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Project: Kerosene Vale Ash Repository Stage 2

Ongoing operational noise measurements

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1. Introduction

Aurecon was engaged by EnergyAustralia NSW to carry out ongoing operational noise monitoring for the Kerosene Vale Stage 2 Ash Repository (KVAR) located in Wallerawang, NSW. The noise measurements were carried out on Sunday 1st December and Monday 2nd December 2013, during the early morning and evening periods as per the requirements outlined in the KVAR Stage 2 Operations, Operational Noise and Vibration Management Plan (ONVMP).

1.1 Site details

The project site consists of an Ash Repository which services the nearby Wallerawang Power Station (WPS). The major noise emissions associated with the Stage 2 KVAR works are:

- Unloading of ash from trucks at the repository.
- Placement and handling of ash at the repository site.
- Operation of trucks on the private haul road; trucks leave WPS loaded with ash (travelling north) and return from the repository empty (travelling south)

Figure 1 shows the site layout and location of sensitive receivers relative to the major noise sources including WPS as well as major roads in the area. Table 1 outlines the most affected sensitive receivers and their distance to the haul road.

Table 1: Representative noise measurement locations

Representative sensitive receiver	Distance to haulage road (meters)*
60 Skelly Road	300
10 Skelly Road	270
21 Neubeck Street	145

Note * - distance relates to the property boundary or a point 30 m from the dwelling location

It should be noted that coal supply trucks also utilise the private haul road. Their noise impacts are not considered to be part of the Stage 2 KVAR works and thus their noise impact is outside the scope of this report. On site it is extremely difficult to visually distinguish between coal supply trucks and ash trucks. Therefore, for the purpose of prediction of noise emissions from ash trucks alone, Kerosene Vale provides truck movement numbers during the assessment periods.

Figure 1 | Site details

2. Noise criteria

The applicable operational noise criteria are outlined in the Project Approval, Application No. 07_0005. The criteria are summarised in condition 2.15 as follows:

> *2.15 The cumulative operational noise from the ash placement area and ash haulage activity shall not exceed a* ***$L_{Aeq\ (15\ minute)}$ of 40 dBA*** *at the nearest most affected sensitive receiver during normal operating hours as defined in condition 2.8.*
>
> *This criterion applies under the following meteorological conditions:*
>
> *a) Wind speeds up to 3 m/s at 10 meters above ground; and/or*
> *b) Temperature inversion conditions of up to 3°C/100 m and source to receiver gradient winds of up to 2 m/s at 10 m above ground level*

Normal operating hours in accordance with Conditions 2.8 are 7:00 am to 10:00 pm Monday to Sunday.

3. Noise measurements

3.1 Measurement methodology

Two types of measurements were carried out at the site: ambient noise measurements and sound exposure level measurements. The measurements were carried out on Sunday 1st December and Monday 2nd December 2013, during the early morning and evening periods, when the noise impacts are likely to be the most significant.

The ambient compliance noise measurements were conducted using a Larson Davis 831 Type 1 sound level meter which was set to 'A' frequency weighting, 'F' time weighting, and was fitted with an approved windshield. Measurements were typically taken at a height of 1.2 metres and at least 3.5 metres from any reflecting structure other than the ground. The measurement period at each location consisted of 15 minutes. A Larson Davis CAL200 was utilised to calibrate all sound level meters before and after each series of measurements with no significant calibration drift noted. The weather during the noise logging ranged from overcast to sunny conditions, and wind speeds less than 3m/s at ground level. Measurements were typically taken in accordance with the Australian Standard *AS 1055 1997: Acoustics – Description and measurement of environmental noise*.

Meteorological data was referenced from Blackmans Flat Weather station for the duration of noise survey to establish stability conditions and wind speeds at 10 metres above ground level.

The Sound Exposure Level (SEL) measurements were also carried out using a Larson Davis 831 Type 1 sound level meter. SEL is the equivalent one second A-weighted sound level which would produce the same sound energy as the actual event. The measurement was commenced when the truck was observed to pass a consistent location and stopped when the end of the truck passed a second consistent location. The reference locations were identified where the truck could be visually observed.

During both types of measurements no rain periods were experienced. Minimal wind was induced on the microphone with light breeze periods being significantly below the 3 m/s threshold.

3.2 Measurement locations

The measurement locations were chosen to represent the three most affected sensitive receivers as outlined in the Operational Noise and Vibration Management Plan (ONVMP). The three most affected receivers prior to commencement of the measurements were identified based on the information in the Stage 2 Kerosene Vale Ash Repository operational noise review.

Due to the increased background noise level at each of the three noise monitoring locations it was difficult to assess individual truck noise events. A fourth noise monitoring location was selected closer to the haulage route to measure individual truck pass-by events (Appendix C). Table 2 and Figure 2 outline the noise measurement locations.

Table 2: Representative noise measurement locations

Measurement location	Measurement distance to haulage road (meters)	Representative sensitive receiver
A	300	60 Skelly Road
B	270	10 Skelly Road
C	145	21 Neubeck Street
D	82	-

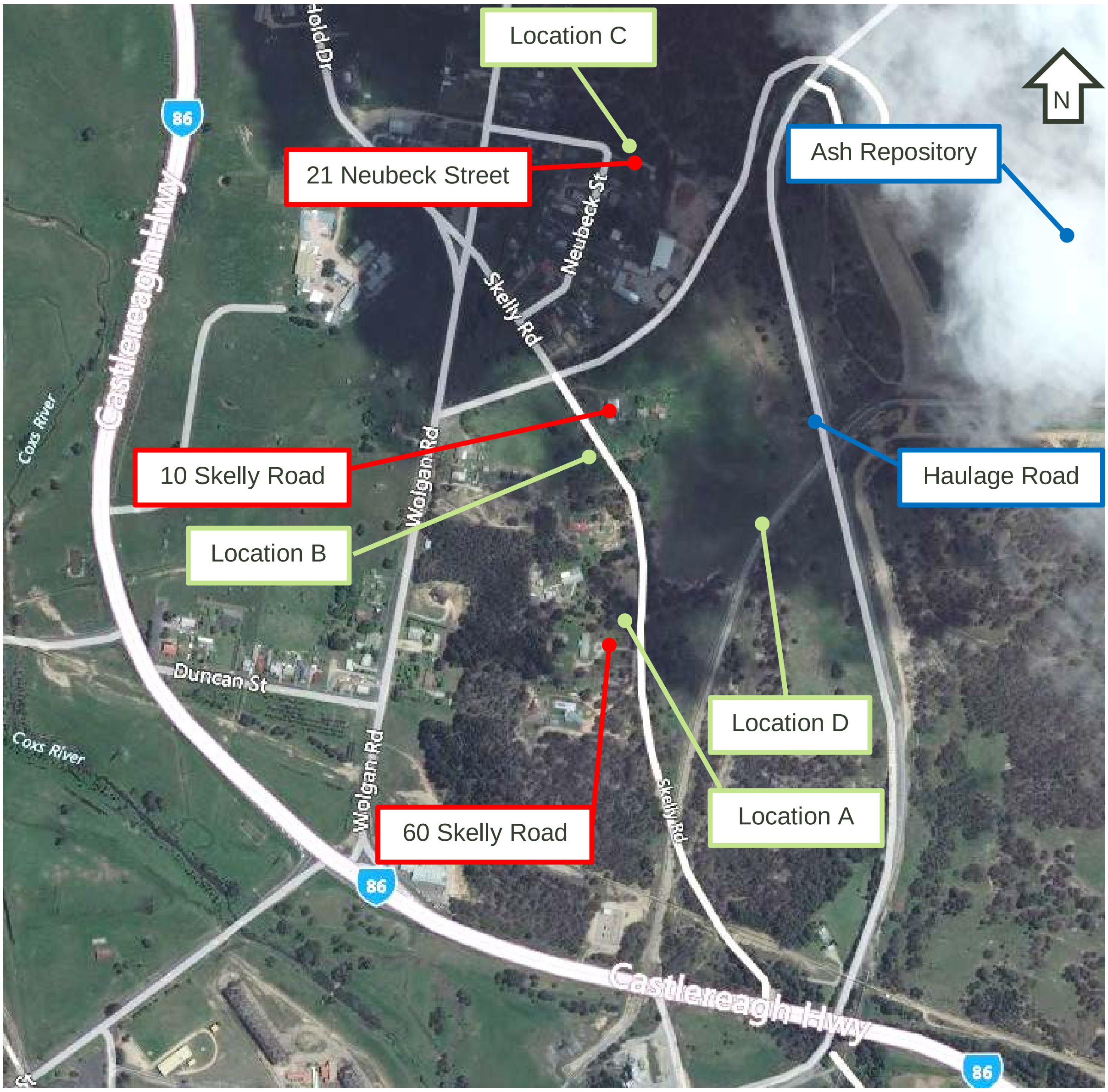


Figure 2 | Noise measurement locations

3.3 Operating and meteorological conditions

EnergyAustralia NSW has provided the following information regarding the operations during the noise survey.

- The ash silos normally operate at approximately 85% capacity.
- Trucks were operating during all measurement periods moving from north to south and visa-versa on the haulage road east of Skelly Road. The truck movements observed during the measurement period included ash trucks, small commercial vehicles and possibly coal trucks. Trucks were operating at a constant rate, with approximate 15 - 20 minute circuits for each truck from 7am – 10pm.

The meteorological conditions during the noise survey based on meteorological data provided at 15 minute intervals from the Blackmans Flat weather station are shown in Appendix D. The weather station details are as follows:

3.4 Results

3.4.1 Ambient noise measurements

The results from the 15 minute ambient noise measurements at each of the measurement locations are shown in Table 3.

Noise measurements were conducted on Sunday 1st December and Monday 2nd December 2013 when normal operations of haul trucks and haulage activity at the ash repository site was evident.

Table 3: Noise measurement results (15 minute)

Location	Date of measurement	Time	Sound pressure level (dBA)					Number of truck Pass-bys and direction of travel[1]		
			L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}	North	South	Total
60 Skelly Road (A)	01/12/2013	7:54	40	59	34	42	36	2	1	3
		19:19	43	65	34	42	36	0	0	0
	02/12/2013	8:11	46	72	33	44	36	2	1	3
		20:57	42	63	37	44	38	2	3	5
10 Skelly Road (B)	01/12/2013	7:33	45	69	35	49	38	3	2	5
		19:02	44	63	33	47	37	0	0	0
	02/12/2013	7:53	45	66	33	48	37	2	3	5
		20:38	40	60	31	43	33	2	2	4
21 Neubeck Street (C)	01/12/2013	7:01	48	64	40	50	43	2	1	3
		18:41	43	66	30	47	33	0	1	1
	02/12/2013	7:32	50	79	30	48	35	2	1	3
		20:18	37	60	29	37	31	2	2	4

Note : 1 - Truck counts include ash trucks and light commercial trucks.

The measured $L_{Aeq\ (15\ min)}$ is generally in excess of the assessment criteria of $L_{Aeq\ (15\ min)}$ of 40 dBA. The high noise levels are mainly associated with local noise events such bird noise and traffic noise levels from surrounding roads as well as some truck pass-bys along the haulage route. The high background noise levels at many of the measured locations were not entirely contributed by KVAR operations.

3.4.2 SEL measurements

The individual truck pass-by noise event (Sound Exposure Level, SEL) measurements at Location D are summarised in Table 4 which were conducted on 7th November 2011 and 21st April 2013. Based on the visual site inspection the grade (slope) of the haul road rises from south to north. This compels the trucks moving on the haul road towards northern direction to rev the engine more compared to the trucks moving towards the opposite direction and thereby producing higher SEL as evident in the results summarised in Table 4.

Table 4: SEL noise measurement results at Location D

Date	Truck travelling direction	Average event duration (sec)	Average SEL (dBA)	No. of valid truck event measurements
7/11/2011	South	28.9	68	8
	North	18.1	70	9
21/04/2013	South	24.0	67	5
	North	19.5	70	7

4. Noise assessment

General observation regarding the ambient noise environment as well as the truck movements and ash repository operations are described as follows. Individual truck noise levels varied significantly between trucks. The noise emissions from the trucks were dependant on their respective travelled speeds, driving techniques and direction of travel. The noise variances were apparent even between the same types of vehicles. Truck pass-by numbers were higher during the morning period on both measurement days when compared to the evening truck counts. Operational noise from the Kerosene Vale Ash Repository site other than the truck movements was usually inaudible at the noise sensitive receiver locations during all the attended noise measurements.

The noise levels at all locations were affected by ambient noise sources such as bird/insects life, domestic animals, passenger and freight train horn, domestic noise while background noise from the Wallerawang Power Station as well as intermittent traffic noise from nearby Castlereagh Highway and Wolgan Road. While there was significant background noise contribution from the activities mentioned above, truck engine noise was clearly audible at the measurement locations.

4.1.1 Location A (60 Skelly Road)

The background noise contributions at Location A were predominantly from the traffic noise from Castlereagh Highway and distant traffic. Faint traffic noise from Wolgan Road was also audible. The haulage road was clearly visible from this measuring location and the trucks moving on the haulage road could be easily identified. There was audible noise of reversing alarm, track slaps and engine noise originating from Wallerawang Power Plant during the morning measurement on 1st December 2013 and evening measurement on 2nd December 2013. After investigation is was apparent that these noises were originating from a dozer operating on the coal stockpile inside the Wallerawang Power Plant site. Noise from birds and insects also contributed to the background and ambient noise at this location.

4.1.2 Location B (10 Skelly Road)

The background noise contributions at Location B were predominantly from the birds/ insects/ animals and traffic on Wolgan Road. Traffic noise from Wolgan Road and Skelly Road was clearly audible at this location. The haulage road was clearly visible from this measuring location and the trucks moving on the haulage road could be easily identified. The background noise level (L_{A90}) was observed to be consistent throughout the 2 days of measurements.

4.1.3 Location C (21 Neubeck Street)

The background noise contributions at Location C were predominantly from the noise from birds/insects/animals and distant traffic. Traffic noise from Wolgan Road was clearly audible and substantially contributed to the ambient noise levels. Wallerawang Power Station hum was audible during the morning measurement on 1st December 2013. The trucks moving on the haulage road were not clearly visible from this location because of an earth mound blocking the line of sight, although the truck engine noise was clearly audible. Background noise (L_{A90}) during the Monday evening measurement was observed to be lower than rest of the measurements predominantly due to negligible traffic on the nearby roads.

4.1.4 Location D

The noise data collected at Location D (Appendix C) measured the Sound Exposure Levels (SEL) of individual truck pass-by events on 07/11/2011 and 22/04/2013. At this closer location to the truck haulage road, each truck pass-by was the dominant noise source (clearly audible above other ambient noise sources).

5. Analysis and recommendations

5.1 Data analysis

As can be observed from the results presented in Table 3, the existing ambient noise levels $L_{Aeq\ (15\ min)}$ exceed the assessment criteria of $L_{Aeq\ (15\ min)}$ of 40 dBA at most of the occasions. The background noise (L_{A90}) from the various noise sources rarely (1 occasions) exceeded the noise criteria of 40dBA during the morning measurement on 1st December 2013 at Location C. Noise contribution from the ash repository activities was masked by high background noise mainly from traffic moving on Wolgan Road and Castlereagh Highway. This indicates that the noise emissions from the truck movements and ash repository cannot be assessed independently based merely on ambient noise measurements.

To assess the impact of the ash truck noise emissions, the influence of individual truck pass-by noise events have to be taken into account. Based on the SEL measurement results (shown in Table 4) and the number of truck movements provided by EnergyAustralia NSW, an $LA_{eq\ (15\ min)}$) noise level was predicted, which takes into account the total number of truck pass-bys (includes ash trucks and small commercial vehicles), and the distance of the noise source from the receiver. The assessment does include potential barrier effect (- 2dBA) at Location C due to the earth mound on the northern side of the site attenuating the noise from haul road. Trucks were operating at a constant rate, with approximate 15-20 minute circuits for each truck.

Table 5 provides a summary of truck pass-bys based on information collected during the site visits.

Table 5: Truck movement data

Time periods	Information collected during site visit on 20-21 April 2013		Information collected during site visit on 1-2 December 2013	
	Average number of trucks pass bys/ hr	Average number of trucks pass bys/ 15 minute	Total number of trucks pass bys/ 45min	Average number of trucks pass bys/ 15 minute
Morning 21/04/2013	8	2.7	11	3.7
Evening 21/04/2013	4	1.3	1	0.3
Morning 22/04/2013	13	**4.3**#	11	3.7
Evening 22/04/2013	4	1.3	13	**4.3**#

Note: Figure in **bold** is the worst-case truck movement (most frequent) used to predict the noise contribution from the truck movements (shown in Table 6)

Maximum number of truck pass- bys as per information collected during the site visit.

As per the information collected during the site visits, the maximum number of truck pass-bys was during the evening period on 02/12/2013 and the lowest was during the evening period on 1/12/2013. The noise emissions from the ash repository are considered to be below the assessment criteria as they were predominantly inaudible during the noise survey and could not be distinguished. Table 6 provides the noise prediction from the movement of ash trucks based on the worst case scenario (i.e. 4.3 truck pass bys based on

Table 5) that have been considered for calculating the noise contribution from haulage trucks alone at the nearest sensitive receivers.

Table 6: Noise predictions from truck movements based on SEL measurements

Sensitive receiver	Distance to haulage road (m)	No. of average truck movements per 15min	Predicted $L_{Aeq\ (15\ min)}$ (dBA)	Criteria $L_{Aeq\ (15\ min)}$ (dBA
60 Skelly Road	300	4.3	34	40
10 Skelly Road	270	4.3	35	40
21 Neubeck Street	145	4.3	39*	40

Note * - Include calculated barrier attenuation (-2dBA) provided by the earth mound between the residence and haul road.

It can be seen from the above results that the predicted $L_{Aeq\ (15\ min)}$ noise emissions based on the SEL measurements satisfy the required assessment criteria. Therefore the operational noise emissions from the Stage 2 KVAR are considered compliant with the Conditions of Approval.

5.2 Recommendations

During the site visit it was observed that the truck pass-by time (time taken by one truck to cross an arbitrary reference location twice on the haul road) ranged between 7.5 – 8 minutes during peak operating time. This equates to a total of 4 truck pass-bys in 15 minute duration if two trucks are operating on the haul road. As seen from the noise prediction (Table 6), approximately ~4 truck movements is the absolute maximum before the predicted noise contribution exceeds the criterion at 21 Neubeck Street (Location C). Therefore it is recommended to maintain truck pass-by events ≤ 4 for any 15 minute period during the operations of haul trucks.

6. Conclusion

Aurecon conducted ongoing operational noise monitoring for the Kerosene Vale Stage 2 Ash Repository (KVAR) located in Wallerawang, NSW. The noise measurements were carried out at the three most affected sensitive receiver locations on Sunday 1st December and Monday 2nd December 2013. The assessment criteria are outlined in the Project Approval, Application No. 07_0005, with the criteria consisting of $L_{Aeq\ (15\ minute)}$ of 40 dBA from all ash haulage and placement associated operational noise emissions at the nearest sensitive receivers.

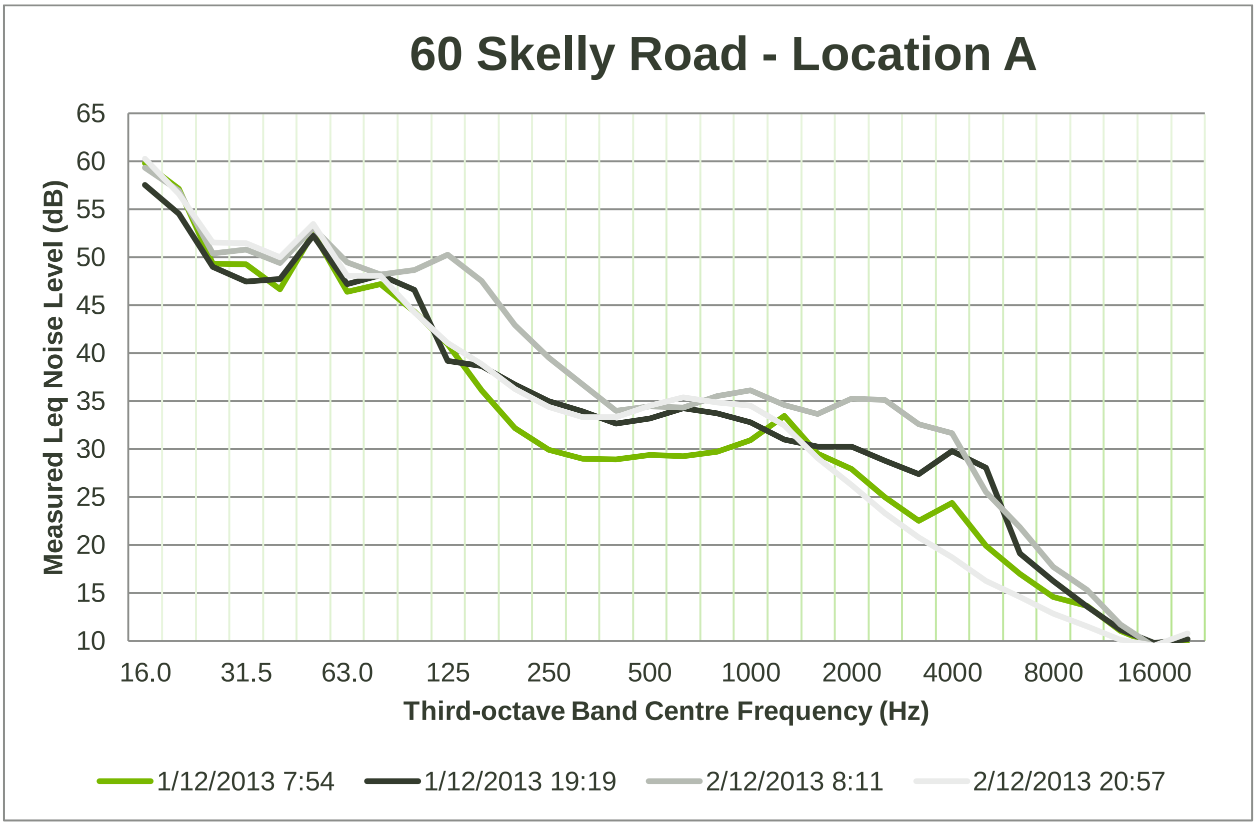
The primary contributors to the background and ambient noise levels at all the locations were the traffic noise on roads other than haulage road. The noise contribution from KVAR Stage 2 activities alone could not be determined based on ambient noise measurements due to contamination from other ambient noises. Additional Sound Exposure Level measurements of individual truck pass-by events at a closer distance to the truck haulage road were carried out on 22 April 2013 noise monitoring. Based on the SEL measurement results and observations of truck movements on site, a $L_{Aeq\ (15\ min)}$ noise level was predicted at each of the assessment sensitive noise receivers. The predicted noise levels took into account ash trucks and light commercial vehicle movement associated with Stage 2 KVAR works and distance of the noise source from the receivers. The predicted noise level at each of the noise receivers showed compliance with assessment criteria, thus the operational noise emissions from the Stage 2 KVAR are considered compliant with the Conditions of Approval.

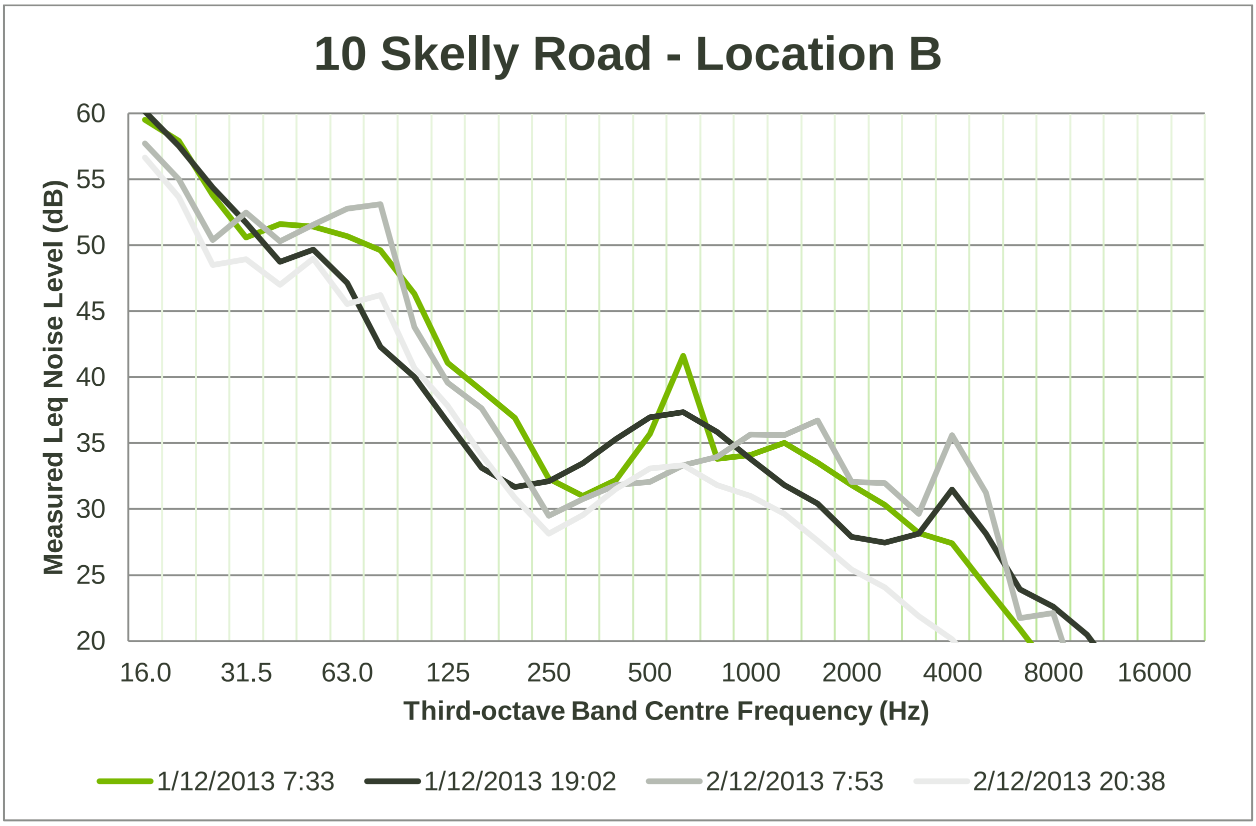
7. References

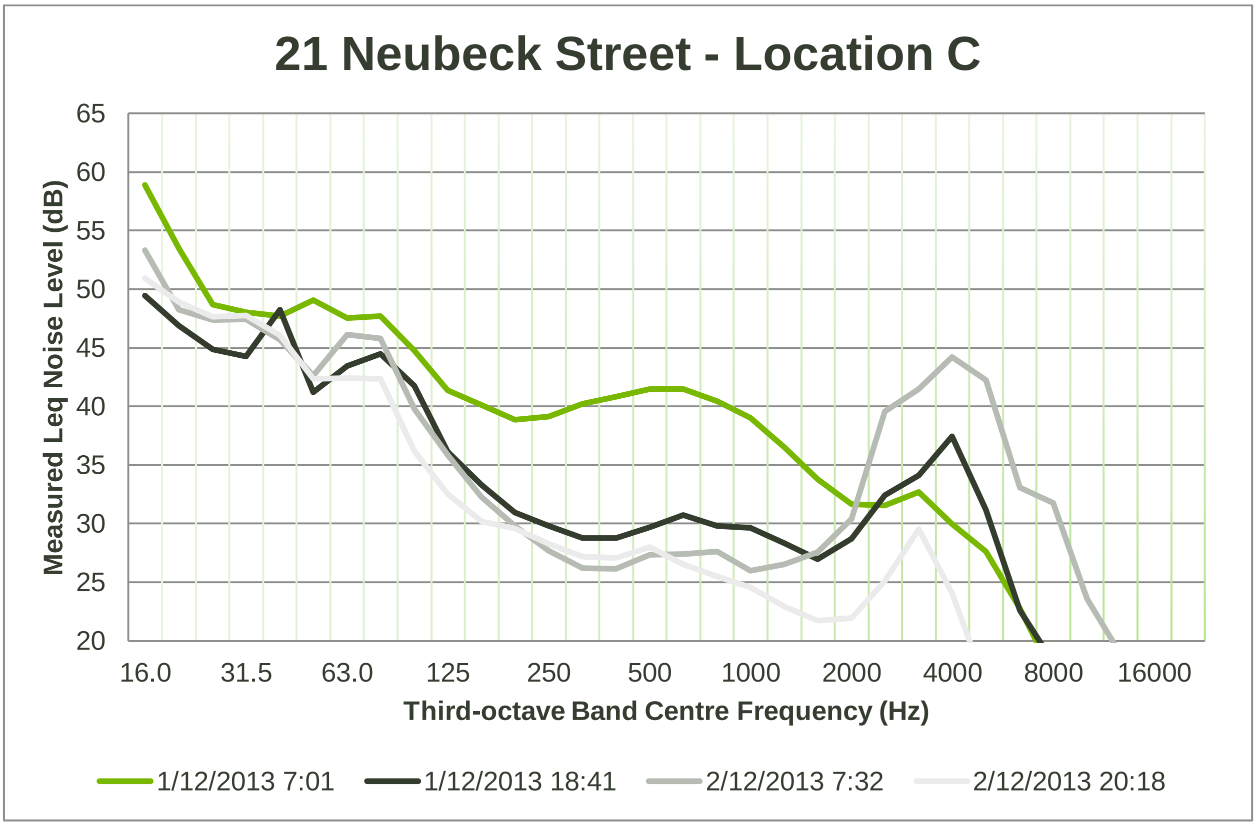
- Kerosene Vale Stage 2 Ash Repository, Operational Environmental Management Plan (OEMP), Parsons Brinckerhoff, April 2009, which includes:
  - Appendix A: KVAR Stage 2 Operations, Operational Noise and Vibration Management Plan (ONVMP), Parsons Brinckerhoff, April 2009
- Project Approval (PA), Application: No 07_0005, Delta Electricity, 26 November 2008, Department of Planning
- Stage 2 Kerosene Vale Ash Repository operational noise review, Parsons Brinckerhoff, September 2009.
- Office of Environment & Heritage (OEH) *Interim Construction Noise Guideline (ICNG).*
- Office of Environment & Heritage (OEH) *Industrial Noise Policy (INP)*.
- Australian Standard *AS 1055 1997: Acoustics – Description and measurement of environmental noise*.

Appendix A

Noise measurement graphs


60 Skelly Road - Location A
65
60
55
50
45
40
35
30
25
20
15
10
Measured Leq Noise Level (dB)
16.0
31.5
63.0
125
250
500
1000
2000
4000
8000
16000
Third-octave Band Centre Frequency (Hz)
1/12/2013 7:54
1/12/2013 19:19
2/12/2013 8:11
2/12/2013 20:57


10 Skelly Road - Location B
60
55
50
45
40
35
30
25
20
Measured Leq Noise Level (dB)
16.0
31.5
63.0
125
250
500
1000
2000
4000
8000
16000
Third-octave Band Centre Frequency (Hz)
1/12/2013 7:33
1/12/2013 19:02
2/12/2013 7:53
2/12/2013 20:38


21 Neubeck Street - Location C
Measured Leq Noise Level (dB)
65
60
55
50
45
40
35
30
25
20
16.0
31.5
63.0
125
250
500
1000
2000
4000
8000
16000
Third-octave Band Centre Frequency (Hz)
1/12/2013 7:01
1/12/2013 18:41
2/12/2013 7:32
2/12/2013 20:18

Appendix B
Glossary of terms

Term	Definition
Sound Pressure Level	Sound or noise is the sensation produced at the ear by very small fluctuations in atmospheric pressure. The human ear responds to changes in sound pressure over a very wide range (from 20 microPascals to 60 Pascals). A scale that compresses this range to a more manageable size and that is best matched to subjective response is the logarithmic scale, rather than a linear scale.
Sound Pressure Level (Lp)	Is defined as: $L_P = 10\log_{10}\left(\frac{p^2}{p_{ref}^2}\right) dB$ In the above equation, p is the sound pressure fluctuation (above or below atmospheric pressure), and p_{ref} is 20 microPascals (2 x 10^{-5} Pa), the approximate threshold of hearing. To avoid a scale which is too compressed, a factor of 10 is included, giving rise to the decibel, or dB for short.
A-Weighted Decibel (dB(A)) & Loudness	In some circumstances, the sound pressure level is expressed as C-Weighted decibels, instead of the more common A-Weighted. The C-Weighting filter is designed to replicate the response of the human ear above 85 dB, and places a greater weighting on low frequency noise.
L_{Aeq}	The time averaged C-weighted sound pressure level for a time interval, as defined in AS1055.1. It is generally described as the equivalent continuous C-weighted sound pressure level that has the same mean square pressure level as a sound that varies over time. It can be considered as the average sound pressure level over the measurement period.
L_{Ceq}	The time averaged C-weighted sound pressure level for a time interval, as defined in AS1055.1. It is generally described as the equivalent continuous C-weighted sound pressure level that has the same mean square pressure level as a sound that varies over time. It can be considered as the average sound pressure level over the measurement period.
L_{An}	The sound level, which, for a specified time interval, in relation to an investigation of a noise, means the A-weighted sound pressure level that is equalled or exceeded for n% of the interval. Commonly used percentages are 1, 10, 90 & 99%.
L_{Cpk}	The peak C-weighted sound pressure level for a time interval.

$L_{Cmax,T}$	The average maximum C-weighted sound pressure level, which, for the specified time interval, means the C-weighted sound pressure level during the interval obtained by using the fast time weighting and arithmetically averaging the maximum sound levels of the noise during the interval. Under certain conditions the 10th percentile noise level, $L_{C10,T}$, can represent the average maximum C-weighted sound pressure level.
L_{A10}	A-weighted noise level which is exceeded for only 10% of the measuring period. It is usually used as the descriptor for intrusive noise level and represents ambient road traffic noise in general.
L_{A90}	A-weighted noise level which is exceeded for 90% of the measuring period. It is usually used as the descriptor for background noise level during the measurement period.
L_{Amin}	Minimum A-weighted noise level detected during the measuring period. It refers to the minimum background noise detected.
Octave	Frequency bands allow a representation of the spectrum associated with a particular noise. They are an octave wide, meaning that the highest frequency in the band is just twice the lowest frequency, with all intermediate frequencies included and all other frequencies excluded. Each octave band is described by its centre frequency.
Maximum Exposure Time (Hours)	The maximum possible time a person can be safely exposed to a specific noise level (L_{Aeq}).
Sound Exposure Level (SEL)	Sound exposure level abbreviated as SEL and L_{AE}, is the total noise energy produced from a single noise event. The Sound Exposure Level is a metric used to describe the amount of noise from an event such as an individual aircraft flyover. It is computed from measured dBA sound levels. The Sound Exposure Level is the integration of all the acoustic energy contained within the event.

Appendix C
Site photograph

Figure 3 | Location D

Appendix D

Weather data

Table 7: Meteorological conditions during noise survey

Date	Time	Rainfall (mm)	Wind Speed 10m above ground (m/s)	Wind Direction (deg)	Temp (°C)	Relative Humidity (%)
1/12/2013	8:00:00	0	1.9	84	14.9	55.6
1/12/2013	8:15:00	0	1.5	96	15.4	53.2
1/12/2013	8:30:00	0	2.3	36	15.1	53.3
1/12/2013	8:45:00	0	1.8	54	15.6	51.2
1/12/2013	9:00:00	0	1.5	84	16.4	47.1
1/12/2013	9:15:00	0	1.5	72	16.8	44.4
1/12/2013	9:30:00	0	1.9	48	17	43.5
1/12/2013	9:45:00	0	1.9	30	17.3	42.4
1/12/2013	10:00:00	0	1.0	24	17.7	40.1
1/12/2013	10:15:00	0	0.7	42	18.9	38.1
1/12/2013	10:30:00	0	1.7	6	18.4	40.4
1/12/2013	10:45:00	0	1.8	24	18.3	41.2
1/12/2013	11:00:00	0	1.3	336	18.2	41.8
1/12/2013	11:15:00	0	1.8	336	18.4	42.6
1/12/2013	11:30:00	0	1.1	312	19.1	41.1
1/12/2013	11:45:00	0	1.2	24	19.4	38
1/12/2013	12:00:00	0	0.6	78	19.8	37.4
1/12/2013	12:15:00	0	0.8	48	20.4	35.9
1/12/2013	12:30:00	0	1.1	60	20	36.5
1/12/2013	12:45:00	0	1.1	90	21.3	34.3
1/12/2013	13:00:00	0	1.5	42	20.8	35
1/12/2013	13:15:00	0	1.4	108	22	33.2
1/12/2013	13:30:00	0	0.7	78	22.2	32.2
1/12/2013	13:45:00	0	1.6	72	21.4	33.1
1/12/2013	14:00:00	0	0.9	54	21.3	33.9

Date	Time	Rainfall (mm)	Wind Speed 10m above ground (m/s)	Wind Direction (deg)	Temp (°C)	Relative Humidity (%)
1/12/2013	14:15:00	0	1.7	48	21.1	34.4
1/12/2013	14:30:00	0	2.4	42	21.3	34.5
1/12/2013	14:45:00	0	1.7	60	21.8	32.8
1/12/2013	15:00:00	0	1.3	114	21.3	33.5
1/12/2013	15:15:00	0	1.9	144	21.8	32.5
1/12/2013	15:30:00	0	1.8	126	22.6	31.4
1/12/2013	15:45:00	0	1.3	114	22.7	30.4
1/12/2013	16:00:00	0	2.3	42	22.2	31.8
1/12/2013	16:15:00	0	3.1	30	20.9	35.3
1/12/2013	16:30:00	0	2.6	42	21	35.5
1/12/2013	16:45:00	0	3.3	42	20.5	36.8
1/12/2013	17:00:00	0	3.4	42	19.3	41.3
1/12/2013	17:15:00	0	2.6	54	19.2	43.1
1/12/2013	17:30:00	0	2.6	54	19.4	42.9
1/12/2013	17:45:00	0	3.0	48	18.1	49.3
1/12/2013	18:00:00	0	2.7	54	17.4	53.2
1/12/2013	18:15:00	0	2.9	54	17.1	55
1/12/2013	18:30:00	0	2.5	66	16.9	55.2
1/12/2013	18:45:00	0	2.6	66	16.2	59.2
1/12/2013	19:00:00	0	2.6	66	15.6	62.5
1/12/2013	19:15:00	0	2.4	66	15	65.7
1/12/2013	19:30:00	0	2.6	60	14.5	68.8
1/12/2013	19:45:00	0	2.9	60	14.1	70.8
1/12/2013	20:00:00	0	2.7	60	13.8	72.7
1/12/2013	20:15:00	0	2.6	54	13.5	74.7
1/12/2013	20:30:00	0	2.3	48	13.2	77.2
1/12/2013	20:45:00	0	2.1	54	13	79
1/12/2013	21:00:00	0	1.4	30	12.7	80.2
1/12/2013	21:15:00	0	0.9	48	12.4	81.9
1/12/2013	21:30:00	0	1.7	42	12.3	83
1/12/2013	21:45:00	0	0.5	348	11.9	84.2
1/12/2013	22:00:00	0	0.2	306	11.5	85.6
1/12/2013	22:15:00	0	0.2	306	11.2	87.5
1/12/2013	22:30:00	0	0.1	30	11.2	88.6
1/12/2013	22:45:00	0	0.2	78	11.1	88.6
1/12/2013	23:00:00	0	0.5	48	11.3	88.9

Date	Time	Rainfall (mm)	Wind Speed 10m above ground (m/s)	Wind Direction (deg)	Temp (°C)	Relative Humidity (%)
1/12/2013	23:15:00	0	0.2	84	11.3	88.2
1/12/2013	23:30:00	0	0.5	36	11.3	87.8
1/12/2013	23:45:00	0	0.7	24	11.4	88.4
2/12/2013	0:00:00	0	1.3	48	11.9	86.4
2/12/2013	0:15:00	0	1.5	42	12.1	83.5
2/12/2013	0:30:00	0	1.6	42	12	83.7
2/12/2013	0:45:00	0	1.7	48	11.9	82.7
2/12/2013	1:00:00	0	1.3	42	11.9	82
2/12/2013	1:15:00	0	1.2	54	11.8	80.9
2/12/2013	1:30:00	0	1.6	24	11.6	81
2/12/2013	1:45:00	0	1.7	36	11.3	80.5
2/12/2013	2:00:00	0	2.0	36	10.9	80.2
2/12/2013	2:15:00	0	1.8	54	10.7	81.1
2/12/2013	2:30:00	0	0.8	30	10.6	82.3
2/12/2013	2:45:00	0	1.5	36	10.5	82
2/12/2013	3:00:00	0	1.4	30	10.4	82.1
2/12/2013	3:15:00	0	1.4	42	10.3	82.2
2/12/2013	3:30:00	0	1.5	24	10.3	82.1
2/12/2013	3:45:00	0	1.4	36	10.2	82.6
2/12/2013	4:00:00	0	1.2	18	10	82.8
2/12/2013	4:15:00	0	0.9	24	9.7	83.4
2/12/2013	4:30:00	0	0.7	24	9.5	85.1
2/12/2013	4:45:00	0	1.2	42	9.6	85.9
2/12/2013	5:00:00	0	1.3	54	9.8	85.3
2/12/2013	5:15:00	0	1.3	48	9.9	85
2/12/2013	5:30:00	0	0.9	24	10.1	84.7
2/12/2013	5:45:00	0	0.6	330	10.3	83.7
2/12/2013	6:00:00	0	1.0	336	10.4	83.1
2/12/2013	6:15:00	0	1.2	348	10.4	82.3
2/12/2013	6:30:00	0	1.2	6	10.5	82.4
2/12/2013	6:45:00	0	1.1	360	11.5	79.8
2/12/2013	7:00:00	0	0.9	360	12.5	74.4
2/12/2013	7:15:00	0	0.9	336	13.3	69.7
2/12/2013	7:30:00	0	0.9	354	13.8	66.6
2/12/2013	7:45:00	0	0.8	18	14.9	62.5
2/12/2013	8:00:00	0	0.4	36	16.3	58.3

Date	Time	Rainfall (mm)	Wind Speed 10m above ground (m/s)	Wind Direction (deg)	Temp (°C)	Relative Humidity (%)
2/12/2013	8:15:00	0	0.3	6	17.3	53.6
2/12/2013	8:30:00	0	0.8	294	17.3	51.3
2/12/2013	8:45:00	0	0.5	300	17.7	47.6
2/12/2013	9:00:00	0	0.8	252	17.6	46
2/12/2013	9:15:00	0	0.7	264	17.5	46.6
2/12/2013	9:30:00	0	0.9	246	18.1	49.7
2/12/2013	9:45:00	0	0.3	264	19.2	46.6
2/12/2013	10:00:00	0	1.1	228	19.2	44.3
2/12/2013	10:15:00	0	0.9	258	19.4	44.2
2/12/2013	10:30:00	0	0.5	252	20.3	40.4
2/12/2013	10:45:00	0	1.0	240	20	40.4
2/12/2013	11:00:00	0	1.0	228	20.8	37.5
2/12/2013	11:15:00	0	0.7	186	22	28.9
2/12/2013	11:30:00	0	1.0	180	22.4	25.2
2/12/2013	11:45:00	0	0.8	174	22.8	24.3
2/12/2013	12:00:00	0	0.9	138	23.5	21.7
2/12/2013	12:15:00	0	1.2	138	24.3	19.3
2/12/2013	12:30:00	0	0.7	162	24.6	19.5
2/12/2013	12:45:00	0	0.3	78	24.1	19.8
2/12/2013	13:00:00	0	0.2	144	24.4	20.3
2/12/2013	13:15:00	0	1.2	36	25.3	20.5
2/12/2013	13:30:00	0	0.5	222	24.8	21
2/12/2013	13:45:00	0	1.5	180	25.7	21.9
2/12/2013	14:00:00	0	1.9	180	26	21.8
2/12/2013	14:15:00	0	1.3	162	26.1	22.2
2/12/2013	14:30:00	0	1.9	156	25.9	22.4
2/12/2013	14:45:00	0	1.7	174	25.7	22.7
2/12/2013	15:00:00	0	1.8	156	26	21.9
2/12/2013	15:15:00	0	1.7	168	25.9	21.7
2/12/2013	15:30:00	0	1.6	144	26.2	21
2/12/2013	15:45:00	0	1.4	132	26	23.8
2/12/2013	16:00:00	0	1.8	144	26.3	23.9
2/12/2013	16:15:00	0	2.0	144	26.1	24.4
2/12/2013	16:30:00	0	2.1	144	26.4	23.6
2/12/2013	16:45:00	0	1.5	156	26.6	23.5
2/12/2013	17:00:00	0	1.4	156	26.6	23.6

Date	Time	Rainfall (mm)	Wind Speed 10m above ground (m/s)	Wind Direction (deg)	Temp (°C)	Relative Humidity (%)
2/12/2013	17:15:00	0	1.9	72	25.5	27.3
2/12/2013	17:30:00	0	2.9	42	24	31.5
2/12/2013	17:45:00	0	3.1	36	23.2	33.7
2/12/2013	18:00:00	0	2.9	42	22.7	34.8
2/12/2013	18:15:00	0	2.5	48	22.1	36
2/12/2013	18:30:00	0	2.2	66	21.7	36.6
2/12/2013	18:45:00	0	1.7	72	21.3	37.4
2/12/2013	19:00:00	0	1.9	60	20.4	39.1
2/12/2013	19:15:00	0	1.8	42	19.4	41.4
2/12/2013	19:30:00	0	1.7	48	18.6	43.3
2/12/2013	19:45:00	0	2.0	60	18.2	44.2
2/12/2013	20:00:00	0	1.8	66	17.9	44.9
2/12/2013	20:15:00	0	1.2	60	17.5	46.5
2/12/2013	20:30:00	0	0.4	18	16.7	48.2

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