NOISE IMPACT ASSESSMENT
PREPARED FOR
344 PARK ROAD, WALLACIA NSW 2745

Prepared for: Greenfields Resource Recovery Facility
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EXECUTIVE SUMMARY

Benbow Environmental has been engaged by Greenfields Resource Recovery Facility to prepare a noise impact assessment for a resource recovery facility at Lot 5, DP 655046 (344 Park Road, Wallacia). The site will have a processing capacity of 95,000 tonnes per year.

The nearest receivers and the noise generating activities have been identified. Noise criteria for the project have been formed, with assessment of the proposed site activities conducted against the NSW Noise Policy for Industry (EPA, 2017) and the NSW Road Noise Policy (DECCW, 2011). Modelling of the activities was conducted using the noise modelling software SoundPlan.

The operational noise levels was predicted to comply with the $L_{Aeq(15\ minute)}$ project specific criteria and L_{AMax} sleep disturbance criteria at all receptors for all scenarios, for all weather conditions.

The noise assessment in Section 7 predicted that if the assumptions listed in 7.1.3 are carried out, noise levels would be met at all surrounding receivers.

Controls important to note are the following:

- No truck deliveries during the evening and night time periods 6pm – 7am;
- No front end loader movement outside during the night time period 10pm-7am;
- The walls must have an R_w of at least 36 dB, double corrugated steel;
- The roof must have an R_w of at least 32 dB, corrugated steel with miwo;
- The conveyor to the aggregate bays must be enclosed such that noise from inside the building cannot directly propagate through these exit holes;
- Roller shutter doors must be kept closed when not in use for deliveries, automatic closing roller shutter doors are recommended; and
- Pedestrian access doors should also be kept close when not in use.

Further proactive noise management practices are described in Section 7.3.

Compliance with the guidelines set out in the NSW Road Noise Policy was predicted at all considered receptors.

Construction noise is predicted to comply with the Interim Construction Guidelines at all surrounding receivers.

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1. INTRODUCTION

Benbow Environmental has been engaged by Greenfields Resource Recovery Facility to prepare a noise impact assessment for a resource recovery facility at Lot 5, DP 655046 (344 Park Road, Wallacia). The site will have a processing capacity of 95,000 tonnes per year.

The principal noise sources associated with the site include noise from crushing and screening equipment, as well as mobile plant, including truck movements, excavators, and front end loaders.

The potential noise impacts of operational and road traffic activities on the nearby receivers have been predicted utilising noise modelling software, SoundPlan. This noise impact assessment has been prepared in accordance with the following guidelines and documents:

- NSW Noise Policy for Industry (EPA, 2017);
- Interim Construction Noise Guideline (DECC, 2009) and
- NSW Road Noise Policy (RNP) (DECCW, 2011).

1.1 SCOPE OF WORKS

This noise impact assessment has been limited to the following scope of works:

a) Review of proposed plans and operations;
b) Long term and short term ambient and background noise monitoring in accordance with relevant guidelines;
c) Identify project specific noise levels;
d) Determine all potential noise sources associated with the proposed development;
e) Collect required noise source data;
f) Predict potential noise impacts at the nearest potentially affected receptors to the site;
g) Assess potential noise impacts against relevant legislation and guidelines;
h) Recommend control measures where required; and
i) Compile this report with concise statements of potential noise impact.

To aid in the review of this report, supporting documentation has been included within the Attachments. A glossary of terminology is included in Attachment 1.

2. PROPOSED DEVELOPMENT

2.1 SITE LOCATION

The site is located at 344 Park Road, Wallacia NSW 2745, in Sydney's west and within the local government area of Penrith City Council. The property is also known as Lot 5 in DP 655046.

The total land area of the property is approximately 200,732 m^2 and the proposed active working area is approximately 84,960 m^2. The site is accessed from Park Road via a lockable access gate. Figure 2-1 shows the location of the subject site.

2.2 HOURS OF OPERATIONS

The proposed facility would operate to the following hours:

Monday – Friday 7am – 6pm
Saturday – 8am – 1pm
Sunday and public Holidays – No operation.

2.3 PROPOSED ACTIVITY

The proposal involves the construction of a purpose-built building to house the resource recovery facility and development of internal access driveways, car park, truck parking area, hardstand areas and associated infrastructure on the north eastern portion of the site. The existing dwelling will be converted into a site office and two weighbridges would be provided on the access driveway from Park Road. The proposed development area would be located in the previously disturbed north-eastern section of the site. The remaining area of the site would not be developed. Extensive landscaping to re-establish areas of native vegetation would enhance the existing visual appearance of the site.

The facility would operate Monday – Friday 1am – 6pm and Saturday 8am – 1pm and accept up to 95,000 tonnes per year of C&D and C&I waste mainly from the local and Sydney metropolitan area. This waste would be separated to generate a range of materials mainly for use in the construction industry and civil works. Due to the quantity of waste to be processed and stored, the facility will require an Environment Protection Licence.

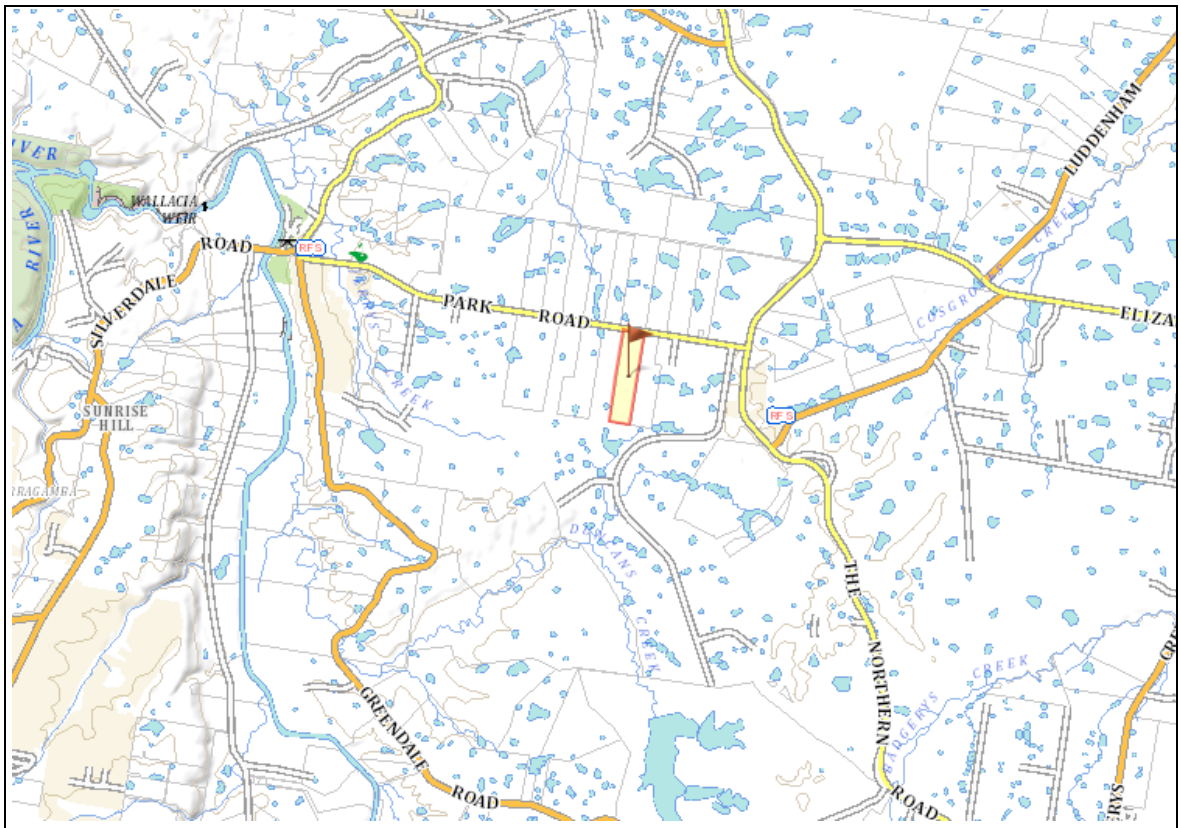
The proposed facility is ideally located, being 10km from the Western Sydney Airport and in close proximity to the associated infrastructure projects required to establish growth centres in Western and Southern Sydney. The proposal would generate 30 new employment positions.

The waste accepted would consist of C&D and C&I waste, classified as "General Solid Waste (Non-putrescible) under the *NSW Waste Classification Guidelines*. The recyclable material accepted at the facility would be made up of:

Construction & Demolition (C&D)	Commercial & Industrial (C&I)
• Wood • Gyprock – plaster board • Concrete • Brick • Aggregates • Steel	• Cardboard • Paper • Plastic • Steel • Aluminium • Wood

The site location is shown in Figure 2-1 and the site aerial is shown in Figure 2-2.

Figure 2-1: Site Location



Source: Six Maps 2020

↑N Not to scale	**Legend**: Site Boundaries	Benbow Environmental 25-27 Sherwood Street, Northmead NSW 2152

Figure 2-2: Site Aerial

Source: Six Maps 2020

↑N **Not to scale**	**Legend:** Site Boundaries	Benbow Environmental 25-27 Sherwood Street, Northmead NSW 2152

2.3.1 Process Description

The plant will be designed to process 95,000 tonnes of C&D and C&I waste materials collected from various businesses across the local and metropolitan Sydney area. The materials will be sorted through the plant in separate runs, the C&I and C&D will not be mixed. This will ensure maximum recovery of recyclables. The following provides the typical steps involved in the day time process that would be undertaken at the facility.

1. All trucks arriving at the site would be directed over the weighbridge and inspected for any abnormal contamination;

2. Trucks with conforming loads would be weighed on the weighbridge then directed inside the building. Non-conforming loads would be turned away via the turning bay adjacent to the weighbridge.

3. Loads of C&I material would be unloaded in a designated storage bunker for processing . Loads of C&D material to be unloaded in the pre-sorting area inside the building for initial separation;

4. A front end loader would transfer the pre-sorted material to the infeed hopper/shredder at the start of the process or to the appropriate storage bunker.

5. The material would be fed into the system and conveyed to an electrical magnet for the removal of steel. Any ferrous material would be separated at this point and fall into a storage bin.

6. The waste stream would then be conveyed through a waste screen where aggregates would be removed and further screened into varying sizes and then directed to external storage bunkers via the conveyor system.

7. The waste stream would be directed to the manual picking station where it is separated into paper/cardboard, wood, plastic and other waste. Paper and cardboard is transferred to the paper baling area for baling. Bales are stored in a designated area within the building.

8. The remaining waste stream is conveyed where it is further separated into heavy and light wastes. The light waste is “solid recovered fuel” or SRF which is the waste that would be suitable for use in a waste to energy plant which is a potential future stage to this development.

9. Recovered waste would be loaded into trucks for transport to various facilities for reuse or further processing.

No retail sales will be made on site. There will be no public access to the premises.

2.3.2 Noise Generating Equipment and Activities

The following noise generating equipment and activities will be used on site

- Shredder;
- Mobile crusher;
- Conveyor belt;
- Vibrating screens x 3;
- Waste trommel screen;
- Air separator;
- Bounce separator;
- Paper Baler;
- 30T Excavator;
- 20T Excavator;
- Front end loader x 2;
- Forklift LPG;
- Sweeper; and
- Aggregate fall x 4.

2.4 DESCRIPTION OF THE SURROUNDING AREA

Surrounding land zoning to the north, east and west is also RU1 – Primary Production under the Penrith City Council Local Environmental Plan 2010 shown below in Figure 2-3. To the south of the site, the existing land zoning is RU4 – Primary Production Small Lots. In the township of Luddenham, to the east of the site, there are areas of RU5 – Village, R2 – Low Density Residential and R5 – Large Lot Residential and small areas of RE1 – Public Recreation and B1 – Neighbourhood Centre land zoning. These land zonings can provide essential services that enable positive relationships between rural and industrial services.

The most major nearby road is The Northern Road – A9 to the east of the site.

Figure 2-3: Land Zoning Map

Source: NSW Planning Portal 2020

↑N
Not to scale

Legend:

Site Boundaries

Benbow Environmental
25-27 Sherwood Street,
Northmead NSW 2152

B1	Neighbourhood Centre	R2	Low Density Residential
B2	Local Centre	R3	Medium Density Residential
B3	Commercial Core	R4	High Density Residential
B4	Mixed Use	R5	Large Lot Residential
B5	Business Development	RE1	Public Recreation
B6	Enterprise Corridor	RE2	Private Recreation
E1	National Parks and Nature Reserves	RU1	Primary Production
E2	Environmental Conservation	RU2	Rural Landscape
E3	Environmental Management	RU4	Primary Production Small Lots
IN1	General Industrial	SP1	Special Activities
IN2	Light Industrial	SP2	Infrastructure
IN3	Heavy Industrial	W1	Natural Waterways
R1	General Residential	WSP	SEPP Western Sydney Parklands

3. NEAREST SENSITIVE RECEPTORS

Table 3-1 lists the location of representative potentially affected receivers that are considered in this assessment. The locations are shown in Figure 3-1.

Table 3-1: Table of Nearest Receptors

Receptor ID	Address	Direction from Site	Lot and DP	Approximate distance to proposed development	Easting	Northing	Type of receiver
R1	334 Park Road Wallacia	W	Lot 1 DP1145597	120 m	285021.638	6249439.302	Residential
R2	322 Park Road Wallacia	W	Lot 1 DP1145716	225 m	284933.078	6249512.917	Residential
R3	323-341 Park Road Wallacia	NW	Lot 8 DP666928	170 m	285037.927	6249646.635	Residential
R4	343-351 Park Road Wallacia	NNW	Lot 71 DP594632	175 m	285134.703	6249714.806	Residential
R5	353-361 Park Road Wallacia	N	Lot 72 DP594632	220 m	285292.865	6249747.295	Residential
R6	363 Park Road Luddenham	NE	Lot 6 DP651102	200 m	285481.825	6249581.294	Residential
R7	364 Park Road Luddenham	E	Lot 4 DP653236	115 m	285403.646	6249481.174	Residential
R8	386 Park Road Luddenham	E	Lot 1 DP557920	245 m	285485.226	6249150.151	Residential
R9	384 Park Road Luddenham	E	Lot 2 DP557920	275 m	285490.185	6248944.237	Residential
R10	45 Willowdene Avenue Luddenham	S	Lot 3 DP248069	565 m	285042.472	6248548.515	Residential
R11	115 Willowdene Avenue Luddenham	SW	Lot 4 DP248069	720 m	284827.59	6248489.29	Residential
R12	288A Park Road Wallacia	WSW	Lot 1 DP1195400	610 m	284516.692	6249018.95	Residential
R13	32 Willowdene Avenue Luddenham	SE	Lot 32 DP771596	865 m	285871.683	6248638.714	School
R14	288A Park Road Wallacia	W	Lot 1 DP1195400	445 m	284654.005	6249225.993	Industrial
R15	380 Park Road Luddenham	E	Lot 1 DP215057	185 m	285441.875	6249297.194	Industrial

Note: distances measured from the boundaries of the site development area

Figure 3-1: Map of Nearest Receptors

Source: Six Maps 2020

N Not to scale	**Legend:** Site development location Receiver location	Benbow Environmental 25-27 Sherwood Street, Northmead NSW 2152

4. EXISTING ACOUSTIC ENVIRONMENT

The level of background noise varies over the course of any 24 hour period, typically from a minimum at 3.00am to a maximum during morning and afternoon traffic peak hours. Therefore the NSW EPA Noise Policy for Industry (2017) requires that the level of background and ambient noise be assessed separately for the daytime, evening and night time periods. The Noise Policy for Industry defines these periods as follows:

- **Day** – the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays;
- **Evening** – the period from 6pm to 10pm; and
- **Night** – the remaining periods.

4.1 NOISE MONITORING EQUIPMENT AND METHODOLOGY

Background noise level measurements were carried out using a Svantek SVAN 957 Precision Sound Level Meter (attended noise monitoring) and one (1) Acoustic Research Laboratories statistical Environmental Noise Logger, type EL-215 (unattended noise monitoring). The instrument sets were calibrated by a NATA accredited laboratory within two years of the measurement period. Calibration certificates have been included in Attachment 2.

To ensure accuracy and reliability in the results, field reference checks were applied both before and after the measurement period with an acoustic calibrator. There were no excessive variances observed in the reference signal between the pre-measurement and post-measurement calibration. The instruments were set on A-weighted Fast response and noise levels were measured over 15-minute statistical intervals. QA/QC procedures applied for the measurement and analysis of noise levels have been presented in Attachment 3. The microphones were fitted with windsocks and were positioned between 1.2 metres and 1.5 metres above ground level. Details of the instrumentation and setting utilised are provided in Table 4-1.

Table 4-1: Instrumentation and Setup Details

Type of Monitoring	Equipment	Serial Number	Setup Details
Long-term Unattended	ARL-215	194702	A-weighted Fast Response 15 minute integration period
Short-term Attended	Svantek SVAN957 Type 1 Integrating Sound and Vibration analyser	15335	Three channels: A-weighted Fast Response C-weighted Fast Response A-weighted Impulse Response 15 minute integration period 1/3 octave band recorded every 100 ms Logger file Recorded at steps of 100 ms

4.2 MEASUREMENT LOCATION

Unattended long-term noise monitoring was undertaken from 17th March 2020 to 29th March 2020 at one representative location at 344 Park Road, Wallacia.

Attended noise monitoring was undertaken at the same location on 17th March 2020. The attended and noise logging locations are shown in Figure 3-1 below. Noise Logger Charts are presented in Attachment 3.

Figure 4-1: Noise Logging Location

Source: Google Maps 2020

N Not to scale	**Legend**: Noise logging locations Site Boundaries	Benbow Environmental 25-27 Sherwood Street, Northmead NSW 2152

4.3 MEASURED NOISE LEVELS

4.3.1 Long-Term Unattended Noise Monitoring Results

The data was analysed to determine a single assessment background level (ABL) for each day, evening and night time period, in accordance with the NSW EPA Noise Policy for Industry. That is, the ABL is established by determining the lowest tenth-percentile level of the L_{A90} noise data over each period of interest. The background noise level or rating background level (RBL) representing the day, evening and night assessment periods is based on the median of individual ABL's determined over the entire monitoring period.

The results of the long-term unattended noise monitoring are displayed in Table 4-2. Daily noise logger graphs have been included in Attachment 3.

Table 4-2: Unattended Noise Monitoring Results at Logger Location, dB(A)

Date	Average L_1			Average L_{10}			ABL (L_{90})			L_{eq}		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
17/03/2020	65	62	57	57	55	48	45	43	40	55	53	47
18/03/2020	65	62	61	57	56	52	42	45	39	55	53	52
19/03/2020	65	63	61	58	56	53	41	44	40	55	53	52
20/03/2020	-	-	61	-	-	55	-	-	43	-	-	53
21/03/2020	65	59	59	57	52	51	41	40	39	54	50	50
22/03/2020	63	61	56	55	53	47	40	40	40	53	51	46
23/03/2020	65	60	60	57	53	51	41	41	39	55	50	53
24/03/2020	65	60	60	58	53	51	41	39	37	55	50	51
25/03/2020	-	-	59	-	-	50	-	-	38	-	-	50
26/03/2020	63	61	60	56	54	51	40	41	39	53	52	51
27/03/2020	65	61	-	57	54	-	41	45	-	55	52	-
28/03/2020	64	-	57	56	-	47	41	**-**	**37**	54	**-**	**47**
29/03/2020	62	-	53	54	-	46	38	-	40	53	-	45
Average	**64**	**61**	**59**	**57**	**54**	**50**	*	*	*	*	*	*
Median (RBL)	*	*	*	*	*	*	**41**	**41**	**39**	*	*	*
Logarithmic Average	*	*	*	*	*	*	*	*	*	**54**	**52**	**51**

Note: - indicates values that has not been considered due to adverse weather conditions.
* Indicates values that are not relevant to that noise descriptor.
Value in bold indicates relevant noise descriptor.

4.3.2 Short-Term Attended Noise Monitoring Results

Given that the results of the unattended noise monitoring are affected by all ambient noise sources such as local fauna, road traffic and industrial sources, it is not possible to determine with precision the exact existing industrial noise contribution based on unattended monitoring alone. Therefore, the attended noise monitoring allows for a more detailed understanding of the existing ambient noise characteristics and a more meaningful final analysis to be undertaken. The results of the short-term attended noise monitoring are displayed in Table 4-3.

Table 4-3: Attended Noise Monitoring Results, dB(A)

Location / Time	Noise Descriptor				Comments
	L_{Aeq}	L_{A90}	L_{A10}	L_{A1}	
344 Park Road, Wallacia 3.16pm	54	45	57	65	*Passing trucks <69 dB(A)* *Plane <62 dB(A)* *Birds <57 dB(A)* *Passing cars <60 dB(A)* *Barking dog <50 dB(A)* *Wind <53 dB(A)* *Insects <45 dB(A)* *Motorised pesticide sprayer <44 dB(A)* *Noise dominated by frequent traffic on Park Road, insect noise and bird noise. Dog barks consistently and constant distant traffic. A few small planes overhead.*

5. METEOROLOGICAL CONDITIONS

Wind and temperature inversions may affect the noise emissions from the site and are to be incorporated in the assessment when considered to be a feature of the area.

In this section, an analysis of the 2019 weather data has been conducted to establish whether significant winds are characteristic of the area.

5.1 WIND EFFECTS

Wind is considered to be a feature where source-to-receiver wind speeds (at 10 m height) of 3 m/s or below occur for 30% or more of the time in any assessment period in any season.

5.1.1 Wind Rose Plots

Wind rose plots show the direction that the wind is coming from, with triangles known as "petals". The petals of the plots in the figures summarise wind direction data into 8 compass directions i.e. north, north-east, east, south-east, etc. The length of the triangles, or "petals", indicates the frequency that the wind blows from that direction. Longer petals for a given direction indicate a higher frequency of wind from that direction. Each petal is divided into segments, with each segment representing one of the six wind speed classes.

Thus, the segments of a petal show what proportion of wind for a given direction falls into each class. The proportion of time for which wind speed is less than 0.5 m/s, when speed is negligible, is referred to as calm hours or "calms". Calms are not shown on a wind rose as they have no direction, but the proportion of time consisting of the period under consideration is noted under each wind rose.

The concentric circles in each wind rose are the axis, which denote frequencies. In comparing the plots it should be noted that the axis varies between wind roses, although all wind roses are similar in size. The frequencies denoted on the axes are indicated beneath each wind rose.

5.1.2 Local Wind Trends

Seasonal wind rose plots for this site utilising Badgerys Creek AWS data have been included in Figure 5-1, Figure 5-2 and Figure 5-3 for day, evening and night periods respectively.

Figure 5-1: Wind Rose Plots – BOM Badgerys Creek AWS ID 067108 – 2019 – Day time

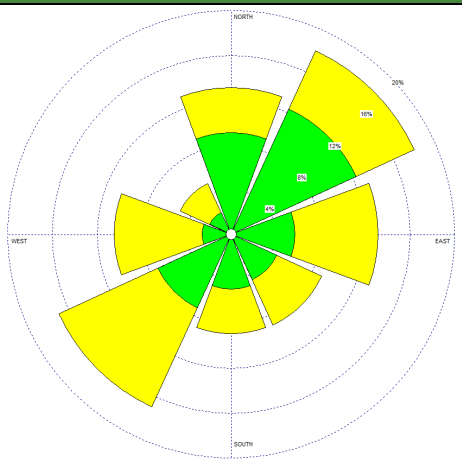
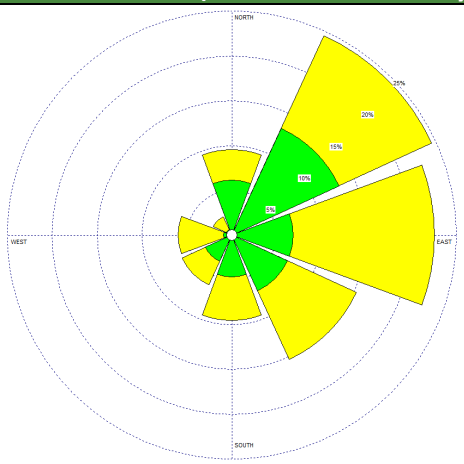
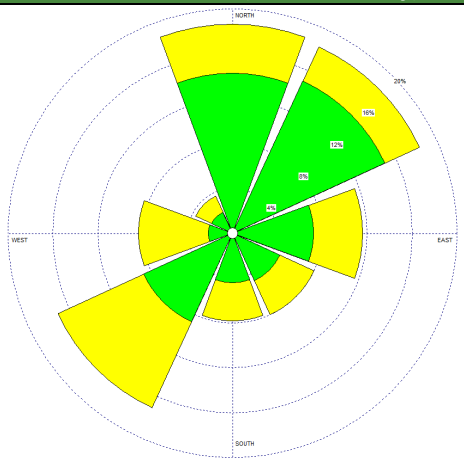
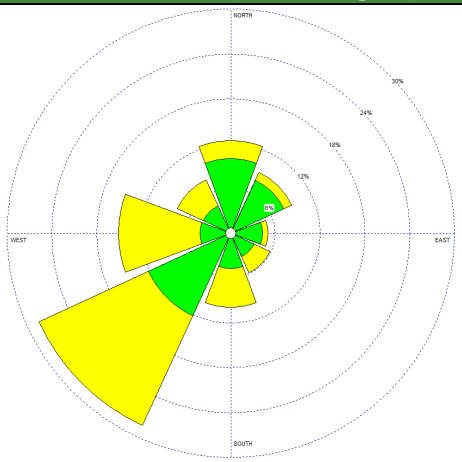
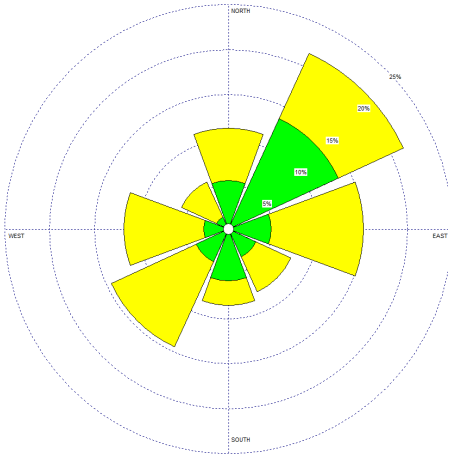
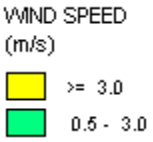
All Seasons	Summer Season (December – February)
	
Average Wind Speed: 3.15 m/s Calms Frequencies: 5.47% Axis Frequencies: 4%, 8%, 12%, 16%, 20%	Average Wind Speed: 3.27 m/s Calms Frequencies: 4.09% Axis Frequencies: 5%, 10%, 15%, 20%, 25%
Autumn Season (March – May)	**Winter Season (June – August)**
	
Average Wind Speed: 2.62 m/s Calms Frequencies: 6.62% Axis Frequencies: 4%, 8%, 12%, 16%, 20%	Average Wind Speed: 3.05 m/s Calms Frequencies: 6.72% Axis Frequencies: 6%, 12%, 18%, 24%, 30%
Spring Season (September – November)	**Legend**
	
Average Wind Speed: 3.70 m/s Calms Frequencies: 4.20% Axis Frequencies: 5%, 10%, 15%, 20%, 25%	

Figure 5-2: Wind Rose Plots – BOM Badgerys Creek AWS ID 067108 – 2019 – Evening time

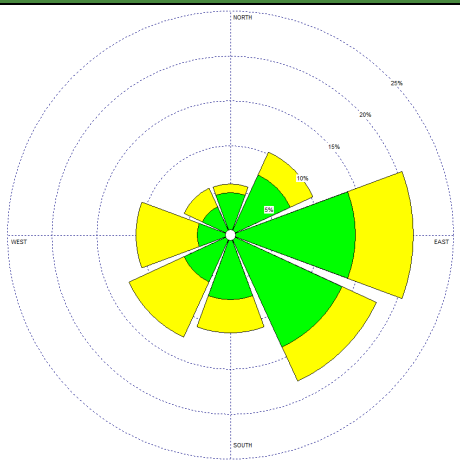
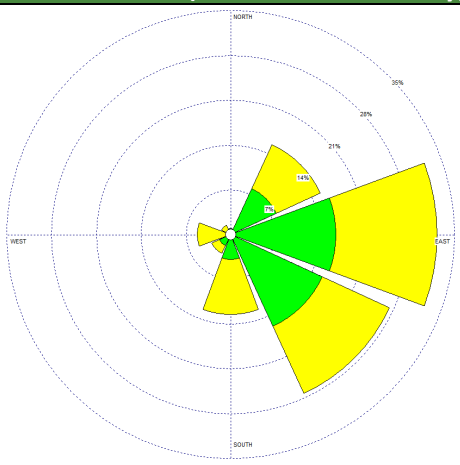
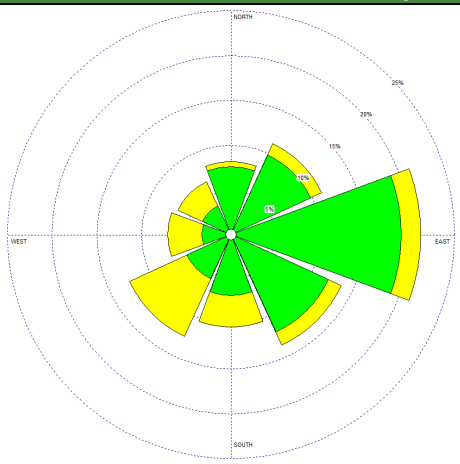
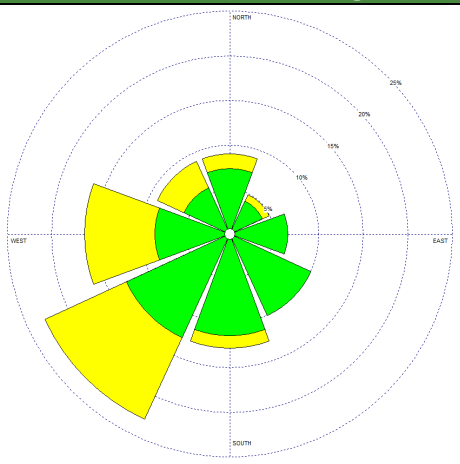
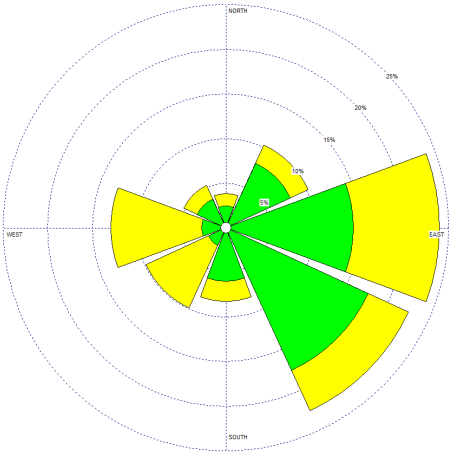
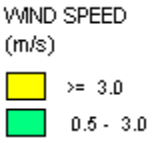
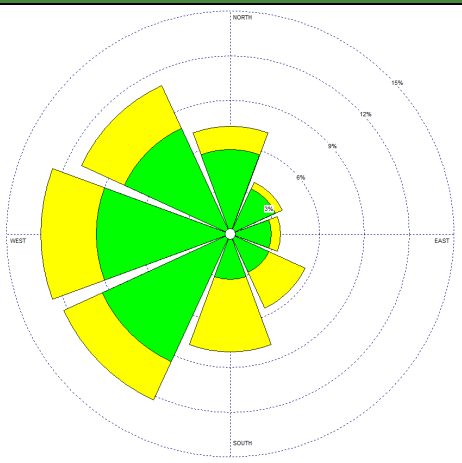
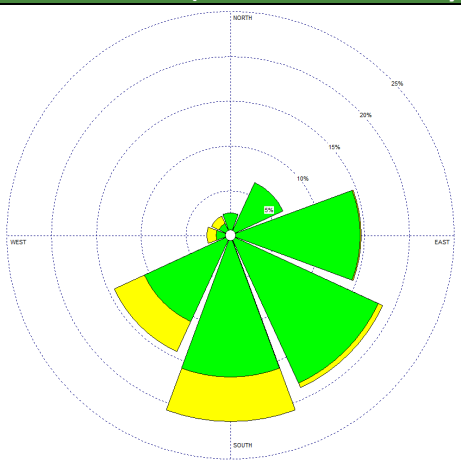
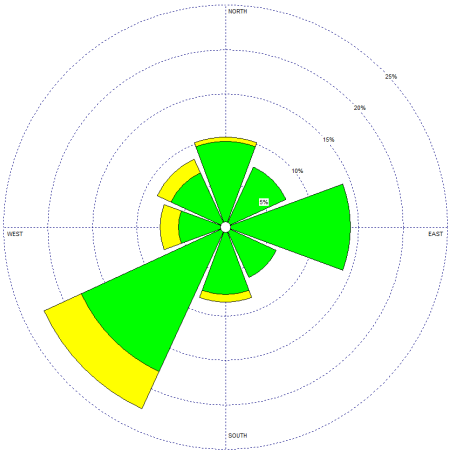
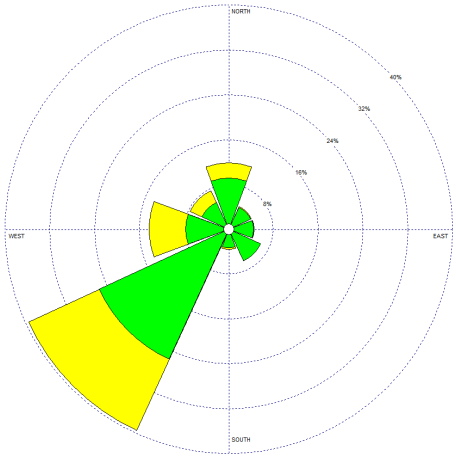
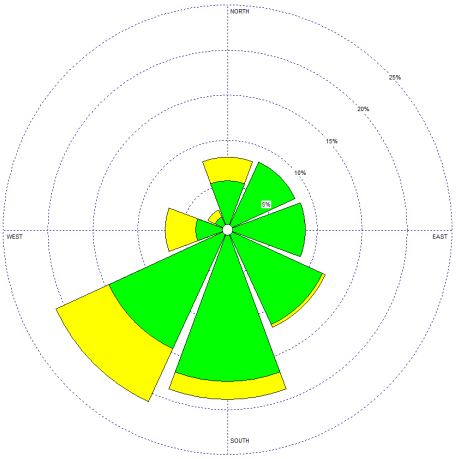
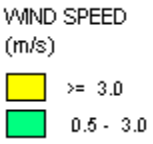
All Seasons	Summer Season (December – February)
	
Average Wind Speed: 2.63 m/s Calms Frequencies: 5.91% Axis Frequencies: 5%, 10%, 15%, 20%, 25%	Average Wind Speed: 4.47 m/s Calms Frequencies: 1.32% Axis Frequencies: 7%, 14%, 21%, 28%, 35%
Autumn Season (March – May)	**Winter Season (June – August)**
	
Average Wind Speed: 2.13 m/s Calms Frequencies: 9.51% Axis Frequencies: 5%, 10%, 15%, 20%, 25%	Average Wind Speed: 2.32 m/s Calms Frequencies: 8.70% Axis Frequencies: 5%, 10%, 15%, 20%, 25%
Spring Season (September – November)	**Legend**
	
Average Wind Speed: 2.96 m/s Calms Frequencies: 3.30% Axis Frequencies: 5%, 10%, 15%, 20%, 25%	

Figure 5-3: Wind Rose Plots – BOM Badgerys Creek AWS ID 067108 – 2019 – Night time

All Seasons	Summer Season (December – February)
	
Average Wind Speed: 1.76 m/s Calms Frequencies: 13.48% Axis Frequencies: 5%, 10%, 15%, 20%, 25%	Average Wind Speed: 1.47 m/s Calms Frequencies: 17.55% Axis Frequencies: 5%, 10%, 15%, 20%, 25%
Autumn Season (March – May)	**Winter Season (June – August)**
	
Average Wind Speed: 1.49 m/s Calms Frequencies: 15.34% Axis Frequencies: 5%, 10%, 15%, 20%, 25%	Average Wind Speed: 2.26 m/s Calms Frequencies: 7.97% Axis Frequencies: 8%, 16%, 24%, 32%, 40%
Spring Season (September – November)	**Legend**
	
Average Wind Speed: 1.74 m/s Calms Frequencies: 13.80% Axis Frequencies: 5%, 10%, 15%, 20%, 25%	

Appendix D2 of the Noise Policy for Industry (EPA, 2017), refers to utilising the Noise Enhancing Wind Analysis (NEWA) program on the NSW EPA website to determine the significance of source-to-receiver winds.

Table 5-1 below contains the noise wind component analysis from the NEWA software. Wind speeds are taken up to 3 m/s and wind direction is taken from source-to-receiver, plus and minus 45 degrees, as per appendix D2 of the Noise Policy for Industry.

It can be seen from Table 5-1 that there are two instances where during a period/season, more than 30% of wind speeds are less than 3 m/s in the plus and minus 45 degree arc from source to receiver.

Therefore, based on the information presented from the weather data, source-to receiver wind speeds of 3 m/s or are present for more than 30% of the time during the winter night time period. Therefore, wind effects have been included in the assessment.

Table 5-1: Noise Wind Component Analysis 2019 Badgerys Creek

Receiver	Day				Evening				Night			
	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring
R1	14.3	13.8	7.2	9.0	27.0	22.0	9.8	25.5	17.7	3.4	0.5	7.9
R2	14.6	13.6	7.1	8.8	26.3	22.3	11.4	26.1	19.3	4.6	0.5	8.2
R3	10.9	11.2	5.6	8.0	19.9	21.5	11.1	20.3	20.0	8.4	0.7	10.6
R4	7.3	8.5	4.0	6.0	14.6	18.5	7.9	17.3	16.0	8.3	0.7	9.5
R5	10.4	13.6	10.9	9.5	13.4	26.4	22.6	19.5	29.5	35.3	24.2	30.9
R6	7.3	12.4	15.7	7.7	5.1	17.1	27.2	9.9	21.0	29.8	31.5	26.4
R7	6.9	12.9	16.7	7.6	4.8	16.0	27.2	7.1	20.0	28.2	32.4	26.3
R8	9.7	16.2	23.4	11.3	2.3	6.8	23.9	2.7	2.9	9.8	23.8	8.3
R9	14.0	20.7	25.9	17.1	2.0	9.0	23.9	2.5	3.4	10.6	25.5	9.0
R10	23.9	20.0	19.0	20.7	7.8	8.4	13.6	9.3	6.6	5.8	15.7	7.6
R11	23.5	19.6	16.4	22.5	13.1	8.4	9.2	12.6	8.2	4.9	12.0	7.7
R12	19.5	12.9	6.9	13.5	24.7	12.0	4.6	19.2	9.4	0.1	0.6	5.1
R13	11.8	18.5	26.1	14.9	1.8	9.0	23.4	2.2	3.3	10.4	25.8	9.0
R14	16.9	12.5	6.2	11.0	28.0	15.5	6.8	21.7	11.1	0.4	0.4	5.5
R15	6.1	14.2	21.4	8.9	2.8	9.5	26.9	3.0	5.1	11.3	24.4	10.3

Noise enhancing meteorological conditions occur for 30% or more of the period and season

5.2 TEMPERATURE INVERSIONS

Temperature inversions are considered a feature where they occur more than 30% of the total night time during winter (June, July and August) between 6:00pm and 7:00am. This is different from the night noise assessment period over which inversions are to be assessed, which is from 10:00pm to 7:00am.

This involves determining the percentage occurrence of moderate (Class F) and strong (Class G) inversions. Weak inversions (Class E) should not be included in the analysis.

The analysis conducted on the 2019 weather data highlighted that during winter 27.51%of the nights presented temperature inversion conditions, therefore these effects have not been included in the noise impact assessment.

5.2.1 Weather Conditions Considered in the Assessment

The following conditions were considered as the facility will only operate during the day time period:

Condition A: neutral weather conditions
The meteorological condition considered in the noise model has been displayed in detail in Table 5-2.

Table 5-2: Meteorological Conditions Assessed in Noise Propagation Modelling

Condition	Classification	Ambient Temp.	Ambient Humidity	Wind Speed	Wind Direction (blowing from)	Temperature Inversion	Affected Receptors	Applicability
A	Neutral	10°C	70%	–	–	No	All	All periods

6. CURRENT LEGISLATION AND GUIDELINES

6.1 NSW EPA NOISE POLICY FOR INDUSTRY

6.1.1 Introduction

The NSW Noise Policy for Industry was developed by the NSW EPA primarily for the assessment of noise emissions from industrial sites regulated by the NSW EPA.

The policy sets out two components that are used to assess potential site-related noise impacts. The intrusiveness noise level aims at controlling intrusive noise impacts in the short-term for residences. The amenity noise level aims at maintaining a suitable amenity for particular land uses including residences in the long-term. The more stringent of the intrusiveness or amenity level becomes the project noise trigger levels for the project.

6.1.2 Project Intrusiveness Noise Level

The project intrusiveness noise level is determined as follows:

$L_{Aeq,\ 15\ minute}$ = rating background noise level + 5 dB

Where the $L_{Aeq,(15minute)}$ is the predicted or measured L_{Aeq} from noise generated within the project site over a fifteen minute interval at the receptor.

This is to be assessed at the most affected point on or within the residential property boundary or if that is more than 30 m from the residence, at the most affected point within 30 m of the residential dwelling.

6.1.3 Amenity Noise Level

To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.2 of the NSW Noise Policy for Industry 2017. The relevant recommended noise levels applicable from the Noise Policy for Industry are reproduced in Table 6-1. The suburban category has been selected for the residential noise amenity criteria to match the characteristics of the area.

Table 6-1: Amenity noise levels.

Receiver	Noise Amenity Area	Time of Day	L_{Aeq} dB(A) Recommended amenity noise level
Residential	Rural	Day	50
		Evening	45
		Night	40
School Classroom	All	Noisiest 1-hour period when in use	Internal: 40[1]
			External: 50[2]
Industrial premises	All	When in use	70

Note: 1) In the case where existing schools are affected by noise from existing sources, the acceptable L_{Aeq} noise level may be increased to L_{Aeq} 1 hour.
2) Where internal amenity noise levels are specified, they refer to the noise level at the centre of the habitable room that is most exposed to the noise and apply with windows opened sufficiently to provide adequate ventilation, except where alternative means of ventilation complying with the Building Code of Australia are provided. In cases where gaining internal access for monitoring is difficult, then external noise levels 10 dB(A) above the internal levels apply.

Source: Table 2.2 and Section 2.6, NSW Noise Policy for Industry

The project amenity noise level for industrial developments = recommended amenity noise level minus 5 dB(A)

The following exceptions to the above method to derive the project amenity noise levels apply:

1. *In areas with high traffic noise levels*
2. *In proposed developments in major industrial clusters*
3. *Where the resultant project amenity noise level is 10 dB or more lower than the existing industrial noise level. In this case the project amenity noise levels can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.*
4. *Where cumulative industrial noise is not a necessary consideration because no other industries are present in the area, or likely to be introduced into the area in the future. In such cases the relevant amenity noise level is assigned as the project amenity noise level for development.*

This development is not considered to be captured by the above exceptions.

6.1.4 Sleep Disturbance Criteria

In accordance with the NSW EPA Noise Policy for Industry, the potential for sleep disturbance from maximum noise level events from premises 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:

- **$L_{Aeq,\ 15\ minute}$ 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 assessment should be undertaken.

6.1.5 Project Noise Trigger Levels

The project noise trigger levels for the site have been established in accordance with the principles and methodologies of the NSW Noise Policy for Industry (EPA, 2017).

The table below presents the rating background level, project intrusive noise level, recommended amenity noise level, and project amenity noise level. The project noise trigger level is the lowest value of intrusiveness or project amenity noise level after conversion to $L_{Aeq\ 15\ minute}$, dB(A) equivalent level. Sleep disturbance trigger levels associated with operational activities are presented in Table 6-2.

Different time periods apply for the noise criteria as the intrusive criterion considers a 15 minute assessment period while the amenity criterion requires assessment over the total length of time that a site is operational within each day, evening or night period. In order to ensure compliance under all circumstances, a 15 minute period assessment has been considered for all receptors.

Table 6-2: Project Noise Trigger Levels (PNTL) for Operational Activities, dB(A)

Receiver	Type of Receptor	Time of day	Rating background noise level	Project intrusiveness noise level $L_{eq\ 15\ minute}$	Recommended amenity noise level $L_{Aeq\ period}$	Project amenity noise level $L_{Aeq\ 15\ minute}$[1]	PNTL $L_{Aeq\ 15\ minute}$	Sleep Disturbance L_{Amax}
R1-R12	Residential – Rural	Day	41	**46**	50	48	**46**	-
		Evening	41	46	45	**43**	**43**	-
		Night	39	44	40	**38**	**38**	**52**
R13	School	When in use	-	-	$L_{Aeq\ 1hr}$ = 50 (external)	50[2]	**50**	-
R14-15	Industrial Premises	When in use	-	-	70	68	**68**	-

Notes:
1) These levels have been converted to $L_{Aeq\ 15\ minute}$ using the following: $L_{Aeq\ 15\ minute} = L_{Aeq\ period} + 3$ dB (NSW Noise Policy for Industry Section 2.
2) This value has been conservatively assumed that $L_{Aeq\ 15\ minute}$ is equivalent to $L_{Aeq\ 1hr}$.

6.2 NSW Road Noise Policy

The NSW Road Noise Policy (RNP) has been adopted to establish the noise criteria for the potential noise impact associated with additional traffic generated by the proposed development. The RNP was developed by the NSW EPA primarily to identify the strategies that address the issue of road traffic noise from:

- Existing roads;
- New road projects;
- Road redevelopment projects; and
- New traffic-generating developments.

6.2.1 Road Category

The subject site is accessed via Park Road. Based on the RNP road classification description, Park Road is classified as a 'local road'. The closest resident is 380 Park Road, Luddenham 30 m from the road.

6.2.2 Noise Assessment Criteria

Section 2.3 of the RNP outlines the criteria for assessing road traffic noise. The relevant sections of Table 3 of the RNP are shown in Table 6-3.

Table 6-3: Road Traffic Noise Assessment Criteria For Residential Land Uses, dB(A)

Road Category	Type of Project/Land Use	Assessment Criteria, dB(A)*	
		Day (7am-10pm)	Night (10pm-7am)
Local roads	6. Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq\ (1\ hour)}$ 55 dB	$L_{Aeq\ (1\ hour)}$ 50 dB

* Measured at 1 m from a building façade.

6.2.3 Relative Increase Criteria

In addition to the assessment criteria outlined above, any increase in the total traffic noise level at a location due to a proposed project or traffic-generating development, must be considered. Residences experiencing increases in total traffic noise levels above the relative criteria should also be considered for mitigation as described in Section 3.4 of the RNP. For road projects where the main subject road is a local road, the relative increase criterion does not apply.

As the site is located on a local road, the relative increase criteria does not apply.

6.2.4 Exceedance of Criteria

If the criteria shown in Table 6-3 cannot be achieved, justification should be provided that all feasible and reasonable mitigation measures have been applied.

For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.

6.2.5 Assessment Locations for Existing Land Uses

Table 6-4: Assessment Locations for Existing Land Uses

Assessment Type	Assessment Location
External noise levels at residences	The noise level should be assessed at 1 metre from the façade and at a height of 1.5 metres from the floor. Separate noise criteria should be set and assessment carried out for each façade of a residence, except in straightforward situations where the residential façade most affected by road traffic noise can be readily identified. The residential noise level criterion includes an allowance for noise reflected from the façade ('façade correction'). Therefore, when taking a measurement in the free field where reflection during measurement is unlikely (as, for instance, when measuring open land before a residence is built), an appropriate correction – generally 2.5 dB – should be added to the measured value. The 'façade correction' should not be added to measurements taken 1 metre from the façade of an existing building. Free measurements should be taken at least 15 metres from any wall, building or other reflecting pavement surface on the opposite side of the roadway, and at least 3.5 metres from any wall, building or other pavement surface, behind or at the sides of the measurement point which would reflect the sound.
Noise levels at multi-level residential buildings	The external points of reference for measurement are the two floors of the building that are most exposed to traffic noise. On other floors, the internal noise level should be at least 10 dB less than the relevant external noise level on the basis of openable windows being opened sufficiently to provide adequate ventilation. (Refer to the Building Code of Australia (Australian Building Codes Board 2010) for additional information.)
Internal noise levels	Internal noise levels refer to the noise level at the centre of the habitable room that is most exposed to the traffic noise with openable windows being opened sufficiently to provide adequate ventilation. (Refer to the Building Code of Australia (Australian Building Codes Board 2010) for additional information.)
Open space – passive or active use	The noise level is to be assessed at the time(s) and location(s) regularly attended by people using the space. In this regard, 'regular' attendance at a location means at least once a week.
Commercial or industrial premises	The noise level is to be assessed at the reasonably most affected point or within the property boundary. This requirement should not be read to infer that the noise level only applies at the 'reasonably worst-affected location'.

6.2.6 Road Traffic Project Specific Noise Levels

The selected project specific noise levels associated with road traffic noise are presented in Table 6-5.

Table 6-5: Project Specific Noise Levels Associated with Road Traffic, dB(A)

Receptor along	Period	Assessment Criteria
Park Road (Local Road)	Day	55 $L_{Aeq,\ 15\ hour}$
	Night	50 $L_{Aeq,\ 9\ hour}$

6.3 CONSTRUCTION NOISE CRITERIA

Criteria for construction and demolition noise has been obtained from the NSW Interim Construction Noise Guideline (DECC, 2009). Guidance for construction vibration has been taken from British Standard BS7385-Part 2: 1993 '*Evaluation and measurement for vibration in buildings*' and other standards.

6.3.1 NSW Interim Construction Noise Guideline

Residential Criteria

Table 2 of the Interim Construction Noise Guideline (DECC, 2009), sets out construction noise management levels for noise at residences and how they are to be applied. The management noise levels are reproduced in Table 6-6 below. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level.

Table 6-6: Management Levels at Residences Using Quantitative Assessment

Time of Day	Management Level $L_{Aeq(15\ minute)}$	How to Apply
Recommended standard hours: Monday to Friday 7am – 6pm Saturday 8am – 1pm No work on Sundays or Public Holidays	Noise Affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq(15\ minute)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practises to meet the noise affected level. • The proponent should also inform all potentially affected residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly Noise Affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school, or mid-morning or mid-afternoon for works near residents. 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise Affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see Section 7.2.2 (RNP)

Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m from the residence.

Other Land Uses

Table 6-7 sets out management levels for construction noise at other land uses applicable to the surrounding area.

Table 6-7: Management Levels at Other Land Uses

Land use	Management Level $L_{Aeq(15\ minute)}$ (applies when properties are being used)
Industrial Premises	External Noise Level 75 dB(A)
Schools	Internal Noise Level 45 dB(A) External Noise Level 55 dB(A)

There are no other sensitive land uses in the area surrounding the site.

Noise Criterion

The noise criterion for construction noise is presented in Table 6-8.

Table 6-8: Construction Noise Criterion dB(A)

Receiver	Land Use	Period	RBL L_{A90}	Management Level $L_{Aeq(15\ minute)}$
R1-R12	Residential	Standard Hours	41	51
R13	School	When in use	-	55
R14-R15	Industrial	When in use	-	75

6.3.2 Vibration Criteria

Vibration criteria from construction works are outlined in this section, including guidelines to avoid cosmetic damage, structural damage or human discomfort. There is no specific vibration standard in NSW to assess cosmetic or structural damage to buildings. Usually the British Standard BS 7385–Part 2: 1993 '*Evaluation and measurement for vibration in buildings*' or the German standard DIN4150–Part 3: 1999 '*Structural Vibration Part 3 – effects of vibration on structures*' is referenced. The *Assessing Vibration – A Technical Guideline* (DEC, 2006) provides guidance on preferred levels for human exposure.

6.3.3 BS 7385-2:1993

The British Standard BS 7385–Part 2:1993 '*Evaluation and measurement for vibration in buildings*' provides vibration limits to avoid cosmetic damage on surrounding structures. Limits are set at the lowest limits where cosmetic damage has previously been shown.

Table 6-9: Vibration criteria for cosmetic damage (BS 7385:2 1993)

Type of building	Peak component particle velocity in frequency range of predominant pulse		
	4 Hz to 15 Hz	15 Hz to 40 Hz	40 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above		
Unreinforced or light framed structures. Residential or light commercial type buildings	15 to 20 mm/s	20 to 50 mm/s	50 mm/s

6.3.4 DIN4150-3:1999

The German standard DIN4150-Part 3:1999 'Structural Vibration Part 3 – effects of vibration on structures' has also been considered. The German standard is considered more onerous than the British standard, and specifically includes more stringent limits to avoid structural damage to surrounding heritage buildings.

Table 6-10: Structural damage criteria heritage structures (DIN4150-3 1999)

Type of building	Peak component particle velocity (PPV) mm/s			
	Vibration at the foundation at a frequency of:			Vibration of horizontal plane of highest floor at all frequencies
	1 to 10 Hz	10 to 50 Hz	50 to 100 Hz	
Buildings used for commercial purposes, industrial buildings or buildings of similar design	20	20 to 40	40 to 50	40
Residential dwellings and similar	5	5 to 15	15 to 20	15
Structures that, because of their particular sensitivity to vibration, cannot be classified as the two categories above, and are of intrinsic value (for example heritage listed buildings).	3	3 to 8	8 to 10	8

6.3.5 Human Exposure

The guideline *Assessing Vibration – A Technical Guideline* (DEC, 2006) describes preferred criteria for human exposure. The limits describe values where occupants of buildings would be impacted by construction work.

Table 6-11: Preferred and maximum weighted rms z-axis values, 1-80 Hz

Location	Daytime		Night time	
	Preferred	Maximum	Preferred	Maximum
Continuous Vibration (weighted root mean square (rms) vibration levels for continuous acceleration (m/s^2) in the vertical direction)				
Residences	0.01	0.02	0.007	0.014
Offices, schools, educational institutions and places of worship	0.02	0.04	0.02	0.04
Workshops	0.04	0.08	0.04	0.08
Impulsive Vibration (weighted root mean square (rms) vibration levels for impulsive acceleration (m/s^2) in the vertical direction)				
Residences	0.3	0.6	0.1	0.2
Offices, schools, educational institutions and places of worship	0.64	1.28	0.64	1.28
Workshops	0.64	1.28	0.64	1.28
Intermittent Vibration (m/s)				
Residences	0.2	0.4	0.13	0.26
Offices, schools, educational institutions and places of worship	0.4	0.8	0.4	0.8
Workshops	0.8	1.6	0.8	1.6

7. OPERATIONAL NOISE IMPACT ASSESSMENT

An outline of the predictive noise modelling methodology and operational noise modelling scenarios has been provided in this section of the report.

7.1 MODELLING METHODOLOGY

Noise propagation modelling was carried out using the ISO 9613-2:1996 algorithm within SoundPLAN. This model has been extensively utilised by Benbow Environmental for assessing noise emissions for existing and proposed developments and is recognised by regulatory authorities throughout Australia. The model allows for the prediction of noise from a site at the specified receptor, by calculating the contribution of each noise source. Other model inputs included the noise sources, topographical features of the subject area, surrounding buildings, noise walls and receiver locations.

The modelling scenario has been carried out using the L_{Aeq} descriptor. Using the model, noise levels were predicted at the potentially most affected receivers to determine the noise impact against the project specific noise levels and other relevant noise criteria in accordance with the NSW Noise Policy for Industry (EPA, 2017).

7.1.1 Noise Sources

The sound power levels for the identified noise sources associated with the operational activities have been taken from Benbow Environmental's database.

A-weighted third octave band centre frequency sound power levels have been used and are presented in Table 7-1 below. The noise sources utilised as part of this assessment comprise of the primary noise generating activities associated with the effective operation of the proposed development.

Table 7-1: A-weighted Sound Power Levels Associated with Operational Activities, dB(A)

Noise Source	Height	Max	Overall	Third Octave Band Centre Frequency (Hz)									
				25	31	40	50	63	80	100	125	160	200
				250	315	400	500	630	800	1000	1250	1600	2000
				2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Shredder	1 m	-	108	41	43	46	52	55	65	72	78	85	88
				89	91	95	98	98	100	97	99	97	97
				95	94	94	93	89	85	80	75	69	61
Mobile Crusher	2 m	-	108	41	43	46	52	55	65	72	78	85	88
				89	91	95	98	98	100	97	99	97	97
				95	94	94	93	89	85	80	75	69	61
Baler	1 m	-	93	-	-	-	-	58	-	-	76	-	-
				84	-	-	83	-	-	91	-	-	83
				-	-	81	-	-	75	-	-	-	-
Waste Screen (Trommel screen)	1 m	-	104	42	44	59	64	75	76	75	81	82	83
				83	84	90	93	90	92	94	95	95	95
				94	93	91	89	86	82	77	73	67	59
Air separator	1 m	-	102	40	42	57	62	73	74	73	79	80	81
				81	82	88	91	88	90	92	93	93	93
				92	91	89	87	84	80	75	71	65	57
Bounce separator (Trommel screen)	1 m	-	105	43	45	60	65	76	77	76	82	83	84
				84	85	91	94	91	93	95	96	96	96
				95	94	92	90	87	83	78	74	68	60
Vibrating Screen	1 m		104	82	80	89	90	97	94	89	92	90	90
				87	86	90	92	88	89	89	90	90	89
				88	87	86	84	82	79	76	73	69	64
20T Excavator	2 m	-	102	-	-	-	-	82	-	-	85	-	-
				91	-	-	97	-	-	96	-	-	95
				-	-	92	-	-	85	-	-	-	-
30T Excavator	2 m	-	103	-	-	-	-	96	-	-	94	-	-
				93	-	-	94	-	-	95	-	-	95
				-	-	90	-	-	83	-	-	-	-
Front End Loader (<111 kW at 2000 rpm)	2 m	-	102	44	51	59	65	64	77	77	78	80	85
				89	85	85	88	88	90	93	94	93	92
				91	90	88	87	84	81	77	73	66	60
Aggregate Transfer	2 m	110	106	-	12	-	-	33	-	-	48	-	-
				63	-	-	75	-	-	82	-	-	86
				-	-	88	-	-	88	-	-	76	-
Conveyor	1 m	-	80	29	31	29	35	38	49	45	49	53	57
				57	65	68	70	68	71	70	72	71	70
				63	63	59	56	52	49	44	42	36	29
LPG Forklift	1 m	-	92	36	59	61	51	65	66	77	68	60	62
				66	69	74	81	78	78	81	85	84	84
				81	75	71	71	65	63	56	51	45	42
Truck Engine	1.5 m	106	103	44	48	57	65	70	73	78	78	80	82
				83	85	94	98	94	96	89	88	82	87
				85	84	82	83	83	82	78	-	-	-

Table 7-1: A-weighted Sound Power Levels Associated with Operational Activities, dB(A)

Noise Source	Height	Max	Overall	Third Octave Band Centre Frequency (Hz)									
				25	31	40	50	63	80	100	125	160	200
				250	315	400	500	630	800	1000	1250	1600	2000
				2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Truck Exhaust	3 m	104	101	42	46	55	63	68	71	76	76	78	80
				81	83	92	96	92	94	87	86	80	85
				83	82	80	81	81	80	76	-	-	-
Sweeper	1 m	-	83	-	-	-	-	80	-	-	75	-	-
				69	-	-	75	-	-	71	-	-	67
				-	-	61	-	-	58	-	-	-	-

7.1.2 Modelling Scenario

One day scenario was modelled for operational noise emissions. Scenario 1 covers the day period with neutral weather conditions and outdoor and indoor noise sources. Figure 7-1 shows the location of the noise sources for the operational scenario.

Table 7-2: Modelled Noise Sources

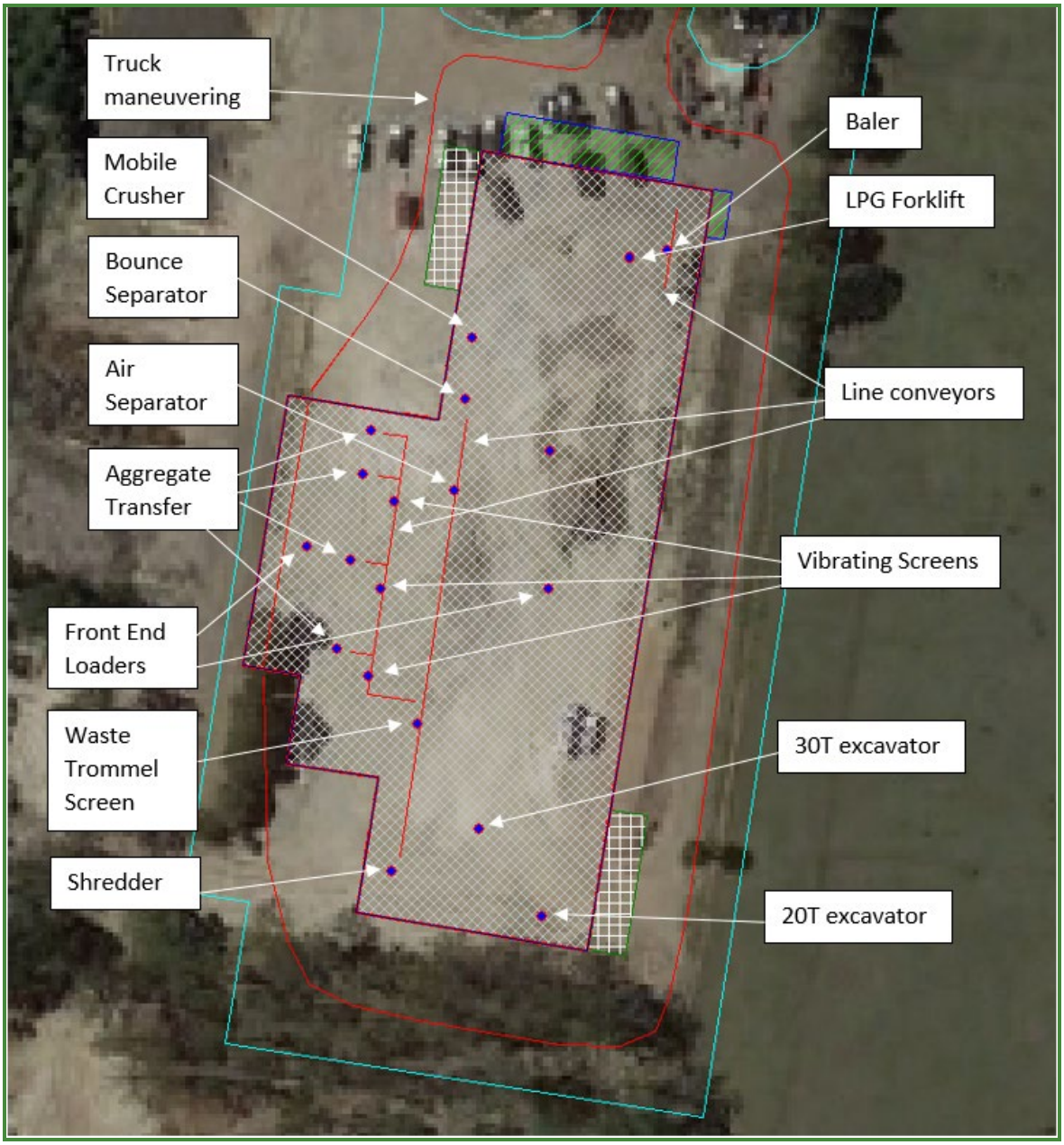
Scenario	Description
Scenario 1: Day Operations Neutral weather conditions	This scenario includes the following: Outdoor noise sources • Truck movements (8 per 1 hour period) Indoor noise sources • Truck movements through loading area (8 per 1 hour period) • Use of 20T excavator x 1; • Use of 30T excavator x 1; • Use of front end loader x 2; • Use of shredder; • Use of mobile crusher; • Use of waste trommel screen; • Use of air separator; • Use of bounce separator; • Use of vibrating screen x 3; • Use of line conveyors; • Use of baler; • Use of sweeper; and • Use of LPG forklift.

Figure 7-1: Day operations – broad view

Figure 7-2: Day operation sources

Figure 7-3: Evening operation sources

Figure 7-4: Night operation sources



7.1.3 Modelling Assumptions

The relevant assessment period for operational noise emissions is 15 minutes when assessing noise levels against the Intrusive Criterion; therefore noise source durations detailed throughout the following assumptions section should be considered per 15 minute period in view of potential noise impacts under worst-case scenarios. Each assessment-specific assumption has been detailed below:

- Topographical information has been obtained from Google Earth and implemented in SoundPLAN.
- All ground areas surrounding the subject site and the nearest nominated occupancies have been modelled considering different ground factors ranging from 0 to 1. The site and surrounding industrial areas have been modelled with a ground absorption factor of 0 (hard) and the surrounding rural area 0.9 (soft).
- Surrounding buildings have been included in the noise model.
- Aggregate transfer from the conveyors inside to the stockpiles in the bays have been modelled at 2 m above the ground.
- Indoor sources are all assumed to be point sources and are assumed to operate 100% of the time as a worst case scenario.
- All residential receivers were modelled at 1.5 m above ground level at the most noise-affected point on the property within 30 m of the dwelling.
- The main building has been modelled with sheet-steel 1 mm double corregated steel facades (R_w 36 dB) and sheet-steel corregated steel with miwo roof, 120 mm thick in total (R_w 32 dB).

Day Scenario

- 2 truck movement looping around the warehouse is assumed to enter and leave the site every 15 minutes in a worst case scenario. Trucks have been assumed to travel on the site at 25 km/h. Trucks are modelled in sound plan as line sources, utilising moving point source definition.
- Roller shutter doors 1-6 and 10-11 have been modelled in the open position (R_w 0 dB) for 5 minutes every 15 minute period.
- Roller shutter doors 7-9 have been modelled in the closed position 100% of the time as trimdek 0.48 R_w 22 dB.
- Pedestrian access doors have been modelled in the open position (R_w 0 dB) for 3 minutes every 15 minute period.
- The front end loader has been modelled as a point source outdoors and is assumed to operate 100% of the time as a worst case scenario.

Figure 7-5: Building diagram view from the east

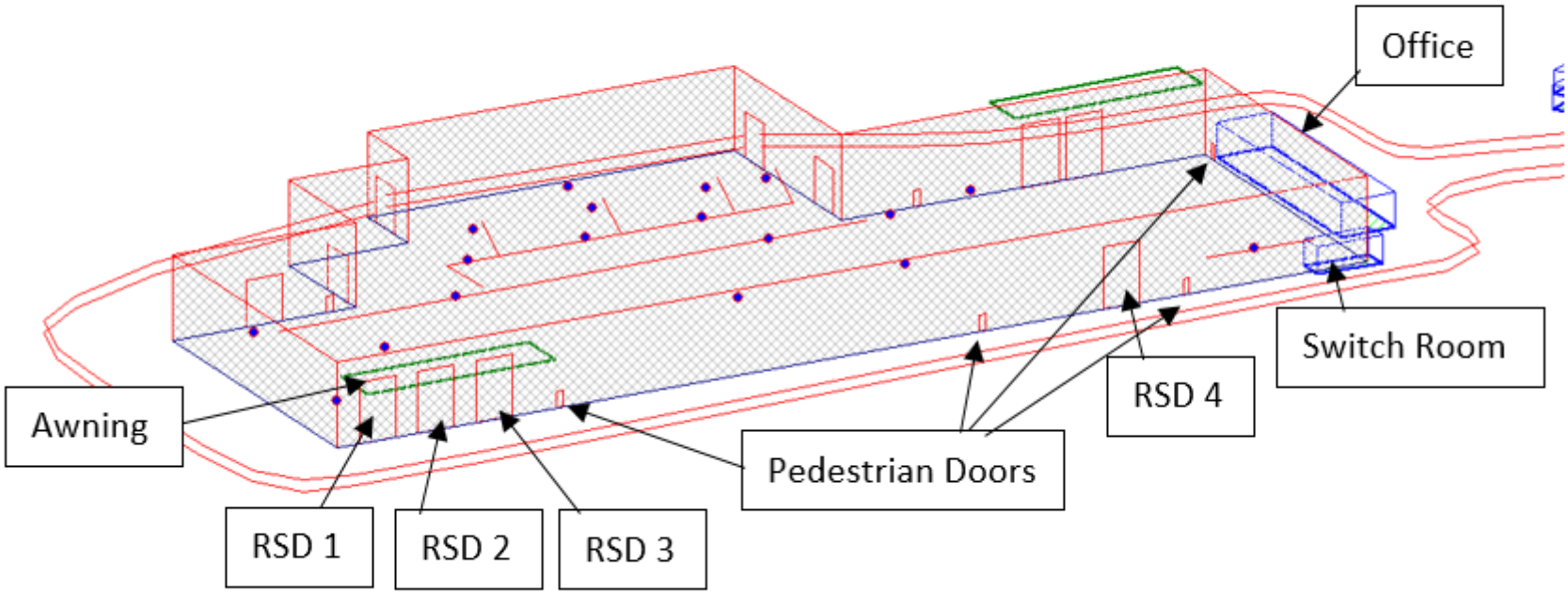
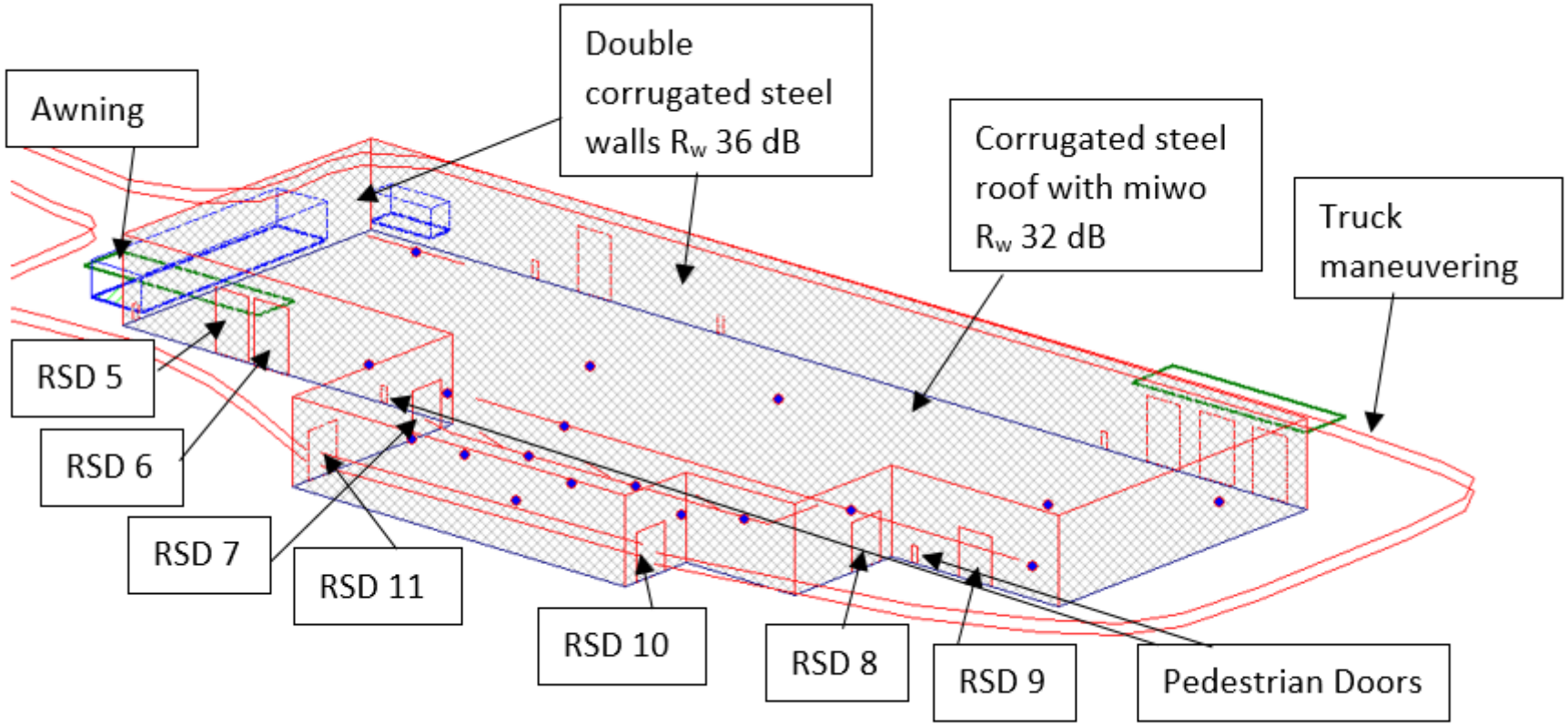


Figure 7-6: Building diagram from the west



7.2 Predicted Noise Levels – Operational

Noise levels at the nearest receptors have been calculated and results of the predictive noise modelling considering operational activities are shown in Table 7-3.

The modelled scenario is predicted to comply with the $L_{eq(15\ minute)}$ project specific criteria at all sensitive receptors.

Proactive noise management practices and controls are outlined in Section 7.3.

Table 7-3: Predicted Noise Levels – Operational Activities dB(A) Day

Receptor	Project Criteria $L_{eq(15\ minute)}$	Scenario 1
	Day	Predicted $L_{eq(15\ minute)}$
R1	46	46 ✓
R2	46	40 ✓
R3	46	39 ✓
R4	46	39 ✓
R5	46	38 ✓
R6	46	41 ✓
R7	46	45 ✓
R8	46	44 ✓
R9	46	42 ✓
R10	46	35 ✓
R11	46	31 ✓
R12	46	36 ✓
R13	50	31 ✓
R14	68	34 ✓
R15	68	44 ✓

✓Complies ✗ Non-compliance

7.3 Recommended Mitigation Measures

The noise assessment in Section 7 predicted that if the assumptions listed in 7.1.3 are carried out, noise levels would be met at all surrounding receivers.

Controls important to note are the following:

- All front-end loaders operated on site are to be no greater than 111 kW in power, and produce no higher sound power level than 102 dB(A) as shown in Table 7-1.
- The activity of aggregate transfer is to create a sound power level of no greater than 106 dB(A).
- The walls must have an R_w of at least 36 dB, double corrugated steel has been modelled;
- The roof must have an R_w of at least 32 dB, corrugated steel with miwo, 120 mm thick in total has been modelled;
- Roller shutter doors must be kept closed when not in use for deliveries, automatic closing roller shutter doors are recommended; and
- Pedestrian doors should also be kept close when not in use.

The following noise control measures are recommended in order to proactively further reduce noise levels at surrounding receivers:

- Prohibition of extended periods of on-site revving/idling;
- Minimisation of the use of truck exhaust brakes on site;
- Enforcement of low on-site speed limits;
- Regular maintenance of plant; and
- Signs to encourage quiet operations during the night period.

8. ROAD TRAFFIC NOISE IMPACT ASSESSMENT

A description of the calculation methodology and the noise predictions associated with road traffic has been provided below. The most likely route to the site travels along Park Road, on towards the A9.

Calculation of road traffic noise contribution has been undertaken using SoundPLAN. Fifty-five trucks per day time period are predicted, therefore, a worst case scenario of two trucks per 15 minutes, 8 per hour has been considered during the day time period. The trucks are assumed to travel along Park Road at the posted speed of 80 km/h adjacent to the closest receptor. Trucks have been modelled considering two moving point sources at heights of 1.5 m and 3 m above ground level in order to account for the engine (1.5 m) and the exhaust outlet (3.0 m).

The $L_{Aeq,\ 1\ hour\text{-}day}$ noise descriptor has been calculated at the most affected residential receptor located nearby along Park Road. The receiver has been selected as it is the closest residential receiver along the road route to the site. The predicted noise levels are displayed in Table 8-1. The highest noise levels would be predicted at this location therefore 380 Park Road is the only location considered.

Table 8-1: Predicted Levels for Road Traffic Noise

Receptor	Criteria	Predicted noise level
	Day $L_{Aeq,\ 1\ hour}$	Day $L_{Aeq,\ 1hour}$
380 Park Road	55	43 ✓

✓Complies × Non-compliance

For the residential dwelling that is adjacent to Park Road, site contribution noise levels associated with the delivery trucks would be below the daytime criteria of $L_{Aeq\ (1\ hour)}$ 55 dB and night-time criteria of $L_{Aeq\ (1\ hour)}$ 50 dB for local roads. Therefore, the site has a negligible contribution on the 380 Park Road receiver.

From Table 8-1, the predicted daytime $L_{Aeq,1\ hour}$ and night-time $L_{Aeq,1\ hour}$ road traffic noise levels comply with the noise criteria, as established in the NSW EPA Road Noise Policy. Therefore, no additional road noise mitigation strategies are recommended.

9. CONSTRUCTION NOISE IMPACT ASSESSMENT

9.1 CONSTRUCTION ACTIVITIES

Construction activities are proposed to include the following:

- Site establishment;
- Civil works to level the property to proposed heights;
- Concreting works of the building base, hardstand areas and driveways; and
- Structure works for the proposed building.

The current residential dwelling and associated sheds are proposed to be kept, therefore no demolition works are proposed.

9.2 MODELLED NOISE GENERATING SCENARIOS

Considering the construction activities outlined in Section 9.1, the four construction stages listed in Table 9-1 are modelled for:

- Site establishment;
- Civil works;
- Concreting works; and
- Structure works.

The noise generating stages consider a worst case scenario in which all equipment is running for 100% of the time over the 15 minute assessment period.

The equipment list for the stages is detailed in Table 9-1, with an equipment location diagrams in Figure 9-1 to Figure 9-4. Equipment is primarily located near the entrance to the site, as equipment such as trucks will have greatest access and are most likely to be positioned at this spot.

All construction works are proposed to be undertaken during standard construction hours mentioned in Table 6-6, that is

- Monday to Friday, 7am to 6pm;
- Saturday 8am to 1pm ; and
- No work on Sundays or public holidays.

Table 9-1: Modelled Noise Stages for Proposed Construction Works

Scenario	Time of the day	Noise Sources for Worst 15-minute Period
1. Site establishment	Standard hours	• Generator • Hand tools • Truck
2. Civil works	Standard hours	• 5T excavator • Backhoe • Dozer • Hand tools • Truck
3. Concreting works	Standard hours	• Concrete mixer truck • Concrete pump • Hand tools
4. Structure works	Standard hours	• Truck • Crane • Hand Tools

Note 1: As per Section 4.5 of the Interim Construction Noise Guideline (DECC, 2009), a number of activities have proven to be particularly annoying to residents and have therefore had 5 dB added to their predicted levels.

Figure 9-1: Construction Stage 1 – Site Establishment

Figure 9-2: Construction Stage 2 – Civil Works

Figure 9-3: Construction Stage 3 – Concreting Works

Figure 9-4: Construction Stage 4 – Structure Works

9.3 MODELLING METHODOLOGY

9.3.1 Noise Model

Noise propagation modelling for the construction activities was carried out using the ISO 9613-2:1996 algorithm within SoundPLAN. The construction stages were modelled using the $L_{Aeq,\ 15\ minutes}$ descriptor.

Assumptions made in the noise modelling of the construction noise stages are as follows:

- The relevant assessment period for operational noise emissions has been considered to be 15 minutes. Construction stages assume all equipment is running 100% of the time during the 15 minute assessment period, to provide a worst case scenario;
- Topographical information for off-site areas was obtained from Google Earth;
- Topographical information for on-site areas was obtained from the site survey;

- All receptors were modelled at 1.5 m above ground level;
- All ground areas have been modelled considering different ground factors ranging from 0 to 1 (Soft to Hard ground). The subject site has been modelled with a ground absorption factor of 0 (hard) and the surrounding rural area, 1 (soft).
- All noise sources associated with the construction works have been modelled as point sources.

9.3.2 Noise Sources

A-weighted octave band centre frequency sound power levels are presented shown in Table 9-2 below. The sound power levels for the relevant noise sources have been calculated from measurements of sound pressure levels undertaken by an acoustic engineer from Benbow Environmental at similar sites and sourced from Benbow Environmental's noise source database, as well as taken from AS 2436-2010 and the UK Department for Environmental Food and Rural Affairs (DEFRA) database, *Update of noise database for prediction of noise on construction and open sites*.

Table 9-2: A-weighted Sound Power Levels Associated with Construction Activities, dB(A)

Noise Source	Overall	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Generator	**93**	79	84	83	85	87	86	83	69
Truck	**106**	77	84	89	104	95	93	88	88
Jackhammer	**114**	82	92	99	112	109	105	102	95
Dozer	**105**	75	89	94	100	100	98	92	82
Backhoe	**96**	76	78	83	89	91	89	88	77
Hand tools	**100**	71	81	91	96	94	90	87	81
Concrete mixer truck	**103**	70	84	92	96	97	98	92	85
Concrete pump truck	**105**	77	92	97	99	100	95	95	89
Crane	**103**	84	84	87	94	98	97	95	85
Excavator	**100**	80	83	89	95	94	93	90	83

9.4 Construction Predicted Noise Levels

Results of the predictive noise modelling of the construction activities are shown in Table 9-3. Compliance with the noise criteria is predicted at all receptors, during all construction scenarios. Noise levels are also predicted to be well below the highly noise affected criteria of 75 dB(A).

Table 9-3: Noise Modelling Results Associated with Construction Activities for L_{eq}, dB(A)

Receiver	Criteria: PSNL ($L_{eq,15\ minute}$ dB(A))	Predicted Levels: Scenario (Standard Hours) (L_{eq}, dB(A))			
	Standard Hours	1	2	3	4
R1	51	45 ✓	48 ✓	45 ✓	47 ✓
R2	51	40 ✓	42 ✓	40 ✓	41 ✓
R3	51	39 ✓	41 ✓	38 ✓	40 ✓
R4	51	38 ✓	40 ✓	38 ✓	39 ✓
R5	51	40 ✓	40 ✓	39 ✓	40 ✓
R6	51	41 ✓	44 ✓	42 ✓	42 ✓
R7	51	45 ✓	47 ✓	45 ✓	46 ✓
R8	51	43 ✓	47 ✓	46 ✓	45 ✓
R9	51	41 ✓	45 ✓	43 ✓	43 ✓
R10	51	34 ✓	38 ✓	36 ✓	35 ✓
R11	51	31 ✓	36 ✓	32 ✓	32 ✓
R12	51	35 ✓	37 ✓	34 ✓	35 ✓
R13	55	31 ✓	33 ✓	31 ✓	32 ✓
R14	75	37 ✓	39 ✓	37 ✓	38 ✓
R15	75	47 ✓	48 ✓	45 ✓	48 ✓

9.5 Construction Noise Mitigation Measures

Construction activities should only take place during standard **construction** hours as follows:

Monday to Friday:	7am to 6pm
Saturday:	8am to 1pm
Sunday and Public Holidays:	No works permitted

10. STATEMENT OF POTENTIAL NOISE IMPACT

Benbow Environmental has been engaged by Greenfields Resource Recovery Facility to prepare a noise impact assessment for a resource recovery facility at Lot 5, DP 655046 (344 Park Road, Wallacia). The site will have a processing capacity of 95,000 tonnes per year.

The principal noise sources associated with the site include noise from a shredder and mobile crusher, screening equipment, conveyors and aggregate transfer as well as mobile plant including truck movements, excavators and front end loaders.

The noise impact assessment was undertaken in accordance with the following guidelines:

- NSW Noise Policy for Industry (EPA, 2017);
- Interim Construction Noise Guideline (DECC, 2009); and
- NSW Road Noise Policy (RNP) (DECCW, 2011).

Assessment criteria for noise emissions from the subject site were used to determine whether the potential noise impacts from the site were within the derived limits or in exceedance of the guidelines.

The nearest receivers and noise criteria were identified. The site operations were modelled using the predictive noise software, Sound Plan V7.3.

The activities proposed by the proponent were found to be within the framework of the NSW EPA Noise Policy for Industry.

The operational noise levels were predicted to comply with the $L_{Aeq(15\ minute)}$ project specific criteria at all receptors.

The noise assessment in Section 7 predicted that if the assumptions listed in 7.1.3 are carried out, noise levels would be met at all surrounding receivers.

Controls important to note are the following:

- All front-end loaders operated on site are to be no greater than 111kW in power, and produce no higher sound power level than 102 dB(A) as shown in Table 7-1.
- The activity of aggregate transfer is to create a sound power level of no greater than 106 dB(A).
- The walls must have an R_w of at least 36 dB, double corrugated steel has been modelled;
- The roof must have an R_w of at least 32 dB, corrugated steel with miwo, 120mm thick in total has been modelled;
- Roller shutter doors must be kept closed when not in use for deliveries, automatic closing roller shutter doors are recommended; and
- Pedestrian doors should also be kept close when not in use.

Further proactive noise management practices are described in Section 7.3.

Compliance with the guidelines set out in the NSW Road Noise Policy was predicted at all considered receptors.

Construction noise is predicted to comply with the Interim Construction Guidelines at all surrounding receivers.

This concludes the report.

Victoria Hale
Senior Environmental Scientist

R T Benbow
Principal Consultant

11. LIMITATIONS

Our services for this project are carried out in accordance with our current professional standards for site assessment investigations. No guarantees are either expressed or implied.

This report has been prepared solely for the use of Greenfields Resource Recovery Facility, as per our agreement for providing environmental services. Only Greenfields Resource Recovery Facility is entitled to rely upon the findings in the report within the scope of work described in this report. Otherwise, no responsibility is accepted for the use of any part of the report by another in any other context or for any other purpose.

Although all due care has been taken in the preparation of this study, no warranty is given, nor liability accepted (except that otherwise required by law) in relation to any of the information contained within this document. We accept no responsibility for the accuracy of any data or information provided to us by Greenfields Resource Recovery Facility for the purposes of preparing this report.

Any opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal advice.

ATTACHMENTS

Attachment 1: Noise Terminology

'A' FREQUENCY WEIGHTING

The 'A' frequency weighting roughly approximates to the Fletcher-Munson 40 phon equal loudness contour. The human loudness perception at various frequencies and sound pressure levels is equated to the level of 40 dB at 1 kHz. The human ear is less sensitive to low frequency sound and very high frequency sound than midrange frequency sound (i.e. 500 Hz to 6 kHz). Humans are most sensitive to midrange frequency sounds, such as a child's scream. Sound level meters have inbuilt frequency weighting networks that very roughly approximates the human loudness response at low sound levels. It should be noted that the human loudness response is not the same as the human annoyance response to sound. Here low frequency sounds can be more annoying than midrange frequency sounds even at very low loudness levels. The 'A' weighting is the most commonly used frequency weighting for occupational and environmental noise assessments. However, for environmental noise assessments, adjustments for the character of the sound will often be required.

AMBIENT NOISE

The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc. Usually assessed as an energy average over a set time period 'T' (L_{Aeq},T).

AUDIBLE

Audible refers to a sound that can be heard. There are a range of audibility grades, varying from "barely audible", "just audible" to "clearly audible" and "prominent".

BACKGROUND NOISE LEVEL

Total silence does not exist in the natural or built-environments, only varying degrees of noise. The Background Noise Level is the minimum repeatable level of noise measured in the absence of the noise under investigation and any other short-term noises such as those caused by all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc.. It is quantified by the noise level that is exceeded for 90 % of the measurement period 'T' (L_{A90}, T). Background Noise Levels are often determined for the day, evening and night time periods where relevant. This is done by statistically analysing the range of time period (typically 15 minute) measurements over multiple days (often 7 days). For a 15 minute measurement period the Background Noise Level is set at the quietest level that occurs at 1.5 minutes.

'C' FREQUENCY WEIGHTING

The 'C' frequency weighting approximates the 100 phon equal loudness contour. The human ear frequency response is more linear at high sound levels and the 100 phon equal loudness contour attempts to represent this at various frequencies at sound levels of approximately 100 dB.

DECIBEL

The decibel (dB) is a logarithmic scale that allows a wide range of values to be compressed into a more comprehensible range, typically 0 dB to 120 dB. The decibel is ten times the logarithm of the ratio of any two quantities that relate to the flow of energy (i.e. power). When used in acoustics it is the ratio of square of the sound pressure level to a reference sound pressure level, the ratio of the sound power level to a reference sound power level, or the ratio of the sound intensity level to a reference sound intensity level. See also Sound Pressure Level and Sound Power Level. Noise levels in decibels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dB, and another similar machine is placed beside it, the level will increase to 53 dB (from $10 \log_{10} (10^{(50/10)} + 10^{(50/10)})$ and not 100 dB. In theory, ten similar machines placed side by side will increase the sound level by 10 dB, and one hundred machines increase the sound level by 20 dB. The human ear has a vast sound-sensitivity range of over a thousand billion to one so the logarithmic decibel scale is useful for acoustical assessments.

dBA – See 'A' frequency weighting

dBC – See 'C' frequency weighting

EQUIVALENT CONTINUOUS SOUND LEVEL, LAeq

Many sounds, such as road traffic noise or construction noise, vary repeatedly in level over a period of time. More sophisticated sound level meters have an integrating/averaging electronic device inbuilt, which will display the energy time-average (equivalent continuous sound level - L_{Aeq}) of the 'A' frequency weighted sound pressure level. Because the decibel scale is a logarithmic ratio, the higher noise levels have far more sound energy, and therefore the LAeq level tends to indicate an average which is strongly influenced by short term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closer to the L_{Aeq} noise level than any other descriptor.

'F'(FAST) TIME WEIGHTING

Sound level meter design-goal time constant which is 0.125 seconds.

FLETCHER–MUNSON EQUAL LOUDNESS CONTOUR CURVES

The Fletcher–Munson curves are one of many sets of equal loudness contours for the human ear, determined experimentally by Harvey Fletcher and Wilden A. Munson, and reported in a 1933 paper entitled "Loudness, its definition, measurement and calculation" in the Journal of the Acoustic Society of America.

FREE FIELD

In acoustics a free field is a measurement area not subject to significant reflection of acoustical energy. A free field measurement is typically not closer than 3.5 metres to any large flat object (other than the ground) such as a fence or wall or inside an anechoic chamber.

FREQUENCY

The number of oscillations or cycles of a wave motion per unit time, the SI unit is the hertz (Hz). 1 Hz is equivalent to one cycle per second. 1000 Hz is 1 kHz.

IMPACT ISOLATION CLASS (IIC)

The American Society for Testing and Materials (ASTM) has specified that the IIC of a floor/ceiling system shall be determined by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The IIC is a number found by fitting a reference curve to the measured octave band levels and then deducting the sound pressure level at 500 Hz from 110 decibels. Thus the higher the IIC, the better the impact sound isolation. Not commonly used in Australia.

'I' (IMPULSE) TIME WEIGHTING

Sound level meter time constant now not in general use. The 'I' (impulse) time weighting is not suitable for rating impulsive sounds with respect to their loudness. It is also not suitable for assessing the risk of hearing impairment or for determining the 'impulsiveness' of a sound.

IMPACT SOUND INSULATION ($L_{nT,w}$)

Australian Standard AS ISO 717.2 – 2004 has specified that the Impact Sound Insulation of a floor/ceiling system be quantified by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The Weighted Standardised Impact Sound Pressure Level ($L_{nT,w}$) is the sound pressure level at 500 Hz for a reference curve fitted to the measured 1/3 octave band levels. Thus the lower $L_{nT,w}$ the better the impact sound insulation.

IMPULSE NOISE

An impulse noise is typified by a sudden rise time and a rapid sound decay, such as a hammer blow, rifle shot or balloon burst.

LOUDNESS

The volume to which a sound is audible to a listener is a subjective term referred to as loudness. Humans generally perceive an approximate doubling of loudness when the sound level increases by about 10 dB and an approximate halving of loudness when the sound level decreases by about 10 dB.

MAXIMUM NOISE LEVEL, LAFmax

The root-mean-square (rms) maximum sound pressure level measured with sound level meter using the 'A' frequency weighting and the 'F' (Fast) time weighting. Often used for noise assessments other than aircraft.

MAXIMUM NOISE LEVEL, LASmax

The root-mean-square (rms) maximum sound pressure level measured with sound level meter using the 'A' frequency weighting and the 'S' (Slow) time weighting. Often used for aircraft noise assessments.

NOISE RATING NUMBERS

A set of empirically developed equal loudness curves has been adopted as Australian Standard AS1469-1983. These curves allow the loudness of a noise to be described with a single NR number. The Noise Rating number is that curve which touches the highest level on the measured spectrum of the subject noise. For broadband noise such as fans and engines, the NR number often equals the 'A' frequency weighted dB level minus five.

NOISE

Noise is unwanted, harmful or inharmonious (discordant) sound. Sound is wave motion within matter, be it gaseous, liquid or solid. Noise usually includes vibration as well as sound.

NOISE REDUCTION COEFFICIENT – See: "Sound Absorption Coefficient"

OFFENSIVE NOISE

Reference: Dictionary of the NSW Protection of the Environment Operations Act (1997). "Offensive Noise means noise:
(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:
(i) is harmful to (or likely to be harmful to) a person who is outside the premise from which it is emitted, or
(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or
(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances prescribed by the regulations."

PINK NOISE

Pink noise is a broadband noise with an equal amount of energy in each octave or third octave band width. Because of this, Pink Noise has more energy at the lower frequencies than White Noise and is used widely for Sound Transmission Loss testing.

REVERBERATION TIME, T60

The time in seconds, after a sound signal has ceased, for the sound level inside a room to decay by 60 dB. The first 5 dB decay is often ignored, because of fluctuations that occur while reverberant sound conditions are being established in the room. The decay time for the next 30 dB is measured and the result doubled to determine the T_{60}. The Early Decay Time (EDT) is the slope of the decay curve in the first 10 dB normalised to 60 dB.

SOUND ABSORPTION COEFFICIENT, α

Sound is absorbed in porous materials by the viscous conversion of sound energy to a small amount of heat energy as the sound waves pass through it. Sound is similarly absorbed by the flexural bending of internally damped panels. The fraction of incident energy that is absorbed is termed the Sound Absorption Coefficient, α. An absorption coefficient of 0.9 indicates that 90 % of the incident sound energy is absorbed. The average α from 250 to 2 kHz is termed the Noise Reduction Coefficient (NRC).

'S' (SLOW) TIME WEIGHTING

Sound level meter design-goal time constant which is 1 second.

SOUND ATTENUATION

A reduction of sound due to distance, enclosure or some other devise. If an enclosure is placed around a machine, or an attenuator (muffler or silencer) is fitted to a duct, the noise emission is reduced or attenuated. An enclosure that attenuates the noise level by 20 dB reduces the sound energy by one hundred times.

SOUND EXPOSURE LEVEL (LAE)

Integration (summation) rather than an average of the sound energy over a set time period. Use to assess single noise events such as truck or train pass by or aircraft flyovers. The sound exposure level is related to the energy average (L_{Aeq}, T) by the formula L_{Aeq}, T = L_{AE} – 10 $\log_{10}$ T. The abbreviation (SEL) is sometimes inconsistently used in place of the symbol (L_{AE}).

SOUND PRESSURE

The rms sound pressure measured in pascals (Pa). A pascal is a unit equivalent to a newton per square metre (N/m^2).

SOUND PRESSURE LEVEL, Lp

The level of sound measured on a sound level meter and expressed in decibels (dB). Where L_P = 10 $\log_{10}$ $(Pa/Po)^2$ dB (or 20 log10 (Pa/ Po) dB) where Pa is the rms sound pressure in Pascal and Po is a reference sound pressure conventionally chosen is 20 µPa (20 x 10^{-6} Pa) for airborne sound. L_p varies with distance from a noise source.

SOUND POWER

The rms sound power measured in watts (W). The watt is a unit defined as one joule per second. A measures the rate of energy flow, conversion or transfer.

SOUND POWER LEVEL, Lw

The sound power level of a noise source is the inherent noise of the device. Therefore sound power level does not vary with distance from the noise source or with a different acoustic environment. Lw = Lp + 10 $\log_{10}$ 'a' dB, re: 1pW, (10^{-12} watts) where 'a' is the measurement noise-emission area (m^2) in a free field.

SOUND TRANSMISSION CLASS (STC)

An internationally standardised method of rating the sound transmission loss of partition walls to indicate the sound reduction from one side of a partition to the other in the frequency range of 125 Hz to 4000 kHz. (Refer: Australian Standard AS 1276 – 1979). Now not in general use in Australia see: weighted sound reduction index.

SOUND TRANSMISSION LOSS

The amount in decibels by which a random sound is reduced as it passes through a sound barrier. A method for the measurement of airborne Sound Transmission Loss of a building partition is given in Australian Standard AS 1191 - 2002.

STATISTICAL NOISE LEVELS, Ln.

Noise which varies in level over a specific period of time 'T' (standard measurement times are 15 minute periods) may be quantified in terms of various statistical descriptors for example:-

- The noise level, in decibels, exceeded for 1% of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF1}, T. This may be used for describing short-term noise levels such as could cause sleep arousal during the night.
- The noise level, in decibels, exceeded for 10% of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF10}, T. In most countries the LAF10, T is measured over periods of 15 minutes, and is used to describe the average maximum noise level.
- The noise level, in decibels, exceeded for 90% of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF90}, T. In most countries the LAF90, T is measured over periods of 15 minutes, and is used to describe the average minimum or background noise level.

STEADY NOISE

Noise, which varies in level by 6 dB or less, over the period of interest with the time-weighting set to "Fast", is considered to be "steady". (Refer AS 1055.1 1997).

WEIGHTED SOUND REDUCTION INDEX, Rw

This is a single number rating of the airborne sound insulation of a wall, partition or ceiling. The sound reduction is normally measured over a frequency range of 100 Hz to 3.150 kHz and averaged in accordance with ISO standard weighting curves (Refer AS/NZS 1276.1:1999). Internal partition wall Rw + C ratings are frequency weighted to simulate insulation from human voice noise. The R_w + C is similar in value to the STC rating value. External walls, doors and windows may be R_w + C_{tr} rated to simulate insulation from road traffic noise. The spectrum adaptation term Ctr adjustment factor takes account of low frequency noise. The weighted sound reduction index is normally similar or slightly lower number than the STC rating value.

WHITE NOISE

White noise is broadband random noise whose spectral density is constant across its entire frequency range. The sound power is the same for equal bandwidths from low to high frequencies. Because the higher frequency octave bands cover a wider spectrum, white noise has more energy at the higher frequencies and sounds like a hiss.

'Z' FREQUENCY WEIGHTING

The 'Z' (Zero) frequency weighting is 0 dB within the nominal 1/3 octave band frequency range centred on 10 Hz to 20 kHz. This is within the tolerance limits given in AS IEC 61672.1–2004: 'Electroacoustics - Sound level meters – Specifications'.

Attachment 2: Calibration Certificates

CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: **SLM 24948 & FILT 5245**

Equipment Description:	Sound & Vibration Analyser		
Manufacturer:	Svantek		
Model No:	Svan-957	**Serial No:**	15335
Microphone Type:	7052H	**Serial No:**	40814
Preamplifier Type:	SV12L	**Serial No:**	18742
Filter Type:	1/3 Octave	**Serial No:**	15335
Comments:	All tests passed for class 1. (See over for details)		
Owner:	Benbow Environmental 25-27 Sherwood Street Northmead, NSW 2152		
Ambient Pressure:	1004 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	39% ±5%
Date of Calibration:	14/06/2019	**Issue Date:**	17/06/2019
Acu-Vib Test Procedure:	AVP10 (SLM) & AVP06 (Filters)		

CHECKED BY: MKB **AUTHORISED SIGNATURE:** ..... Jack Kiett

Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

NATA
WORLD RECOGNISED ACCREDITATION

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Accredited Lab. No. 9262
Acoustic and Vibration Measurements

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: 24945

EQUIPMENT TESTED: Sound Level Calibrator

Manufacturer: B & K
Type No: 4230 **Serial No:** 565912
Owner: Benbow Environmental
25-27 Sherwood Street
Northmead, NSW 2152

Tests Performed: Measured output pressure level was found to be:

Parameter	Pre-Adj	Adj Y/N	Output: (db re 20 µPa)	Frequency: (Hz)	THD&N (%)
Level 1:	NA	N	94.03	987.01	0.45
Level 2:	NA	N	NA	NA	NA
Uncertainty:			±0.11 dB	±0.05%	±0.20 %
Uncertainty (at 95% c.l.) k=2					

CONDITION OF TEST:
Ambient Pressure: 1001 hPa ±1.5 hPa **Relative Humidity:** 48% ±5%
Temperature: 23 °C ±2° C
Date of Calibration: 14/06/2019 **Issue Date:** 17/06/2019
Acu-Vib Test Procedure: AVP02 (Calibrators)
Test Method: AS IEC 60942 - 2017
CHECKED BY: ..KB **AUTHORISED SIGNATURE:** .....
Jack Kielt

.Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.
The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.

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Sound Level Meter
AS 1259.1:1990 - AS 1259.2:1990
Calibration Certificate

Calibration Number C19409

Client Details Benbow Environmental
25-27 Sherwood Street
NORTHMEAD NSW 2152

Equipment Tested/ Model Number : ARL EL-215
Instrument Serial Number : 194702
Microphone Serial Number : N/A
Pre-amplifier Serial Number : N/A

Atmospheric Conditions
Ambient Temperature : 22.9°C
Relative Humidity : 37.2%
Barometric Pressure : 100.71kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 22 Jul 2019
Secondary Check: Sandra Minto
Report Issue Date : 25 Jul 2019

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	*Pass*	10.3.4: Inherent system noise level	*Pass*
10.2.3: Frequency weighting	*Pass*	10.4.2: Time weighting characteristic F and S	*Pass*
10.3.2: Overload indications	*Pass*	10.4.3: Time weighting characteristic I	*Pass*
10.3.3: Accuracy of level range control	*Pass*	10.4.5: R.M.S performance	*Pass*
8.9: Detector-indicator linearity	*Pass*	9.3.2: Time averaging	*Pass*
8.10: Differential level linearity	*Pass*	9.3.5: Overload indication	*Pass*

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.15dB*	*Temperature*	*±0.2°C*
12.5kHz	*±0.2dB*	*Relative Humidity*	*±2.4%*
16kHz	*±0.29dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.11dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

The sound level meter under test has been shown to conform to the type 2 requirements for periodic testing as described in AS 1259.1:1990 and AS 1259.2:1990 for the tests stated above.

NATA
WORLD RECOGNISED ACCREDITATION

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/National standards.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

Attachment 3: QA/QC Procedures

Calibration of Sound Level Meters

A sound level meter requires regular calibration to ensure its measurement performance remains within specification. Benbow Environmental sound level meters are calibrated by a National Association of Testing Authority (NATA) registered laboratory or a laboratory approved by the NSW Environment Protection Authority (EPA) every two years and after each major repair, in accordance with AS 1259–1990.

The calibration of the sound level meter was checked immediately before and after each series of measurements using an acoustic calibrator. The acoustic calibrator provides a known sound pressure level, which the meter indicates when the calibrator is activated while positioned on the meter microphone.

The sound level meters also incorporate an internal calibrator for use in setting up. This provides a check of the electrical calibration of the meter, but does not check the performance of the microphone. Acoustical calibration checks the entire instrument including the microphone. Calibration certificates for the instrument sets used have been included as Attachment 1.

Care and Maintenance of Sound Level Meters

Noise measuring equipment contains delicate components and therefore must be handled accordingly. The equipment is manufactured to comply with international and national standards and is checked periodically for compliance. The technical specifications for sound level meters used in Australia are defined in Australian Standard AS 1259–1990 "*Sound Level Meters"*.

The sound level meters and associated accessories are protected during storage, measurement and transportation against dirt, corrosion, rapid changes of temperature, humidity, rain, wind, vibration, electric and magnetic fields. Microphone cables and adaptors are always connected and disconnected with the power turned off. Batteries are removed (with the instrument turned off) if the instrument is not to be used for some time.

Investigation Procedures

All investigative procedures were conducted in accordance with AS 1055.1–1997 *Acoustics – Description and Measurement of Environmental Noise* Part 1: *General Procedures*.

The following information was recorded and kept for reference purposes:

- type of instrumentation used and measurement procedure conducted;
- description of the time aspect of the measurements, ie. measurement time intervals; and
- positions of measurements and the time and date were noted.

As per AS 1055.1–1997, all measurements were carried out at least 3.5 m from any reflecting structure other than the ground. The preferred measurement height of 1.2 m above the ground was utilised. A sketch of the area was made identifying positions of measurement and the approximate location of the noise source and distances in meters (approx.).

Unattended Noise Monitoring

NOISE MONITORING EQUIPMENT

ARL noise loggers type Ngara and EL-215 were used to conduct the long-term unattended noise monitoring. This equipment complies with Australian Standard 1259.2–1990 *Acoustics – Sound Level Meters* and is designated as a Type 1 and Type 2 instrument suitable for field use.

The measured data is processed statistically and stored in memory every 15 minutes. The equipment was calibrated prior and subsequent to the measurement period using a Rion NC-73 sound level calibrator. There were no significant variances observed in the reference signal between the pre-measurement and post-measurement calibrations. Instrument calibration certificates have also been included in Attachment 1.

METEOROLOGICAL CONSIDERATION DURING MONITORING

For the long-term attended monitoring, meteorological data for the relevant period were provided by the Bureau of Meteorology, which was considered representative of the site for throughout the monitoring period.

DESCRIPTORS & FILTERS USED FOR MONITORING

Noise levels are commonly measured using A-weighted filters and are usually described as dB(A). The "A-weighting" refers to standardised amplitude versus frequency curve used to "weight" sound measurements to represent the response of the human ear. The human ear is less sensitive to low frequency sound than it is to high frequency sound. Overall A-weighted measurements quantify sound with a single number to represent how people subjectively hear different frequencies at different levels.

Noise environments can be described using various descriptors depending on characteristics of noise or purpose of assessments. For this survey the L_{A90} was used to analyse the monitoring results. The statistical descriptors L_{A90} measures the noise level exceeded for 90% of the sample measurement time, and is used to describe the “Background noise”. Background noise is the underlying level of noise present in the ambient noise, excluding extraneous noise or the noise source under investigation.

Measurement sample periods were fifteen minutes. The Noise -vs- Time graphs representing measured noise levels at the noise monitoring location are presented in Attachment 3.

ATTENDED NOISE MONITORING

NOISE MONITORING EQUIPMENT

The attended short-term noise monitoring was carried out using a SVANTEK SVAN957 Class 1 Precision Sound Level Meter. The instrument was calibrated by a NATA accredited laboratory within two years of the measurement period. The instrument sets comply with AS 1259 and was set on A-weighted, fast response.

The microphone was positioned at 1.5 metres above ground level and was fitted with a windsock. The instrument was calibrated using a Rion NC-73 sound level calibrator prior and subsequent to the measurement period to ensure the reliability and accuracy of the instrument sets. There were no significant variances observed in the reference signal between the pre-measurement and post-measurement calibrations. Instrument calibration certificates have also been included in Attachment 1.

WEATHER CONDITIONS

It was partially cloudy, fine without significant breeze.

METHODOLOGY

The attended noise measurements were carried out generally in accordance with Australian Standard AS 1055-1997 "Acoustics – Description and Measurement of Environmental Noise".

Attachment 4: Daily Noise Logger Charts