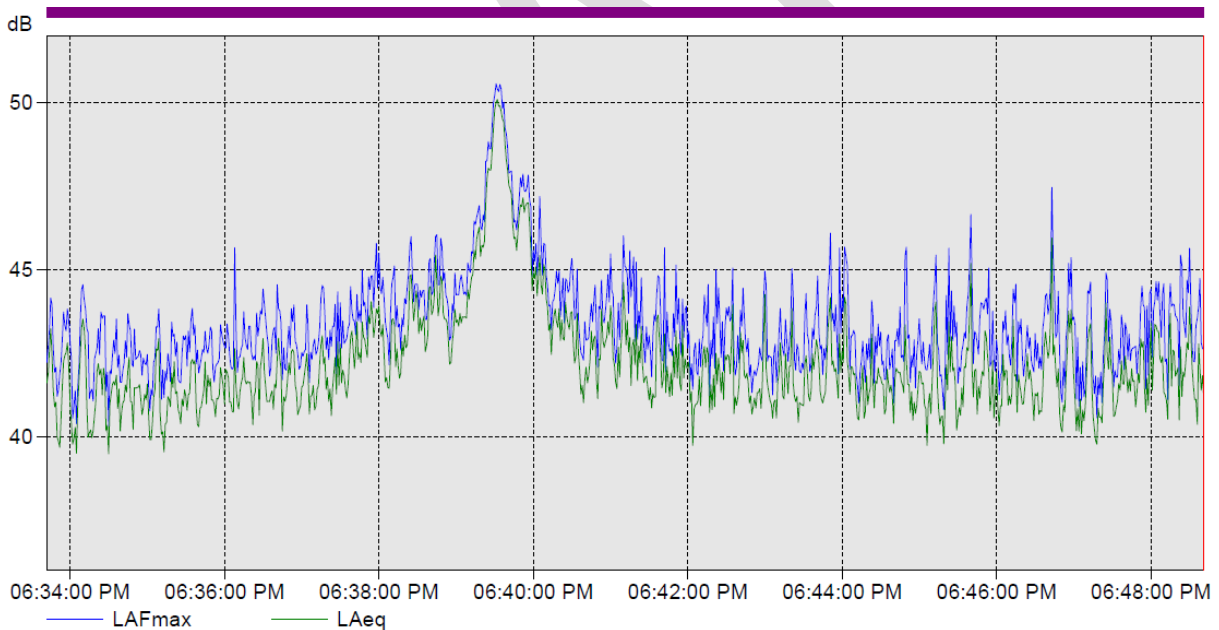


Figure B6 – Evening Period – NM1 Operator Attended Noise Survey Results



MEASURED AMBIENT NOISE LEVELS

Figure B7 – Evening Period – NM2 Operator Attended Noise Survey Results [Shaded bands represent periods containing audible DCM noise contribution]

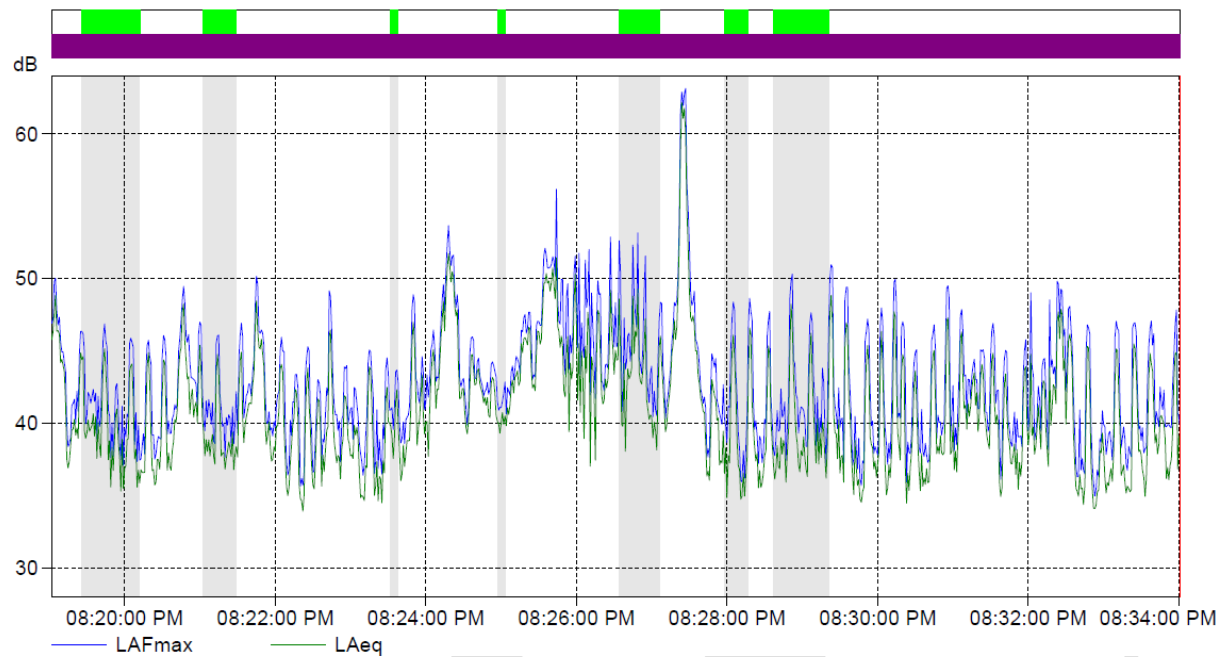
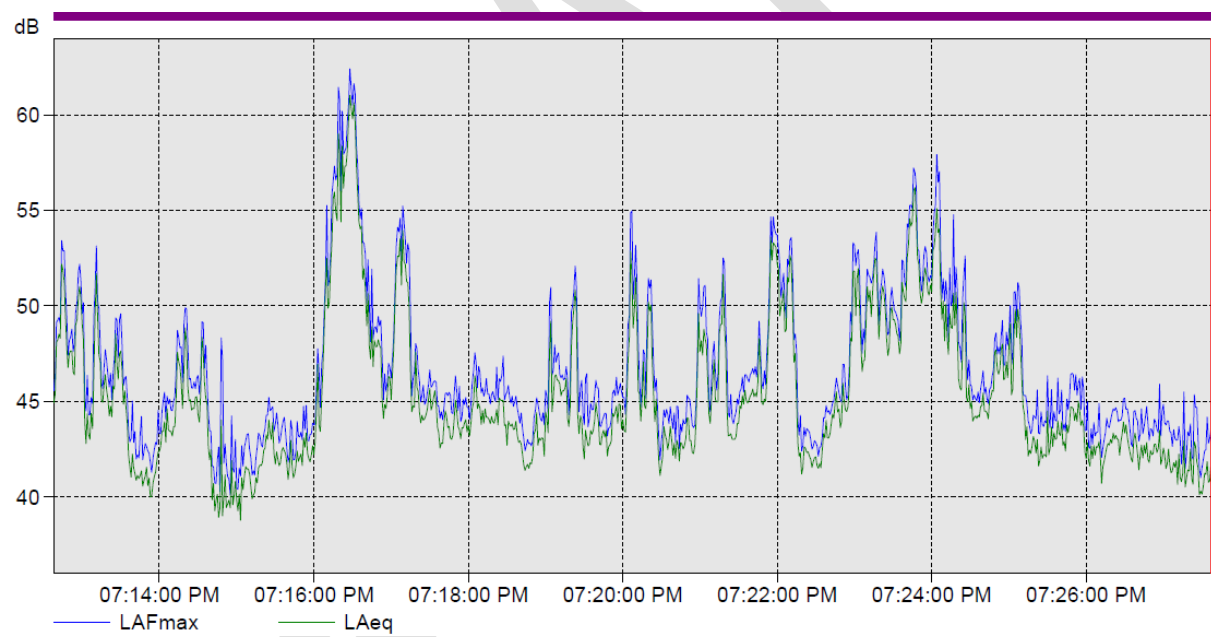


Figure B8 – Evening Period – NM3 Operator Attended Noise Survey Results



MEASURED AMBIENT NOISE LEVELS

Figure B9 – Evening Period – NM4 Operator Attended Noise Survey Results [Shaded bands represent periods containing audible DCM noise contribution]

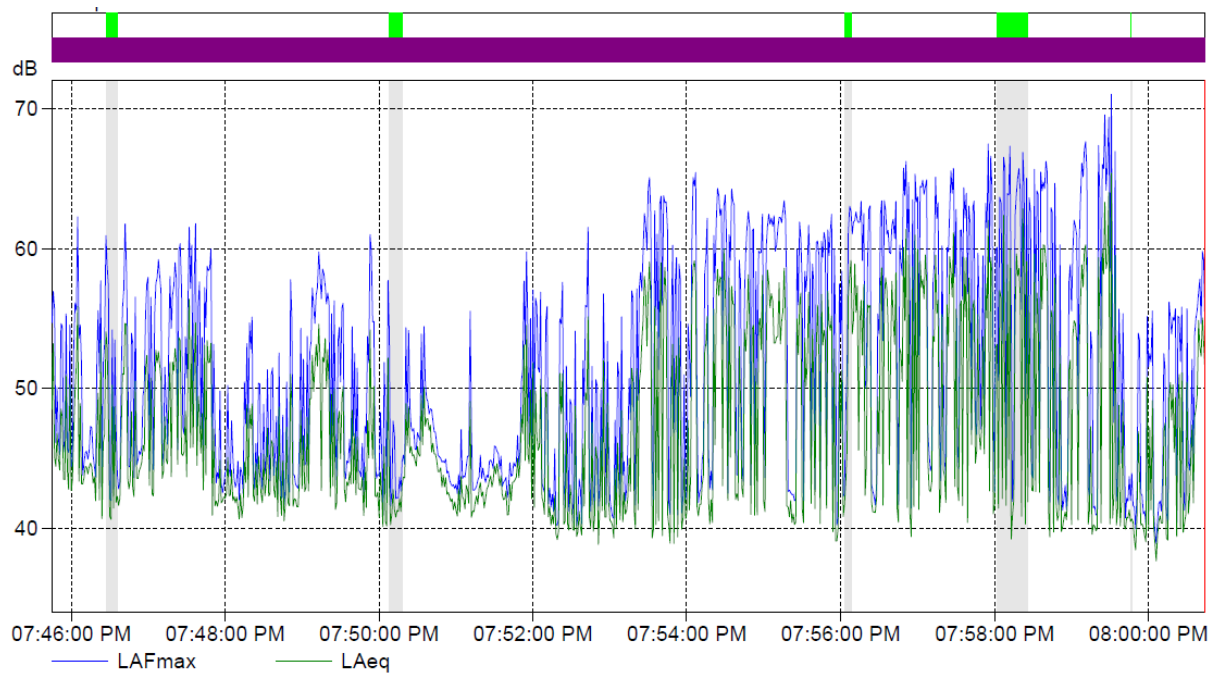
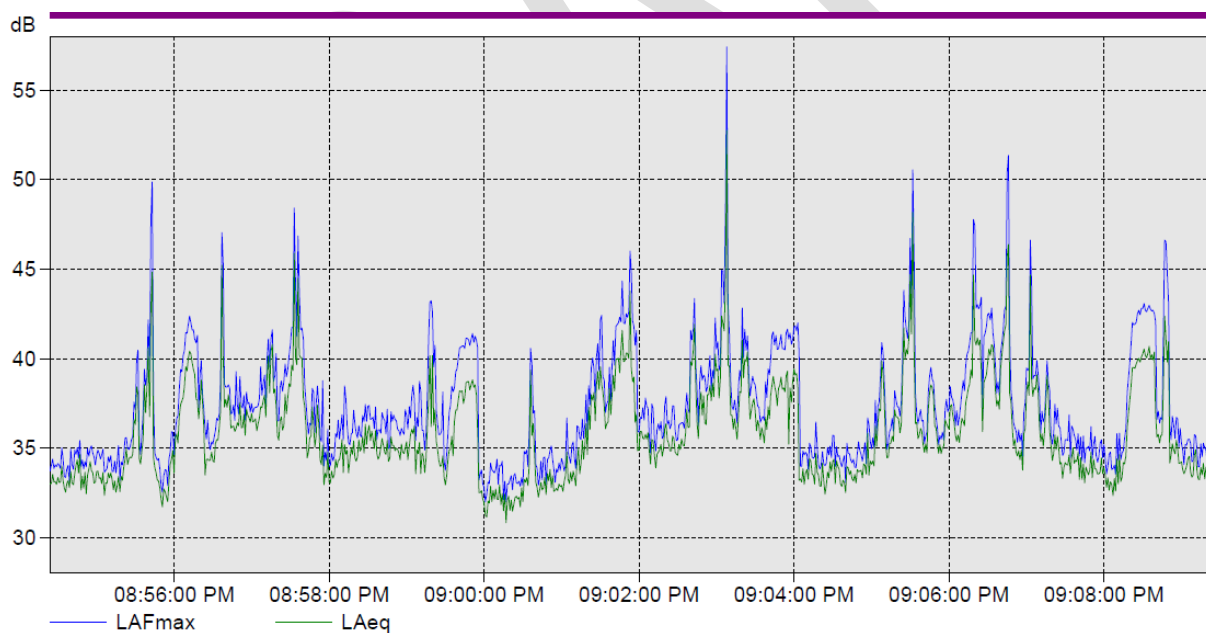


Figure B10 – Evening Period – Wards River Operator Attended Noise Survey Results



MEASURED AMBIENT NOISE LEVELS

Figure B11 – Night Period – NM1 Operator Attended Noise Survey Results [Shaded bands represent periods containing audible DCM noise contribution]

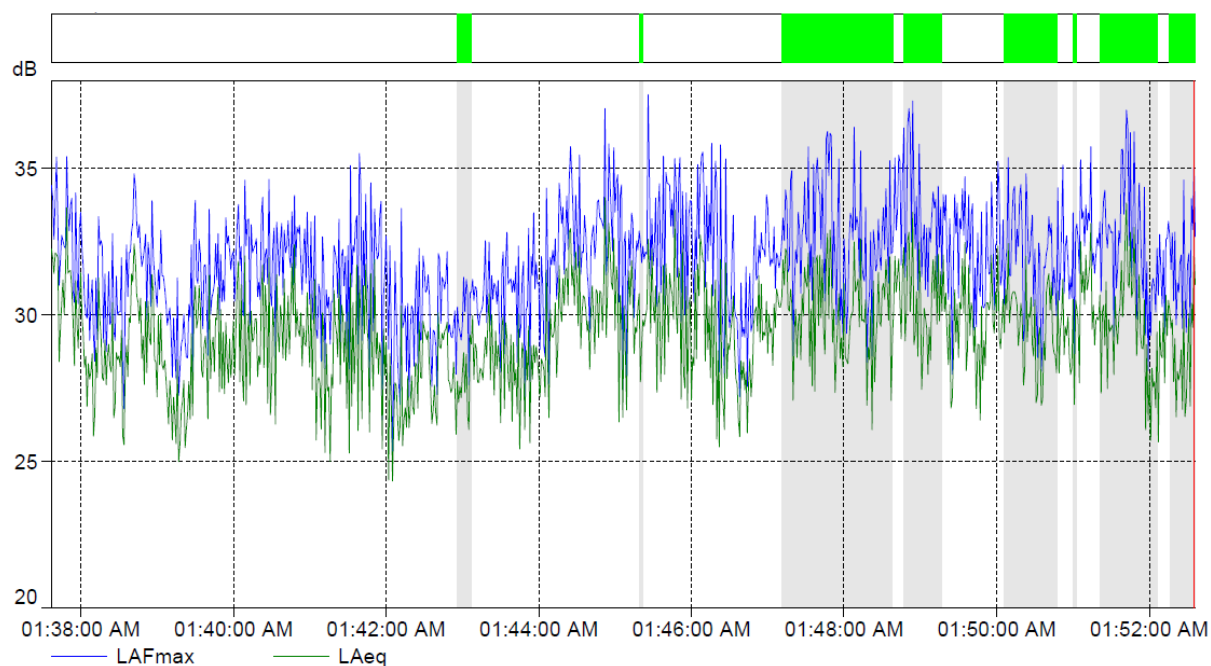
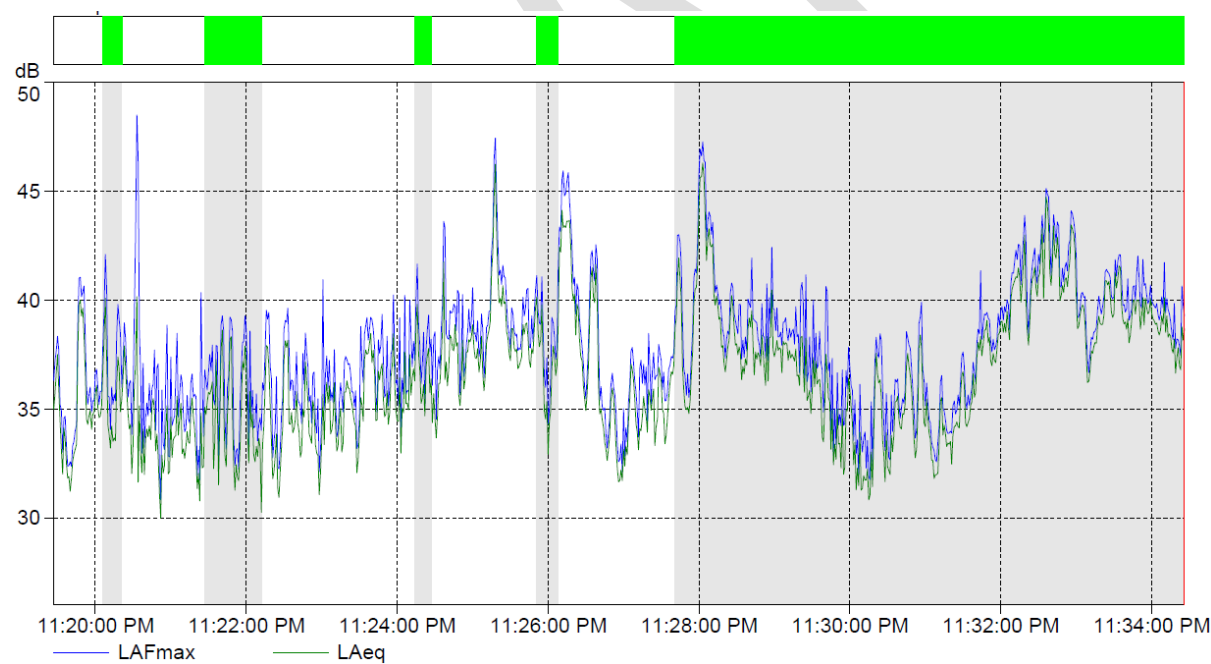


Figure B12 – Night Period – NM2 Operator Attended Noise Survey Results [Shaded bands represent periods containing audible DCM noise contribution]



MEASURED AMBIENT NOISE LEVELS

Figure B 13 – Night Period – NM3 Operator Attended Noise Survey Results [Shaded bands represent periods containing audible DCM noise contribution]

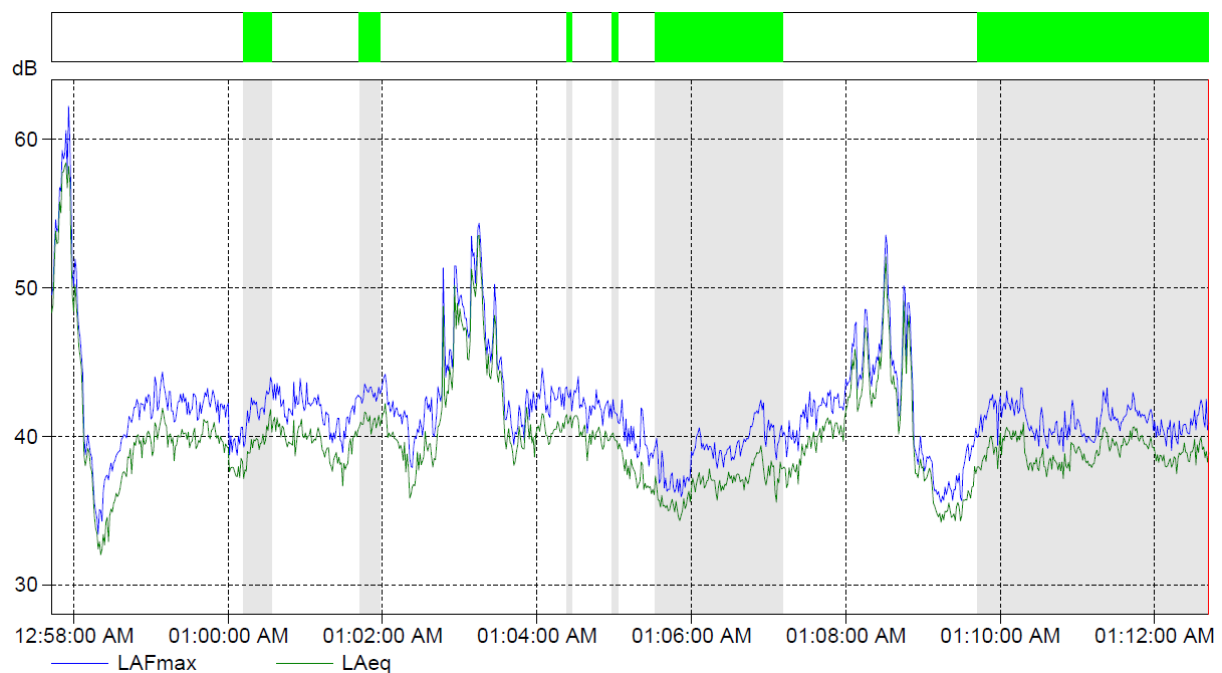


Figure B14 – Night Period – NM4 Operator Attended Noise Survey Results [Shaded bands represent periods containing audible DCM noise contribution]

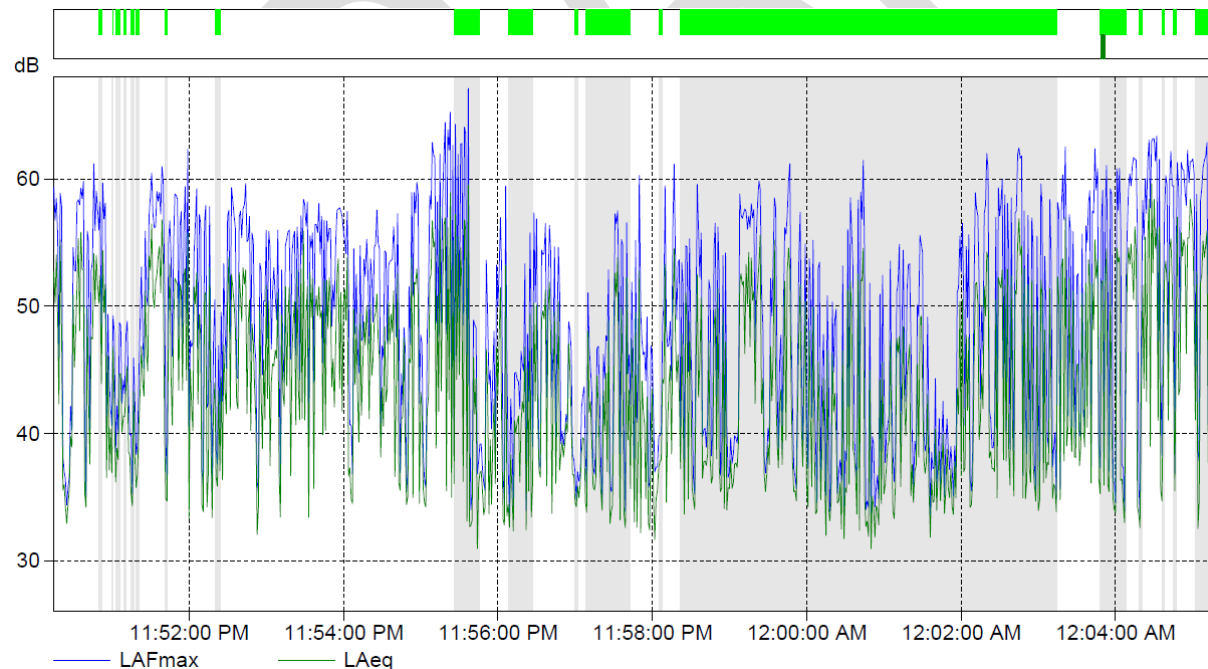


Figure B15 – Night Period – Wards River Operator Attended Noise Survey Results [Shaded bands represent periods containing audible DCM noise contribution]