OCTAVE ACOUSTICS

Smart Planning and Design
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8 Noonan Road, Ingleburn

Noise Impact Assessment

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Disclaimer

Contents

1. Introduction

Octave Acoustics was engaged by Smart Planning and Design to prepare a noise and vibration assessment to address the applicable Secretary's Environmental Assessment Requirements (SEARs) for the use of the site at 8 Noonan Road, Ingleburn as a Waste Management Facility.

The requirements of the SEARS 1616, dated 14th of January 2022, relating to noise and vibration, are as follows:

Noise and vibration – including:

- *a description of all potential noise and vibration sources during operation, including road traffic noise*
- *a noise and vibration assessment in accordance with the relevant Environment Protection Authority guidelines, including consideration of cumulative impacts from nearby industry*
- *a description and appraisal of noise and vibration mitigation and monitoring measures.*

Table 1 identifies where each SEARs requirement is addressed in this report.

Table 1 – Response to SEARS

SEARs Page No.	SEARs Requirement: Noise and Vibration	Addressed in this report
Page 2	A description of all potential noise and vibration sources during operation, including road traffic noise	Section 2
	A noise and vibration assessment in accordance with the relevant Environment Protection Authority guidelines, including consideration of cumulative impacts from nearby industry	Section 5, 6
	A description and appraisal of noise and vibration mitigation and monitoring measures.	Section 6

2. Site Assessment

2.1. Development Description

It is proposed to change the use at the subject site to that of a waste management facility. The proposed use will not involve changes to the existing buildings or infrastructure on the site. The facility comprises of the following:

- A brick office building containing offices, conference rooms and associated amenities.
- A large brick/rendered warehouse (currently used for materials breakdown and processing).
- 6 parking spaces for staff.
- 4 parking spaces for customers.
- Large External loading bay for materials along the northern Perimeter.
- 550m^2 external storage area along the east perimeter (where processed materials are stockpiled).
- Open covered area beneath a metal awning currently used to store received materials.

2.2. Potential Noise Sources

The main sources of noise associated with the use are expected to include:

- Material Processing/sorting/separating (indoors).
- Operation of a compactor (indoors).
- Stockpiling of refined processed materials (indoors).
- On-site vehicle movements (indoors and outdoors):
  - Forklifts and excavators loading and moving materials
  - Delivery vehicles
- Vehicle movements on the surrounding road network resulting from the use.

Shredding and screening of waste will not take place at the site.

2.3. Potential Vibration Sources

The primary source of vibration associated with the use is expected to be associated with materials handling, specifically, potential dropping of whole car bodies onto concrete.

2.4. Operational Hours

The proposed hours for the use are as defined in Table 2 below and are confined solely to the Day period as defined by the EPA Noise Policy for Industry. Assessments of potential impacts during the Evening and Night periods are therefore not required.

Table 2 - Proposed Operational Hours

Operational Activity	Monday – Friday	Saturday
Opening hours	7am – 5pm	7am – 1pm
Waste deliveries		
Waste processing		
Product shipped off-site		

2.5. Equipment & On-Site Vehicles

On-site equipment and vehicles that will be used in the operation of the proposed development include:

- 1 x Hydraulic compactor
- 1 x 8 tonne diesel excavator
- 2 x 20 tonne diesel excavators; and
- 3 x LPG forklifts.

2.6. Road Traffic Generation

The proposed traffic movements for receiving and removal of material at the site has been provided by Smart Planning and Design as presented in Table 3. The maximum future operation of the site is estimated to generate up to 100 vehicles trips per day. I.e. 50 inbound and 50 outbound trips.

Table 3 - Traffic Generation rates

Road	Parameter	Existing Road Traffic Volumes			Traffic Generated by the Use		
		AM Peak	Off Peak Day	PM Peak	AM Peak	Off Peak Day	PM Peak
Wilkinson Road	Period Traffic Rates	2,342	2,817	2,892	28	44	28
	Heavy Vehicle Percentage	9%	10%	6%	33%	28%	33%

2.7. Site Surroundings

The subject site and use is located on land zoned IN1 General Industrial. The site is bounded to the north, east and west by land zoned IN1 Industrial. The land to the south is Bunbury Curran creek with the greater Ingleburn Industrial estate beyond (Zoned IN1), refer to Figure 1.

The sensitive receivers potentially most affected by noise and vibration associated with the use are industrial developments immediately adjacent to the subject site. It is noted that there are no residential receivers located within 750m of the proposed use. Nonetheless, the closest residential dwelling (1 James Street) has been identified to provide a scenario for assessment of impacts to a residential receiver. Compliance of noise emissions from the use at 1 James Street will indicate compliance at all other surrounding residential receiver locations.

Table 4 identifies all adjacent noise sensitive receivers and their distances from the site.

Table 4 – Potentially Affected Proximate Sensitive Receivers

Receiver	Receiver Type	Distance from the Boundary of the Proposed Use (m)
1, 3 5 Noonan Road	Industrial	10
2, 4, 6 Noonan Road	Industrial	20
38 Williamson Road	Industrial	35
46 Williamson Road	Industrial	50
19 Aero Road	Industrial	120
2-4 York Road	Industrial	135
6 York Road	Industrial	140
1 James Street	Residential	750m

Figure 1: Site Context

3. Noise Measurements

3.1. Unattended Noise Monitoring

Octave Acoustics attended site on Tuesday the 5th of April 2022 to observe existing conditions on and around the subject site, and to set up an unattended noise monitor. The noise monitor was installed at the nearest secure area proximate the subject site (refer to Figure 1) and left to collect data until Tuesday the 12th of April. The microphone of the monitor was situated in free field conditions at a height of 1.2m above ground level.

The monitor consisted of an NTI XL2 sound level meter which was calibrated before and after the assessment using a Bruel Kjaer 4320 calibrator. No drift in calibration was detected. The NTI XL2 complies with the requirements of IEC 61672-1.2013 Sound Level Meters and is classified as a Class 1 instrument. The calibrator complies with the requirements of IEC 60942.2004 Sound Calibrators. Both the NTI XL2 and calibrator carry current NATA certification. A summary of the results of these measurements is presented in Table 5 below. Detailed noise monitoring results are presented in Appendix C.

Table 5 – Summary of Unattended Noise Monitoring Results

Date	Day	Evening	Night	Day	Evening	Night
Parameter	Existing Ambient Noise Level, dB, L_{Aeq}			Assessment Background Level, dB L_{A90}		
Tuesday, 5 April	n/a	47	47	n/a	39	37
Wednesday, 6 April	n/a	n/a	n/a	n/a	n/a	n/a
Thursday, 7 April	n/a	n/a	51	n/a	n/a	38
Friday, 8 April	n/a	n/a	n/a	n/a	n/a	n/a
Saturday, 9 April	n/a	49	n/a	n/a	43	n/a
Sunday, 10 April	52	50	51	44	43	38
Monday, 11 April	59	46	48	49	38	36
Tuesday, 12 April	58	49	51	47	42	40
	Existing Ambient Noise Level, dB, L_{Aeq})			Rating Background Level, dB L_{A90}		
5-12 April	56	48	50	47	42	38
Notes:	n/a denotes data that has been excluded due to weather events.					

3.2. Attended Noise Measurements

Octave Acoustics carried out an attended noise measurement on Tuesday the 12th of April at 19 Aero Road (refer to Figure 1). The attended measurement was undertaken in free field conditions at a height of 1.5m above the ground level. The results are shown in Table 6.

The measurement was carried out using an NTi XL2 sound level meter which was calibrated before and after the assessment using a Bruel and Kjaer 4230 calibrator. No drift in calibration was detected. The NTi XL2 complies with the requirements of IEC 61672-1.2013. Sound Level Meters and is classified as a class 1 instrument. The calibrator complies with the requirements of IEC 60942.2004. Sound Calibrators. Both the XL2 and the Calibrator carry current NATA certification or manufacturers certification if less than two years old.

Table 6 – Summary of Attended Measurement Result

Location	L_{Aeq}	L_{AFmax}	L_{AF90}	Character of ambient noise
19 Aero Road	63	80	50	Local traffic movements, noise from local industrial sites.

4. Criteria

4.1. Development Control Plan

Part 7 of the Campbelltown Development Control Plan sets out specific requirements applying to Industrial uses within the Campbelltown LGA. Part 7 contains the following acoustic / noise related requirements.

7.7.3 Noise

> *Design Requirements*:
>
> > *Any development that is likely to or capable of generating levels of noise exceeding the requirements of the Industrial Noise Policy (published by the Office of Environment and Heritage) shall demonstrate appropriate measure to mitigate against noise pollution.*

At the time of this report, the Industrial Noise Policy has since been superseded by the Noise Policy for Industry (NPI) 2017. Therefore, the DCP requirements shall be equivalent to the requirements of the NPI.

4.2. Noise

4.2.1. Noise Policy for Industry

The EPA's Noise Policy for Industry (NPI) establishes Project Trigger Noise Levels (PTNLs) for the project, which are determined through the establishment of the Intrusiveness and Amenity criteria as described below.

4.2.1.1. Intrusiveness Criteria

The intrusiveness of a noise source may generally be considered acceptable if the level of noise from the source (LAeq), does not exceed the background noise level by more than 5dB when beyond a minimum threshold. The intrusiveness noise level seeks to limit the degree of change a new noise source introduces to an existing environment. The intrusiveness noise level is determined as follows:

$L_{Aeq, 15 min}$ = Rating Background Noise Level +5dB

Where:

$L_{Aeq, 15 min}$ represents the equivalent continuous (energy average) A-weighted sound pressure level of the source over 15 minutes.

And

Rating Background Noise Level (RBL) represents the background level to be used for assessment purposes, as determined by the methods outlined in the Noise Policy for Industry; typically being the median LA90 for each period, day, evening and night.

It should be noted that intrusiveness noise levels are not used directly as regulatory limits. They are used in combination with the amenity noise level to assess the potential impact of noise, assess reasonable and feasible mitigation options and subsequently determine achievable noise requirements. The applicable rating background noise levels have been calculated from the results of on-site monitoring and the resulting intrusiveness noise level set out in Table 7 below.

Table 7 – Applicable Intrusiveness Noise Levels, L_{Aeq}, dB(A)

Period	RBL dB(A)	Intrusiveness Levels $L_{Aeq, 15min}$ dB(A)
Day	47	52
Evening	42	47
Night	38	43

4.2.1.2. Amenity Noise Criteria

To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in the following table where feasible and reasonable. The recommended amenity noise levels (will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance. These levels are shown below in Table 8.

Table 8 - Applicable Amenity Noise Levels (ANL), L_{Aeq}, dB(A)

Receiver	Noise Amenity Area	Time of Day	Recommended ANL	Project ANL, Period[5]	Project ANL, 15 min[6]
Industrial	Industrial	When In Use	70	65	68
Residential	Suburban[4]	Day[1]	55	50	53
		Evening[2]	45	40	43
		Night[3]	40	35	38

Notes:
1. Day is: 7am – 6pm Monday to Saturday & 8am – 6pm Sundays and public holidays
2. Evening is: 6pm – 10pm
3. Night is all remaining times.
4. 'Suburban' is an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry.
5. Project Amenity noise level, Period = Recommended Amenity Noise Level - 5dB
6. Project Amenity noise level, 15 min= Project Amenity Noise Level, Period + 3dB

The recommended amenity noise levels represent the objective total industrial noise at a receiver location, whereas the project amenity noise level represents the objective for noise from a single industrial development at a receiver location.

To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows (refer to Table 8).

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

Amenity noise levels are not used directly as regulatory limits. They are used in combination with the project intrusiveness noise level to assess the potential impact of noise, and subsequently determine achievable noise requirements.

In order to standardize the time periods between the intrusiveness criteria (15 minute) and the amenity noise level (Period), the NPI adopts the following conversion:

Project Amenity Noise Level $L_{Aeq, 15min}$ = Project Amenity Noise Level $L_{Aeq, Period}$ + 3dB

4.2.1.3. Project Trigger Noise Levels (PTNLs)

The Project Trigger Noise Levels (PTNL) is the lowest value of the intrusiveness or amenity noise level for each operational period. The noise emission trigger levels for the development during the proposed operational period are provided in Table 9.

Table 9 – Applicable Project Trigger Noise Levels, L_{Aeq}, dB(A)

Receiver	Period	Intrusiveness	Amenity	PNTLs
1 James Street, Ingleburn	Day	52	53	52
Industrial	When In Use	---	68	68

4.2.1.4. Maximum Noise Level Assessment

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:

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

a detailed maximum noise level event assessment should be undertaken.

As the development is operating during the day-time only, a sleep disturbance assessment will not be required.

4.2.2. NSW Road Noise Policy

The NSW Road Noise Policy (RNP) provides noise criteria with the aim to provide traffic noise protection inside and immediately around noise sensitive receivers. These noise criteria are consistent with current international practice for managing traffic noise impacts. The criteria applied in the RNP have been set approximately at the point where 90% of residents are not highly annoyed by noise. Table 10 sets out the Traffic Noise Assessment criteria for residential land uses.

Table 10 - Road Traffic Noise Assessment Criteria for Residential Land Uses

Road Category	Type of Project/land use	Assessment Criteria – dB(A) Day (7am – 10pm)
Freeway / arterial / sub arterial Roads	Existing residences affected by additional traffic on freeway / arterial / sub arterial Roads generated by land use developments.	$L_{Aeq, (15 hour)}$ 60 (external)
Local Roads	Existing residences affected by additional traffic on existing local roads generated by land use developments.	$L_{Aeq, (1 hour)}$ 55 (external)

Where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce these through feasible and reasonable measures to meet the assessment criteria. A secondary objective is to protect against excessive decreases in amenity as the result of a project by applying the relative increase criteria. Table 11 sets out the relative increase criteria.

Table 11 - Relative Increase Criteria

Road Category	Type of Project/land use	Total traffic noise level increase – dB(A) Day (7am – 10pm)
Freeway/ arterial/sub-arterial roads and transitways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road	Existing traffic $L_{Aeq, (15\ hour)}$ + 12dB (external)

In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person. As such, the RNP states that 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'.

4.3. Vibration Guidelines

4.3.1. Assessing Vibration, A Technical Guideline

The NSW EPA Guideline *Assessing Vibration: A Technical Guideline* is based on the British Standard BS6472:1992 *Evaluation of human exposure to vibration in buildings (1 Hz to 80Hz).* The guideline presents preferred and maximum vibration values for use in assessing human response to vibration and provides recommendations for measurement and evaluation techniques. Table 12 shows acceptable vibration dose values for intermittent vibration for residents and workshops ($m/s^{1.75}$).

Table 12 - Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$).

Location	Daytime[1]	
	Preferred Value	Maximum Value
Residences	0.20	0.40
Workshops	0.80	1.60
Notes:	*1. Daytime is 7:00am to 10:00pm*	

4.3.2. British Standard BS7385-2

The British Standard BS7385-2:1993 "*Evaluation and measurements for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration*" provides guide values for transient vibration relating to cosmetic damage. Table 13 shows vibration limits for residential and Industrial buildings.

Table 13 - Transient Vibration Guide Values for Cosmetic Damage

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Residential Buildings	15 mm/s at 4 Hz increasing to 20mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Industrial Buildings	50 mm/s at 4 Hz and above	

5. Noise Modelling

A 3-D computer noise model of the Subject site was built in CadnaA software and calculations run implementing the CONCAWE algorithms. The CONCAWE algorithms calculate the propagation of noise between source and receiver taking into account propagation effects associated with:

- Source sound power
- Geometrical spreading
- Atmospheric conditions
- Air absorption
- Ground absorption (G=0)
- Reflections
- Barrier effects associated with topography and built form, including buildings.

The noise sensitive receivers most potentially affected by noise emanating from the proposed development are identified in Table 4. Compliance with the established noise criteria at these locations is expected to result in compliance at all other noise sensitive receivers.

To examine potential noise impacts associated with the use, the following were incorporated into the model:

- The materials processing shed is an industrial building with vertical area sources representing the sliding warehouse doors modelled in the open position for the entire 15 minute assessment period.
- Surrounding buildings and noise barriers.
- All receptors were modelled at 1.5 m above ground level.
- Source Sound Power Levels as per Table 14.
- Matrix of Operations as per Table 15.

Fixed noise sources were incorporated to represent stationary plant and materials recovery activities. Moving point sources were incorporated into the model to represent vehicles arriving at and departing as well as forklifts and excavators moving around the site. Octave band sound power levels used in noise model were taken from measurements carried out at other, similar facilities and the Octave Acoustics Noise Database (refer to Table 14).

Table 14 – On-Site Octave Band Sound Power Levels, dB re 10-12 Watts

Metric	Octave Band Centre Frequency (Hz)						
	63	125	250	500	1000	2000	4000
Truck delivery / waste collection	98	93	88	90	91	89	82
Small rigid truck	100	98	96	96	96	93	86
Unloading activity	94	86	84	86	82	76	67
Excavators Breaking up Materials	102	101	100	98	97	94	92
Compactor	103	105	103	102	103	100	94
Manual Material Break Down	75	76	79	86	89	93	96
Excavator – Shifting Waste	102	101	100	98	97	94	92
Fork lift – Loading Containers	104	106	100	99	99	98	94
Excavators Moving	102	98	98	95	94	92	91
Container Loaded on to Truck	104	102	99	97	96	90	86

Table 15 sets out a matrix of activities applied to the noise model for assessment over a worst case 15 minute period.

Table 15 – Matrix of Operations Input to Noise Model

Item/Activity	Number of Events/Duration
Truck delivery / waste collection	1
Small rigid truck	2
Unloading activity x 1	Continuous over the 15 minute period.
Excavator Breaking up Materials x 1	Continuous over the 15 minute period.
Compactor	Continuous over the 15 minute period.
Manual Material Break Down	Continuous over the 15 minute period.
Excavator – Shifting Waste x 2	Continuous over the 15 minute period.
Fork lift – Loading Containers	5
Excavators Moving	1
Container Loaded on to Truck	1

6. Assessment

The noise and vibration assessments were carried out with respect to the preliminary issue architectural drawings (dated 5th May 2022) prepared by Smith + Tracy Architects (refer to Figure 2) and the noise model and inputs described in Section 5.

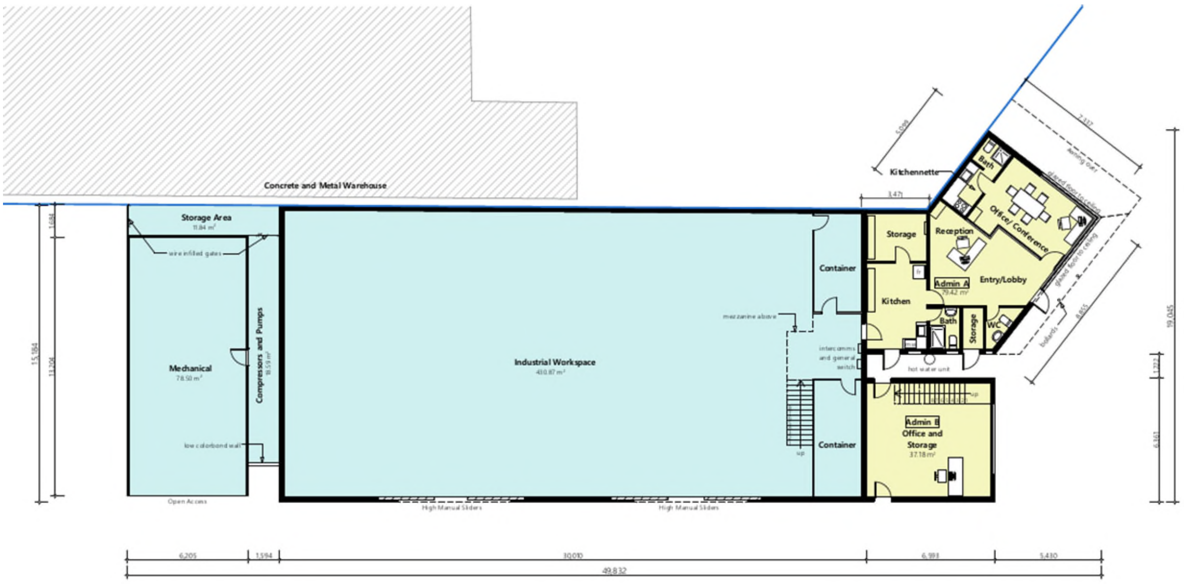

Figure 2 – Architectural Plan for 8 Noonan Road, Ingleburn

6.1. Noise

The results of assessment are presented in Table 16 below. The results indicate that noise impacts will fall comfortably below the PTNLs for all receivers. As a result, operational mitigation measures are not required. Compliance with the NPI PTNLs results in compliance with the applicable DCP requirement.

Table 16 – Noise Level Assessment, L_{Aeq} dB(A)

Receiver Type	Assessment Location	PTNL	Calculated Noise Level	Complies with NPI?
Industrial	1, 3 5 Noonan Road	68	52	✓
	2, 4, 6 Noonan Road	68	59	✓
	38 Williamson Road	68	56	✓
	46 Williamson Road	68	61	✓
	19 Aero Road	68	62	✓
	2-4 York Road	68	62	✓
	6 York Road	68	59	✓
Residential	1 James Street	52	37	✓

6.1.1. Cumulative Noise Assessment

A cumulative noise level assessment has been carried out as required by the SEARs to assess the overall impacts of the development and surrounding existing industrial developments during all operational hours.

Cumulative noise contributions due to the use are calculated to be more than 10dB below the established existing ambient noise levels at the nearest residential receiver at 1 James Street. This indicates that cumulative impacts at the nearest residential receiver are negligible.

Worst case noise impacts from the proposed use to the most affected industrial receiver fall 5dB(A) below the established project amenity criteria. Furthermore, use is set within a major industrial cluster therefore the use of a project amenity criterion is conservative as strictly speaking only the general amenity criterion (which is 5dB(A) greater) ought to apply. The purpose of the amenity criteria is to prevent cumulative industrial noise creep / increases. As such, potential cumulative noise impacts (including noise from the proposed use) at surrounding industrial receivers is considered to be insignificant.

6.1.2. Traffic Noise Assessment

All vehicles associated with the use will enter and exit the site via Noonan Road to Williamson Road and join the greater road network. Referring to relatively small volumes of traffic generated by the use compared to existing road traffic volumes (Table 3), the resulting increase in traffic noise levels will be nil (refer to Table 17). This outcome indicates that additional traffic movements resulting from the use will not exceed the trigger levels set out in the Road Noise Policy.

Table 17 – Summary of Traffic Noise Increases on Surrounding Roads (from available traffic data)

Road	Period	Existing Traffic Volume	Percentage Heavy Vehicles (%)	Increase in Traffic (due to Site)		Increase in Noise Levels (dB)
				Volume	Percentage Heavy Vehicles (%)	
Wilkinson Road	AM	2342	9.3 %	2370 (+28)	9.6 %	0.05 dB
	Off Peak Day	2817	9.7 %	2861 (+44)	9.9 %	0.07 dB
	PM	2892	6 %	2920 (+28)	6.3 %	0.04 dB

6.2. Vibration

The proposed use is only likely to generate one to two significant vibration generating events per day (car bodying being dropped from a low height). Considering the distances to potentially affected receivers and the infrequency and relatively low (vibration) magnitude of these events, resultant vibration levels are expected to satisfy both the established human comfort and building damage criteria.

7. Conclusion

Octave Acoustics has conducted a noise and vibration impact assessment of the proposed Resource Recovery use at 8 Noonan Road, Ingleburn. Analysis indicates that noise impacts associated with the proposed use will comply with the applicable Noise Policy for Industry Project Trigger Noise Levels. As a result, noise mitigation measures are not required. Compliance with the Noise Policy for Industry triggers implies compliance with the applicable DCP requirement.

Cumulative noise contributions at the project are calculated to be more than 10dB below the established existing background noise levels at the nearest residential receiver at 1 James Street. Considering this, cumulative impacts for the nearest residential receiver is considered to be negligible.

Assessment indicates that noise associated additional traffic movements associated with the use will comply with the appliable requirements of the NSW Road Noise Policy.

Potential vibration impacts associated with the use have been assessed as compliant with the established criteria for human comfort and building damage.

This report has identified all potential noise and vibration sources during use operation and a noise and vibration impact assessment has been undertaken. The outcome of this assessment indicates noise and vibration emission will comply with the established criteria and no mitigation measures are required as a result.

Therefore, all of the requirements described in SEARs 1616 regarding noise and vibration are considered to be addressed.

Appendix A: Glossary of Terms

'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' (LAeq,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' (LA90,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 the 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 - LAeq) 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 LAeq noise level than any other descriptor.

'F'(FAST) TIME WEIGHTING

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

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.

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

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.

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."

'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 (LAeq,T) by the formula LAeq,T = LAE – 10 $\log_{10}$ T. The abbreviation (SEL) is sometimes inconsistently used in place of the symbol (LAE).

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 LP = 10 $\log_{10}(Pa/Po)^2$ dB (or 20 $\log_{10}$ (Pa/ Po) dB) where Pa is the rms sound pressure in Pascal and Po is a reference sound pressure conventionally chosen is 20 µPa (20×10^{-6} Pa) for airborne sound. Lp 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 (m2) in a free field.

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 AS1191 - 2002.

STATISTICAL NOISE LEVELS, Ln

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

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 LAF1,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 LAF10,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 LAF90,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.

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 Rw+C is similar in value to the STC rating value. External walls, doors and windows may be Rw+Ctr 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.

'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'.

Appendix B: Noise Contour Maps

Point Source	> 35.0 dB
Line Source	> 40.0 dB
vert. Area Source	> 45.0 dB
Building	> 50.0 dB
Barrier	> 55.0 dB
3D-Reflector	> 60.0 dB
Receiver	> 65.0 dB
Building Evaluation	> 70.0 dB
Calculation Area	> 75.0 dB
	> 80.0 dB
	> 85.0 dB

OCTAVE ACOUSTICS

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Modelled Noise Emissions for worse case operational period.

LAeq
1.5m Above Ground Noise Contour Map

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Appendix C: Unattended Noise Monitoring Graph