Technical report I

Noise and vibration impact assessment

Cleanaway Operations Pty Ltd

Western Sydney Energy and Resource Recovery Centre

Technical Report I
Noise and Vibration Impact Assessment

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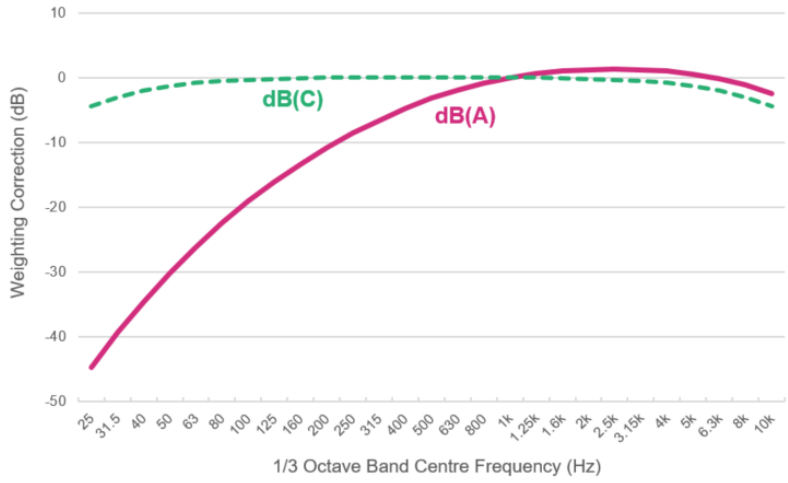
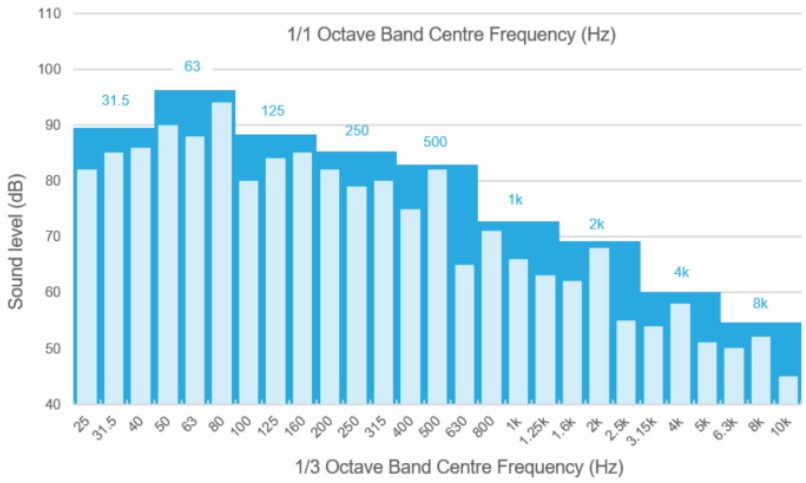
Glossary and abbreviations

Abbreviation / Term	Definition
Project-Specific Terms	
BA	Boiler Ash Ash from boiler hoppers. Fine granular material; typically, agglomerations of particles.
C&I Waste	Commercial and Industrial (C&I) Waste: Solid waste (putrescible and non-putrescible) generated by businesses, industries (including shopping centres, restaurants and offices) and institutions (such as schools, hospitals and government offices).
CIV	Capital Investment Value
EIS	Environmental impact statement
EfW	Energy-from-waste: The process of generating energy in the form of electricity and/or heat from the primary treatment of waste, or the processing of waste into a fuel source. EfW is a form of resource recovery.
ERF	Energy Recovery Facility: Defined in the NSW Energy from Waste Policy Statement as: A facility that thermally treats a waste or waste-derived material that does not meet the definition of an eligible waste fuel. These facilities must be able to demonstrate that they will be using current international best practice techniques.
FGTr	Flue Gas Treatment Residue: A fine-grained powder known as one of the residual products from EfW facilities. Flue gas treatment is one of the key steps in the EfW process, the cooled flue gases leaving the boiler pass through a series of scrubbing and cleaning processes, which comprise the FGT system and are designed to meet best available technology emissions standards. The FGT system produces FGTr at the end of this process which is formed of scrubber residue and/or bag house filter dust. The residues are produced by the injection of lime into the flue gas to react with the acidic gases and capture the particulates in filter bags. FGTr are typically a mixture of ash, carbon and lime. Note that where we refer to FGTr in this report, we are also referring to and including Boiler Ash (BA) (which is also a fine-grained powder residual product from EfW facilities).
Flue gas	Flue gas (sometimes called exhaust gas or stack gas) is the gas that emanates from combustion plants and which contains the reaction products of fuel and combustion air and residual substances.
IBA	Incineration Bottom Ash Ash from the end of the grate and from the siftings that pass through the gate. Granular material; typically contains glass, ceramics, silicates, rocks, masonry products and carbon/organics. Typically contains some ferrous and non-ferrous metals, which can be extracted for recycling.
ICNG	NSW Interim Construction Noise guideline [1]
IPC	Independent Planning Commisssion
LGA	Local Government Area
Moving grate	Moving grate is a common form of EfW technology where the waste is fed into the combustion chamber by a travelling grate. The primary function of the moving grate is the controlled transport of the waste through the

Abbreviation / Term	Definition
	combustion chamber to guarantee efficient mixing of the fuel bed and permanent coverage of the metal parts to protect them against over-heating.
MSW	Municipal Solid Waste: Solid waste (putrescible and non-putrescible) from households and local government operations, including waste placed at the kerbside for local council collection and waste collected by councils from municipal parks and gardens, street sweepings and public council bins.
NVIA	Noise and Vibration Impact Assessment
NPfI	NSW Noise Policy for Industry [2]
Putrescible waste	Solid waste that contains organic material capable of being decomposed by micro-organisms and cause odours. (Source: https://www.lawinsider.com/dictionary/putrescible-waste)
Residual C&I	Waste that is left over following the recycling and recovery of resources from the C&I waste stream. Residual C&I is a feedstock for the EfW facility.
Residual MSW	Waste that is left over following the recycling and recovery of resources from the MSW waste stream. Residual MSW is a feedstock for the EfW facility.
SEARs	Secretary's Environmental Assessment Requirements The issues to be addressed and the information to be provided in an EIS. SEARs are prepared by the Planning Secretary in consultation with public authorities.
SSD	State Significant Development
WSP	Western Sydney Parklands
WSERRC	Western Sydney Energy and Resource Recovery Centre
Noise and Vibration-Specific Terms	
Ambient noise level	The ambient noise level is the overall noise level measured at a location from multiple noise sources. When assessing noise from a particular development, the ambient noise level is defined as the remaining noise level in the absence of the specific noise source being investigated. For example, if a fan located on a building is being investigated, the ambient noise level is the noise level from all other sources without the fan operating, such as traffic, birds, people talking and other noise from other buildings.
Background noise level	The background noise level is the noise level that is generally present at a location at all or most times. Although the background noise may change over the course of a day, over shorter time periods (e.g. 15 minutes) the background noise is almost-constant. Examples of background noise sources include steady traffic (e.g. motorways or arterial roads), constant mechanical or electrical plant and some natural noise sources such as wind, foliage, water and insects. **Assessment Background Level (ABL)** A single-number figure used to characterise the background noise levels from a single day of a noise survey. ABL is derived from the measured noise levels for the day, evening or night time period of a single day of background measurements. The ABL is calculated to be the tenth percentile of the background L_{A90} noise levels – i.e. the measured background noise is above the ABL 90% of the time. **Rating Background Level (RBL / min$L_{A90,1hour}$)**

Abbreviation / Term	Definition
	A single-number figure used to characterise the background noise levels from a complete noise survey. The RBL for a day, evening or night time period for the overall survey is calculated from the individual Assessment Background Levels (ABL) for each day of the measurement period, and is numerically equal to the median (middle value) of the ABL values for the days in the noise survey.
Decibel (dB)	The logarithmic scale used to measure sound and vibration levels. Human hearing is not linear and involves hearing over a large range of sound pressures, which would be cumbersome if presented on a linear scale. Use of a logarithmic scale allows all sound levels to be expressed based on how loud they are relative to a reference sound (typically 20 µPa, which is the approximate human threshold of hearing). For sound in other media (e.g. underwater noise) a different reference level is used. An increase of approximately 10 dB corresponds to a subjective doubling of the loudness of a noise. The minimum increase or decrease in noise level that can be noticed is typically 2 to 3 dB.
dB weighting curves	The frequency of a sound affects its perceived loudness and human hearing is less sensitive at low and very high frequencies. When seeking to represent the summation of sound pressure levels across the frequency range of human hearing into a single number, weighting is typically applied. Most commonly, A-weighting, denoted as dB(A), is used for environmental noise assessment. This is often supplemented by the linear or C-weighting curves, where there is the potential for excess low-frequency sound at higher sound pressure levels. 
dB(A)	dB(A) denotes a single-number sound pressure level that includes a frequency weighting (‘A-weighting’) to reflect the subjective loudness of the sound level. The frequency of a sound affects its perceived loudness. Human hearing is less sensitive at low and very high frequencies, and so the A-weighting is used to account for this effect. An A-weighted decibel level is written as dB(A). Some typical dB(A) levels are shown below. **Sound Pressure Level dB(A)** — **Example** 130 — Human threshold of pain 120 — Jet aircraft take-off at 100 m

Abbreviation / Term	Definition
	110 Chain saw at 1 m 100 Inside nightclub 90 Heavy trucks at 5 m 80 Kerbside of busy street 70 Loud stereo in living room 60 Office or restaurant with people present 50 Domestic fan heater at 1m 40 Living room (without TV, stereo, etc) 30 Background noise in a theatre 20 Remote rural area on still night 10 Acoustic laboratory test chamber 0 Threshold of hearing
Frequency	Frequency is the number of cycles per second of a sound or vibration wave. In musical terms, frequency is described as 'pitch'. Human hearing ranges approximately from 20 Hz to 20 kHz. Sounds towards the lower end of the human hearing frequency range are perceived as 'bass' or 'low-pitched' and sounds with a higher frequency are perceived as 'treble' or 'high pitched'. Frequency analysis is often grouped into bands, or 'octave bands'. 1/1 octave or 1/3 octave bands are most commonly utilised and named based on the nominal centre frequency of the band (e.g. 31.5 Hz), are a summation of all frequencies between a defined lower and upper frequency. 
$L_{10(period)}$	The sound level exceeded for 10% of the measurement period, or alternatively, the sound levels would be lower for 90% of the time. The L_{10} is often defined as the 'average maximum' sound levels, as in AS1055-1984 with the advent of statistical sound level meters.
$L_{90(period)}$	The sound level exceeded for 90% of the measurement period. The L_{90} is often defined as the 'average minimum' or 'background' noise level for a period of measurement. For example, 45 $dBL_{A90,15min}$ indicates that the sound level is higher than 45 dB(A) for 90% of the 15-minute measurement period.
$L_{eq(period)}$	The equivalent ('eq') continuous sound level, used to describe the level of a time-varying sound or vibration measurement.

Abbreviation / Term	Definition
	The L_{eq} is often defined as the 'average' level, and mathematically, is the energy-average level over a measurement period – i.e. the level of a constant sound that contains the same sound energy as the measured sound.
L_{max}	The L_{max} is the 'absolute maximum' level of a sound or vibration recorded over the measurement period. As the L_{max} is often caused by an instantaneous event, it can vary significantly between measurements.
Peak Particle Velocity (PPV)	The highest velocity of a particle (such as part of a building structure) as it vibrates. PPV is commonly used as a vibration criterion for the assessment of cosmetic and structural damage.
Sound Power and Sound Pressure	The sound power level (L_w) of a source is a measure of the total acoustic power radiated by a source. The sound pressure level (L_p) varies as a function of the environment and distance from a source. The sound power level is an intrinsic characteristic of a source (analogous to its mass), which is not affected by the environment within which the source is located.
Vibration	Waves in a solid material are called 'vibration', as opposed to similar waves in air, which are called 'sound' or 'noise'. If vibration levels are high enough, they can be felt; usually vibration levels must be much higher to cause structural damage. A vibrating structure (e.g. a wall) can cause airborne noise to be radiated, even if the vibration itself is too low to be felt. Structure borne vibration limits are sometimes set to control the noise level in a space. Vibration levels can be described using measurements of displacement, velocity and acceleration. Velocity and acceleration are commonly used for structure borne noise and human comfort. Vibration is described using either metric units (such as mm, mm/s and mm/s^2) or else using a decibel scale.

1 Introduction

This section provides an overview of the proposed development, a summary of expected sources of noise and vibration and an overview of the Secretary's Environmental Assessment Requirements (SEARs) that are related to noise and vibration.

1.1 Proposed development overview

Cleanaway and Macquarie Capital are jointly developing an energy-from-waste (EfW) facility known as the Western Sydney Energy and Resource Recovery Centre (WSERRC) (the proposal).

The proposal will be designed to thermally treat up to 500,000 tonnes per year of residual Municipal Solid Waste (MSW) and residual Commercial and Industrial (C&I) waste streams that would otherwise be sent to landfill. This process would generate up to 58 megawatts (MW) of base load electricity some of which would be used to power the facility itself with the remaining 55MW exported to the grid. The proposal involves the building of all onsite infrastructure needed to support the facility including site utilities, internal roads, weighbridges, parking and hardstand areas, storm water infrastructure, fencing and landscaping.

The application is categorised as State significant development (SSD) as it is electricity generating works with a capital investment value (CIV). It will be assessed and determined by the Minister for Planning and Public Spaces or the Independent Planning Commission (IPC).

Energy-from-waste technology

Energy-from-waste (EfW) refers to a broad range of technologies which involve the combustion of residual waste streams, significantly reducing the volume of waste being sent to landfill while generating renewable energy. The most common EfW technology is called 'moving grate' where residual waste is fed onto a grate which moves the waste through a combustion chamber to ensure the complete combustion of the waste material.

The hot gases from the combustion process are used to generate steam which drives a turbine to produce electricity. Emissions in the resulting gas are cleaned using established FGTs technologies before being released to the atmosphere through a stack.

Whilst some residual materials are produced because of the EfW process, including incinerator bottom ash (IBA), boiler fly ash and flue gas treatment residues (FGTr), the EfW process typically leads to about 90% reduction in the volume, or 80% reduction in mass (tonnes), of waste that would otherwise go to landfill.

The EfW facility will also include a ferrous metal separator to recover ferrous metals from the IBA for recycling and sale to market. The remaining IBA will be transported to a dedicated offsite IBA storage, treatment, metal recovery and

maturation facility where non-ferrous metals (or secondary metals) recovery will be carried out.

Operational Sources of Noise and Vibration

The following operational noise sources have been identified as items which require assessment as part of the NVIA:

- Noise emission from equipment and activities with the EfW facility buildings
- Noise emission from the exhaust stack, external plant and electrical equipment
- Noise generated by vehicle movements within the EfW facility and onto the road network.

1.2 SEARs

The Secretary's Environmental Assessment Requirements (SEARs) for SSD 10395, along with relevant agency requests have been reviewed. The key SEARs relevant to the acoustic assessment are listed in Table 1.

Table 1: Key SEARs relevant to the acoustic assessment

Item	Description	Reference in this technical paper
Main SEARS		
Statutory and Strategic Context	• Demonstration the proposal is generally consistent with all relevant planning strategies, environmental planning instruments, district plans and justification for any inconsistencies. • Addressing the statutory provisions applying to the development contained in all relevant environmental planning instruments, including: ○ State Environmental Planning Policy (Western Sydney Parklands) 2009 • Blacktown Local Environmental Plan 2012.	
Noise and vibration	• A quantitative assessment of potential construction, operational and transport noise and vibration impacts, including impacts on nearby sensitive receivers, landowners and businesses, in accordance with relevant environment protection authority guidelines. • Details and justification of the proposed noise management, mitigation and monitoring measures.	• Sections 4.2, 4.3, 5.2, 6, 7.3, 7.4 • Sections 4.3, 6, 7.3
Relevant policies	• NSW Noise Policy for Industry 2017 [2]. NOTE: this is proposed to be adopted as it supersedes the NSW Industrial Noise Policy listed in the SEARS. Used for the assessment of operation and maintenance of the project within the project site • NSW Road Noise Policy 2011 [3]. NOTE: This supersedes the Environmental Criteria for Road Traffic Noise (ECRTN), EPA 1999 [4], also listed in the SEARs. The ECRTN will not be relied upon). Used for the assessment of traffic noise generated by the	• Section 4.1 • Section 5.1

	operation and maintenance of the project when travelling on public roads • Interim construction noise guideline (DECC 2009) [1]. Used for the assessment of the construction of the project • Assessing vibration: A technical guideline (DEC 2009) [5]. Used for the assessment of the operation, maintenance and construction of the project	• Section 7.1 • Section 7.2
Blacktown City Council SEARs		
Noise and vibration	• Identify the main noise generating sources and activities at all stages of construction, • and any noise sources during operation including noise associated with vehicle movements, standby generators, fans and pumps (noise levels shall take into consideration the effect of wind speed and temperature). • Outline measures to minimise and mitigate the potential noise impacts on occupiers of surrounding land.	• Section 7.3 • Section 4.2, 4.3 • Section 7.3
Relevant policies and guidelines	• NSW Industrial Noise Policy (EPA) • Interim Construction Noise Guideline (DECC) • Assessing Vibration: A Technical Guideline 2006.	• Section 4.1 • Section 7.1 • Section 7.2
Reporting	• Provide an acoustic report to be prepared by a consultant that is a member of the Association of Australian Acoustical Consultants (AAAC) that assesses the noise levels of proposed operations of the facility. • The report will consider the NSW Industrial Noise Policy, published by the NSW Office of Environment and Heritage. • As the facility is proposed to operate 24 hours, 7 days a week, the sleep disturbance criteria is to be considered. • The report is to provide recommendations to mitigate noise pollution. Matters to be considered in the report include, but are not limited to, potential unexpected noise from changes in feed stock or possible contamination of the waste which may react when heated. It is recommended that a 6 month post commissioning report be considered as part of this assessment.	• Arup Acoustics Sydney is a member of the ACCC • Section 4.1 • Section 4.1, 4.3 • Section 4.3, 7.3, 8
EPA SEARS		
Sensitive locations	• Identify any noise sensitive locations likely to be affected by activities at the site, such as residential properties, schools, churches, and hospitals. Typically, the location of any noise sensitive locations in relation to the site should be included on a map of the locality.	• Section 2.2
	• Construction noise associated with the proposed development should be assessed using the *Interim Construction Noise Guideline* (DECC, 2009).	• Section 7.1
	• Operational noise from all industrial activities to be undertaken on the premises should be assessed using the guidelines contained in the *Noise Policy for Industry*	• Section 4.1, 4.3

	(EPA, 2017). This assessment should be undertaken for all proposed operational times (i.e. day, evening and night). The assessment must include detail of all noise management, mitigation and monitoring measures.	
	• Noise on public roads from increased road traffic generated by land use developments should be assessed using the guidelines contained in the *NSW Road Noise Policy* (DECCW, 2011). http://www.epa.nsw.gov.au/resources/noise/2011236nswroadnoisepolicy.pdf	• Section 5
	• Vibration from all activities (including construction and operation) to be undertaken on the premises should be assessed using the guidelines contained in the *Assessing Vibration: a technical guideline* (DEC, 2006).	• Section 6, 7.2
WaterNSW SEARS		
	Vibration — an assessment of the construction and operation vibration impacts of the development on the Pipelines corridor and the proposed measures to mitigate those risks and impacts.	• Section 6, Section 7.2.2.2, Section 7.3.6

2 Site description and surrounding land uses

2.1 Site description

The proposal site is located at 339 Wallgrove Road, Eastern Creek, NSW (Lot 1 DP 1059698) which is in the Blacktown local government area (LGA). The site is in the Wallgrove Precinct of the Western Sydney Parklands (WSP) Plan of Management.

The site is accessed via a dedicated access road off an unnamed road (known as the Austral Bricks Road) adjacent to the southern site boundary. The unnamed road provides access to Wallgrove Road which connects to the surrounding road network including the M7 motorway.

The existing site includes buildings associated with a disused poultry facility, which will be cleared from the site prior to starting construction.

2.2 Surrounding land uses

The area immediately surrounding the site is characterised by industrial and transport infrastructure.

The site is bounded by the M7 motorway to the west with the Eastern Creek industrial area located farther west. The now-closed Eastern Creek landfill site (which still has an operational organics recycling facility component) is located to the north and north-east with the operational Global Renewables waste management facility located immediately to the east. To the south, the site is bounded by the Warragamba Pipeline Corridor with the Austral Bricks facility located farther south. The site is located within the Western Sydney Parklands; however the nearest passive recreation area is located around 3.5 km north of the site in Bungarribee Park and the nearest active recreation areas, North Shore sporting car club, Sydney Dragway and Sydney Motorsport Park are located approximately 1.5 km east and north-east.

The nearest residential area in Horsley Park is located around 1 km to the south of the site. The Erskine Park residential area is located around 3.5 km to the west with Minchinbury located around 3 km to the north. Horsley Park Public School is located over 2 km south of the site and a childcare centre is located within the Eastern Creek industrial area approximately 1 km to the west of the site.

A range of infrastructure is also planned in proximity of the site to support the NSW Government's planned growth in Western Sydney. The current noise environment (currently dominated by traffic noise) may change in the future, most likely with noise levels increasing as a result of the urban development of the Western Sydney Employment Area and the Aerotropolis. Notwithstanding, the assessment herein has been based on current measured noise levels at residential receivers and is therefore considered to present an appropriately conservative assessment.

The nearest most potentially affected land uses surrounding the proposed development and relevant to this assessment have been identified graphically in Figure 1 and are summarised in Table 2.

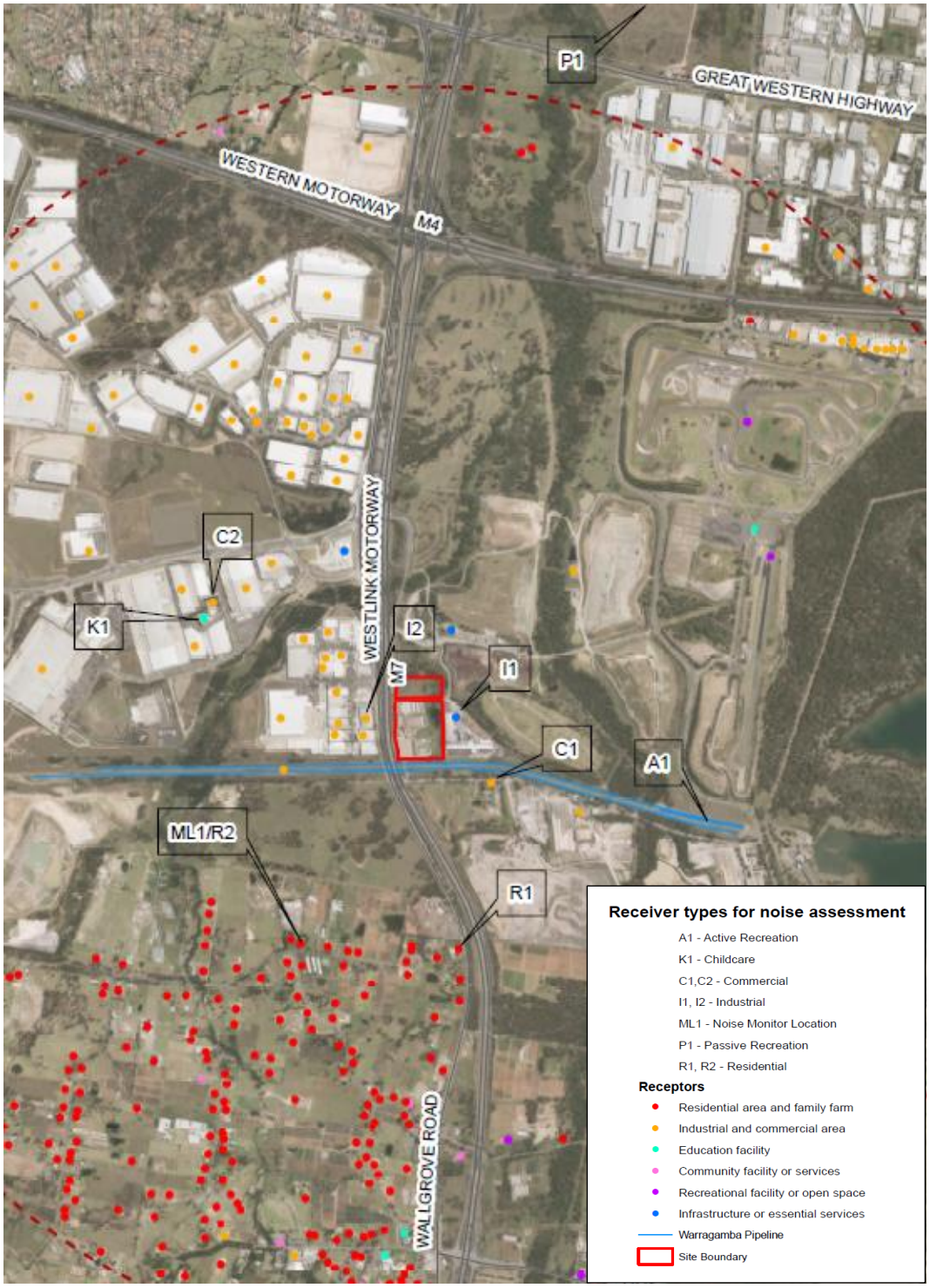


Figure 1: Site and receiver locations

Table 2 summarises the location of the nearest most potentially affected receivers together with the location of the unattended noise monitoring location.

Table 2: Receiver and logger locations

Receiver	ID	Address	Distance to site (m)
Residential	R1	783 Wallgrove Road, Horsley Park, NSW 2175	920
	R2	58 Burley Road, Horsley Park NSW 2175	955
Commercial	C1	Brickworks Building Products, 738-780 Wallgrove Rd, Horsley Park NSW 2175	260
	C2	Plus Fitness 24/7, 7-8/2A Southridge St, Eastern Creek NSW 2766	935
Industrial	I1	Global Renewables, Wallgrove Rd, Eastern Creek NSW 2766	70
	I2	Century Yuasa Batteries, 17 Shale Pl, Eastern Creek NSW 2766	105
Child Care	K1	Little Graces Childcare Centre, Unit 2 Southridge St, Eastern Creek NSW 2766	965
Passive recreation area	P1	Bungarribee Trail, Western Sydney Parklands, Eastern Creek NSW 2766	3200
Active recreation area	A1	North Shore Sporting Car Club, Ferrers Rd, Eastern Creek NSW 2766	1340
Noise Logger	ML1	58 Burley Road, Horsley Park NSW 2175 (same location as R2)	955

3 Existing environment

Criteria for the assessment of operational and construction noise are usually derived from the existing noise environment of an area, excluding noise from the subject development.

Fact Sheet B of the NPfI outlines two methods for determining the background noise level of an area, being 'B1 – Determining background noise using long-term noise measurements' and 'B2 – Determining background noise using short-term noise measurements'. This assessment used long-term noise monitoring, being the preferred method outlined in the NPfI for assessment during the planning and consent stage for development that have the potential to cause significant noise nuisance.

3.1 Noise measurement location

Noise measurements are ideally carried out at the nearest or most potentially affected locations surrounding a development. The unattended long-term measurement location is outlined in Table 2 and shown graphically in Figure 1.

3.2 Unattended long-term noise measurement results

Unattended long-term noise monitoring was carried out from Thursday 6 February 2020 to Monday 17 February 2020. The long-term noise monitoring methodology and noise level-vs-time graphs of the data are included in Appendix A.

Table 3 presents the overall single Rating Background Levels (RBL) and representative ambient L_{eq} noise levels for each assessment period, determined in accordance with the NPfI.

Table 3: Long-term noise monitoring results, dB(A)

Location	**Time period**	**Rating Background Levels (RBL) L_{A90}**	**Adjusted[2] RBL L_{A90}**	**Ambient L_{Aeq} noise levels**
ML1 – 58 Burley Road, Horsley Park NSW 2175	Day	42	42	52
	Evening	47	42[2]	57
	Night	43	42[2]	51

Notes:

1. Day: 07:00-18:00 Monday to Saturday and 08:00-18:00 Sundays & Public Holidays
   Evening: 18:00-22:00 Monday to Sunday & Public Holidays
   Night: 22:00-07:00 Monday to Saturday and 22:00-08:00 Sundays & Public Holidays
   As required by the NPfI, the external ambient noise levels presented are free-field noise levels [i.e. no façade reflection]. No correction was required to the measured results
2. Background corrected in accordance with NPfI as measured level was higher than measured daytime

The ambient environment was controlled by the traffic noise on the M7 motorway and by wildlife (birds and insects). The measured noise levels during evening and night were also higher than measured during the day. The NPfI states that the community generally expects greater control of noise during the more sensitive evening and night-time periods than during the less sensitive daytime period.

Therefore, the NPfI recommends that when setting up project specific noise levels for the site, the background noise levels for evening and night-time be set up no higher than the daytime one. This approach will be used in Section 4.1.

4 Operational noise assessment

4.1 Operational noise criteria

Operational noise emissions from the project have been assessed in accordance with the NPfI, which is primarily concerned with controlling intrusive noise impacts in the short-term for residences and maintaining long-term noise level amenity for residences and other land uses.

The NPfI sets out the procedure to determine the project noise trigger levels relevant to an industrial development. The project noise trigger level is a level that, if exceeded would indicate a potential noise impact on the community and so 'trigger' a management response.

4.1.1 Intrusive noise trigger level

The intrusiveness noise trigger level is applicable to residential premises only and is established relative to the existing background noise level, as follows:

- $L_{Aeq,15minute} \leq$ Rating Background Level (RBL) plus 5 dB

4.1.2 Recommended and project amenity noise level

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 Table 2.2 of the NPfI where feasible and reasonable. An extract from the policy pertinent to this assessment is given below in Table 4.

Table 4: NPfI Recommended Amenity Noise Levels (RANLs)

Receiver(s)	**Time Period[1]**	**Recommended amenity noise level (RANLs)[2] dBL$_{Aeq(period)}$**
Residential (Urban)[3]	Day	60
	Evening	50
	Night	45
School Classroom	Noisiest 1-hour when in use	35 (Internal noise level)
Commercial premises	When in use	65
Industrial premises	When in use	70
Active recreation area	When in use	55
Passive recreation area	When in use	50

1. The NPfI defines day, evening and night time periods as:
   a. Day: 7 am to 6 pm Monday to Saturday; or 8 am to 6 pm on Sundays and Public Holidays.
   b. Evening: 6 pm to 10 pm.
   c. Night: the remaining period.
2. The levels represent outdoor levels except where otherwise stated.
3. Residential receivers located within a rural environment, however due to existing noise levels, receivers are classified as urban according to Table 2.3 of NPfI 2017.

The project amenity noise level (PANL) represents the objective for noise from a single industrial development at a receiver location.

To ensure that any new industrial source of noise is within the RANLs for an area, the PANL applies for each new source of industrial noise as follows:

- *Project Amenity Noise Level (PANL) = Recommended Amenity Noise Level (RANL) minus 5 dB(A)*

The NPfI also provides the following exceptions to the above method for deriving the project amenity noise level apply:

- *In areas with high traffic noise levels.*
- *In proposed developments in major industrial clusters.*
- *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.*
- *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 the development.*

While the nearest residential receivers (to the south) are located within a rural area, their ambient noise levels are higher than those anticipated for rural receivers which is likely due to their proximity to the M7. Therefore, in accordance with NPfI, those receivers will fall into the urban category under the NPfI, as their ambient noise levels is controlled by traffic noise.

The NPfI sets the PANLs to $L_{Aeq(period(traffic))}$ minus 15 dB(A) in the case that the level of transport $L_{Aeq(period(traffic))}$ exceeds the RANL by 10 dB or more.

Table 5 shows the Project Amenity Noise Levels (PANLs) for each of the nearby noise sensitive receivers.

Table 5: NPfI RANLs and PANLs

ID	**Indicative Noise Amenity Area**	**Time period[1]**	**Recommended Amenity Noise Level (RANL) dBL$_{Aeq(period)}$**	**Existing Traffic L$_{Aeq(period)}$ [2]**	**Project Amenity Noise Level (PANL) L$_{Aeq(period)}$**
R1, R2	Residential (Urban)	Day	60	52	55
		Evening	50	57	45
		Night	45	51	40
C1, C2	Commercial	When in use	65	N/A[3]	60
I1, I2	Industrial	When in use	70	N/A[3]	65

ID	Indicative Noise Amenity Area	Time period[1]	Recommended Amenity Noise Level (RANL) $dBL_{Aeq(period)}$	Existing Traffic $L_{Aeq(period)}$ [2]	Project Amenity Noise Level (PANL) $L_{Aeq(period)}$
K1	Childcare (external)	Noisiest 1-hour	55[4]	N/A[3]	50
P1	Passive Recreation	When in use	50	N/A[3]	45
A1	Active Recreation	When in use	55	N/A[3]	50

Notes:

1. The NPfI defines day, evening and night time periods as:
   - Day: the period from 7 am to 6 pm Monday to Saturday; or 8 am to 6 pm on Sundays and Public Holidays.
   - Evening: the period from 6 pm to 10 pm.
   - Night: the remaining period.
2. Traffic noise is the dominant source of noise at the receiver location IF:
   a. the existing traffic noise is 10 dB(A) or more above the ANL for the area; and
   b. it is unlikely that traffic noise will reduce over time
3. N/A Not Applicable
4. For predictive assessment it is often more practical to assess at external locations. For purpose, external noise levels have been established assuming premises have closed windows with a nominal noise reduction of 20 dB(A).

4.1.3 Sleep disturbance

The NPfI [2] recommends the following screening criteria for the assessment of potential sleep disturbance, for the night-time period between 10 pm and 7 am:

- $L_{Aeq,15min}$ 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

As the former is equivalent to the intrusive noise trigger levels at night, the $L_{Amax(night)}$ parameter has been assessed, as it provides an additional and alternative assessment.

4.1.4 Modifying factors

Table C1 of the NPfI sets modifying factor corrections for annoying noise characteristics such as tonality, dominant low frequency, intermittency or irregularity.

When assessing low frequency impacts, an initial screening test is first undertaken by evaluating whether the difference in noise levels in C-weighted and in A-weighted are 15 dB or more at the receivers, which identifies the potential for an unbalanced spectrum in which case further assessment is required.

4.1.5 Project specific noise levels

The project-specific noise trigger levels applicable to this assessment are summarised in Table 6.

Regarding the Project Amenity Noise Levels, the NPfI outlines a simplified correction between $L_{Aeq(period),}$ being the average noise level over the entire day, evening and night period, and the intrusiveness $L_{Aeq(15minute)}$ 'worst-case period being:

- $L_{Aeq(15minute)} = L_{Aeq(period)} + 3$ dB [2]

This correction assumes that the worst-case activities or noise emission will not occur for the whole day, evening or night period. The NPfI adopts this assumption to set a 15-minute 'equivalent' Project Amenity Level as 3 dB higher than the 'period' level.

A reason for this simplification is to allow just one assessment for the worst-case 15-minute period for the day, evening and night. However, for sites that could emit relatively continuous noise, the NPfI ultimately sets a less stringent amenity criteria. For this assessment, as the project may emit relative continuous noise from plant and equipment, but also, a traffic schedule is available to assess both the worst case and average activity, both the intrusive and the amenity assessments have been conducted rather than the alternative simplified assessment procedure outlined in the NPfI.

Table 6: NPfI Project specific noise levels for residential receivers

Receiver	**ID**	**Time period**	**Intrusive Noise Trigger Levels dBL$_{Aeq, 15min}$**	**Project Amenity Noise Level (PANL) dBL$_{Aeq(period)}$**	**Sleep disturbance dBL$_{Amax}$ (night)**
Residential	R1, R2	Day	47	55	N/A
		Evening	47[3]	45	N/A
		Night	47[3]	40	57[3]
Commercial	C1, C2	When in use	N/A[2]	60	N/A
Industrial	I1, I2	When in use	N/A	65	N/A
Childcare	K1	Noisiest 1-hour	N/A	50	N/A
Passive Recreation area	P1	When in use	N/A	45	N/A
Active recreation area	A1	When in use	N/A	50	N/A

Notes:

1. The NPfI defines day, evening and night time periods as:
   - Day: the period from 7 am to 6 pm Monday to Saturday; or 8 am to 6 pm on Sundays and Public Holidays.
   - Evening: the period from 6 pm to 10 pm.
   - Night: the remaining period.
2. N/A Not Applicable
3. Refer to Table 3

4.2 Operational noise assessment

This section describes the assessment of operational noise emissions from the proposal. The assessment of noise emissions from vehicle movements on the external road network is assessed in Section 5.

4.2.1 Site layout

The proposed site layout is shown in Figure 2 and the build identification adopted in the assessment is presented in Figure 3.

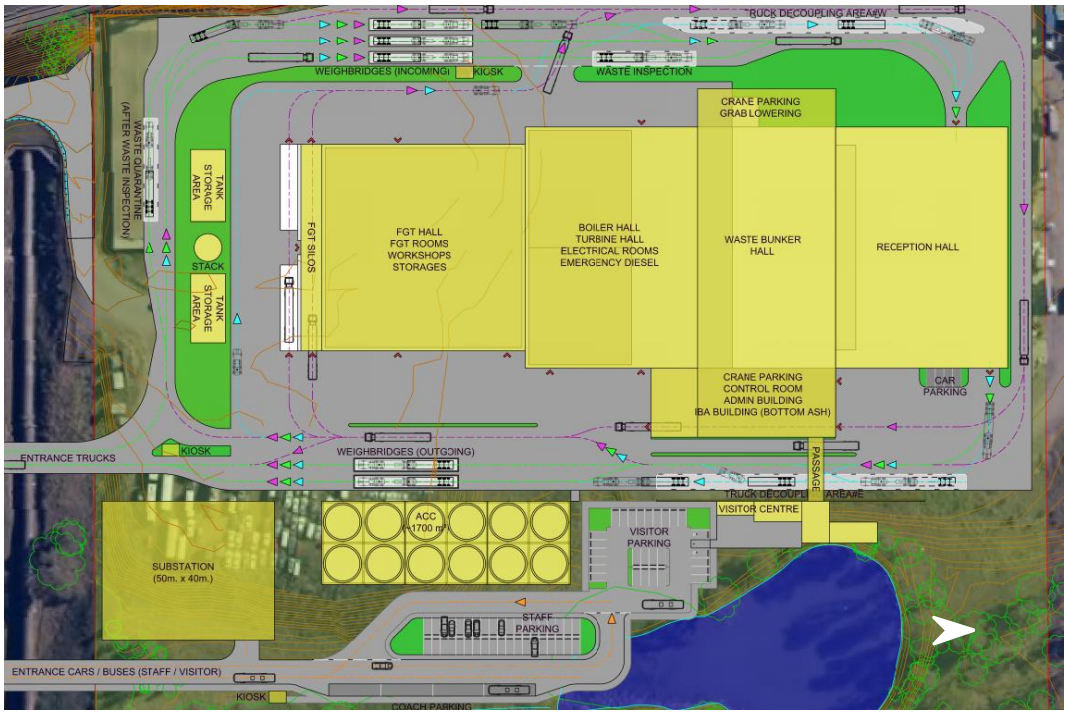


Figure 2: Site layout

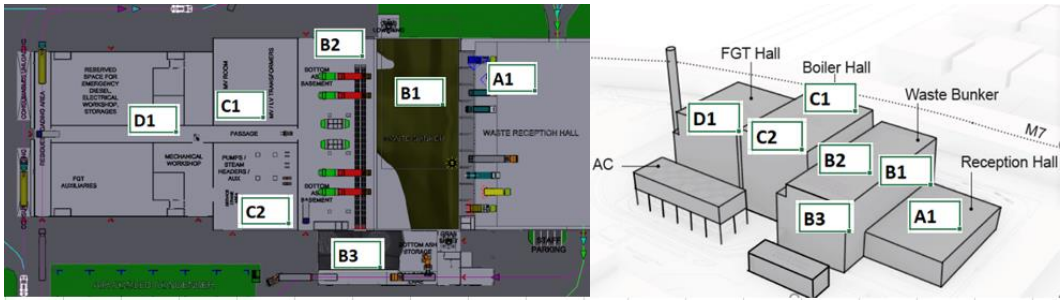


Figure 3: Buildings identification

4.2.2 Primary noise sources

The primary operational noise sources associated with the development are listed below and identified in Section 4.2.1:

- **Vehicular traffic:**
  - Heavy vehicles (trucks) travelling within the site (Refer to Section 4.2.3 for a description of the truck movements):
    - to deliver waste to the tipping hall
    - to deliver/pick up consumables/residues
  - Light vehicles travelling to/from the staff/visitor entrance via the staff/visitor entrance
  - Buses travelling to/from the staff/visitor entrance via the staff/visitor entrance
- **Plant and equipment:**
  - Air Cooled Condensers (ACCs)
  - Substation
  - Various internal processes and equipment operating within the buildings such as generators, turbine, ID fans and pumps
  - Exhaust stack
  - Component Cooler (Banks of fans on top of waste bunker)
  - Condensate pump (below ACCs)

4.2.3 Vehicular movement

Figure 4 and Figure 5 below show the travel path of vehicles within the site along with an estimated time spent at key locations such as weighbridges and within buildings (either dumping or collecting). Table 7 provides a description of the travel paths.

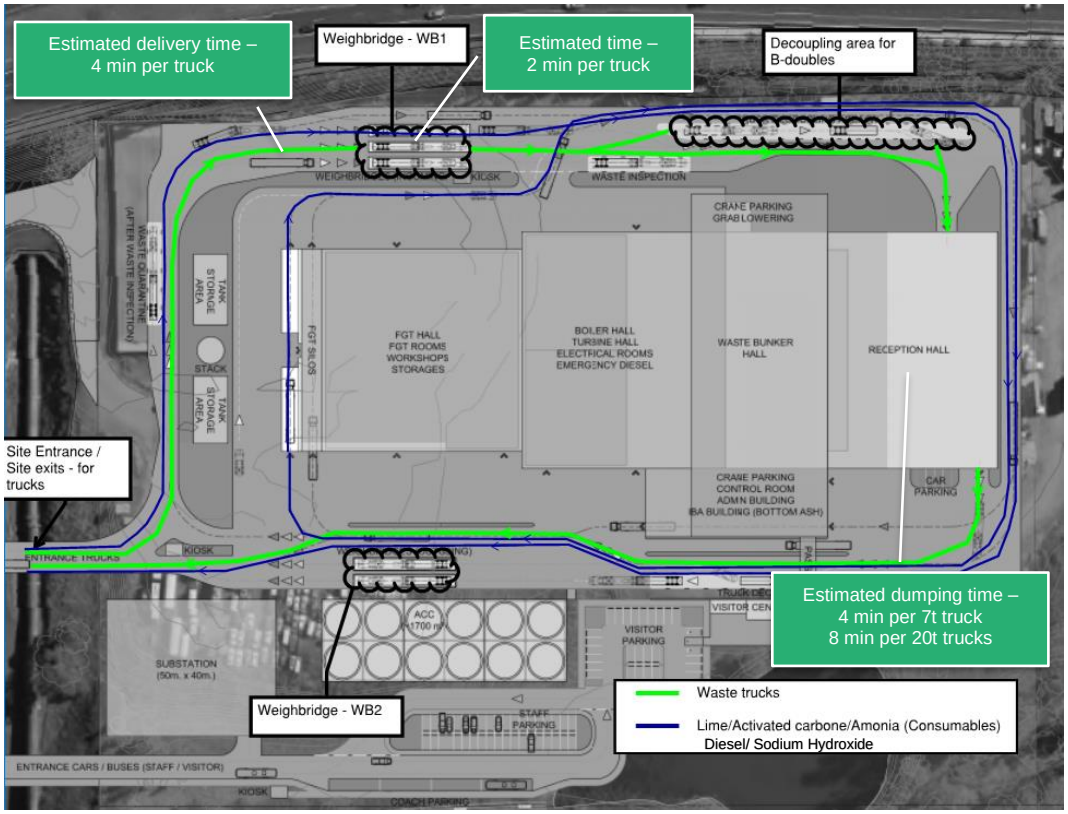


Figure 4: Origins and Destinations of trucks within the site - Arriving loaded

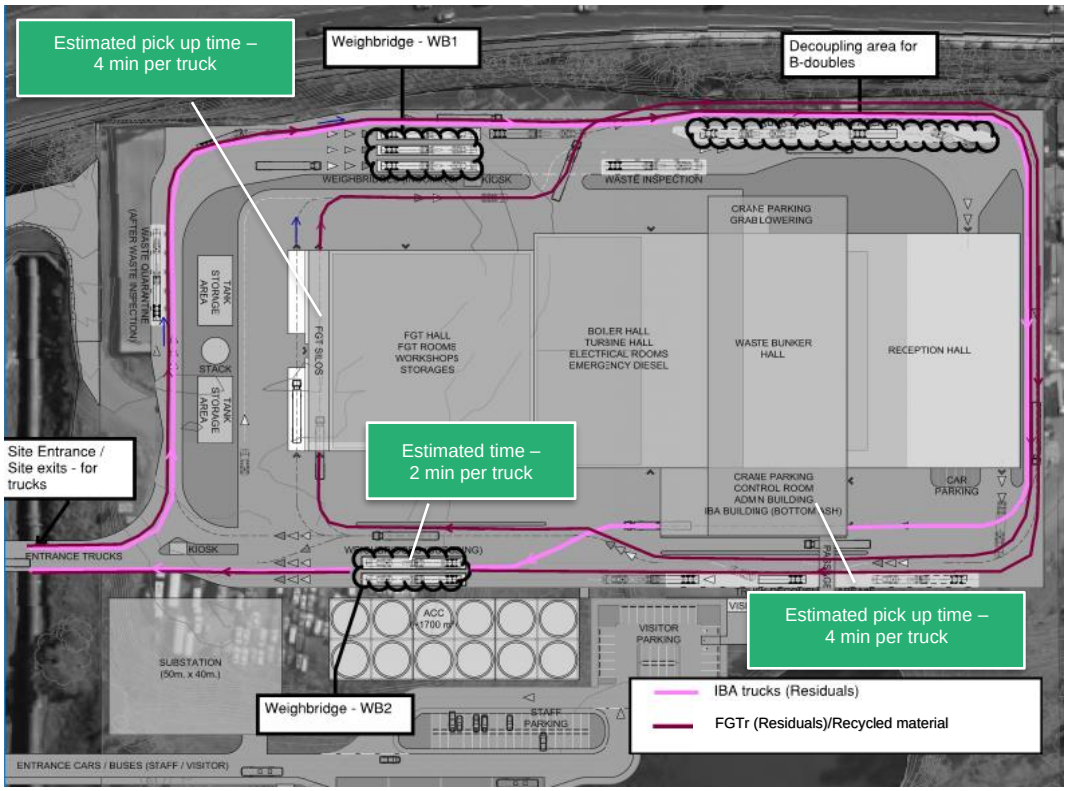


Figure 5: Origins and Destinations of the trucks within the site - Arriving empty

Table 7: Origins and Destinations of the trucks within the site

Trucks	Travel path (indicative)
Waste[1]	**Step 1**: Truck loaded – Travel from site entrance to weighbridge WB1 **Step 2a**: Travel to reception hall to dump waste **Step 2b**: Travel to decoupling area if B-double, then travel to reception hall to dump waste **Step 3**: Truck empty – travel from reception hall to exit
Lime/Activated Carbon/Ammonia / Diesel / Sodium Hydroxide [2]	**Step 1**: Truck loaded – Travel from site entrance to weighbridge WB1 **Step 2**: Travel from WB1 to FGT hall for delivery of consumables **Step 3**: Travel from FGT hall all the way around the site again to the exit
IBA [3]	**Step 1**: Truck empty – Travel from site entrance to Bottom Ash building for collection of ash **Step 2**: Truck loaded – travel from bottom ash building to weighbridge WB2 **Step 3**: Truck loaded – Travel from weighbridge WB2 to site exit
FGTr (Residuals)[4] / Recycled material	**Step 1**: Truck empty – Travel from site entrance to FGT hall for collection of residues **Step 2**: Truck loaded – Travel from FGT hall all the way around the site again to the weighbridge WB2 **Step 3**: Truck loaded – Travel from WB2 to site exit

Notes:

1. Shown in green in Figure 4
2. Shown in blue in Figure 4
3. IBA - Incineration Bottom Ash - Shown in pink in
4. Figure 5
5. FGTr – Flue Gast Treatment Residue Trucks- Shown in purple in
6. Figure 5

Anticipated truck volumes are given in Table 8 as per Technical report K: Traffic and transport assessment report (Refer to as the traffic report).

Table 8: Truck volumes

Type	Assumption	Yearly Volume (tonnes)	Truck Capacity (Tonnes)	Daily deliveries
Residual waste	50% of waste	250,000	20	42
	50% of waste	250,000	7	119
Lime	15kg / tonne of waste	7,500	20	2
Activated Carbon	0.5 kg / tonne of waste	250	20	~1
Ammonia	4 kg / tonne of waste	2,000	20	~1
IBA	17% of processed waste	85,000	20	15
FGTr	3% of processed waste	15,000	20	3

Type	Assumption	Yearly Volume (tonnes)	Truck Capacity (Tonnes)	Daily deliveries
Sodium Hydroxide	1kg/ tonne of waste	500	20	~1
Recycled materials		15,000	20	3
Diesel	Fuel deliveries	-	20	~1
Total				**188**

Breakdown of heavy and light vehicles throughout the day was established in the traffic report and is reproduced in Appendix B.

In accordance with Table 8 and Appendix B a worst case scenario for the intrusive assessment was used to model waste delivery trucks within a 15-minute period conservatively assuming that half of the truck movements would occur during the first 15-minutes of the hour. Table 9 summarises number of trucks and light vehicles used in the noise modelling. It has been assumed that one visitor bus will be coming to the facility per day.

Table 9: Number of vehicles modelled

Trucks	Number of vehicles			
	Intrusive Scenario (Worst 15 minutes)		Amenity scenario (whole period)[1]	
	Day	Night	Day (11 hours)	Night (9 hours)
Residual waste – 20t trucks	3[2]	2[2]	33	9
Residual waste – 7t trucks	9[2]	6[2]	94	25
IBA	2	1	12	3
FGTr	1	1	2	1
Lime/Activated Carbone/Ammonia/ Sodium Hydroxide/ Diesel	2	1	5	1
Recycled materials	0	0	2	1
Staff/visitors	2	0	71	0
Visitors	1	0	1	0

Notes:

1 - There are no trucks accessing site during evening time. Hours of deliveries are 4 am to 5 pm

2 - Assumed that half of the trucks would be entering/leaving the site during the first 15 minutes of the hour

4.2.4 Noise source data and building construction

A summary of the noise levels data used in the model is given in Table 10. Noise levels use in this assessment were agreed with the design team. Note that detail information regarding plant and equipment is not fully known at this stage and all plant and equipment and building design will be reviewed at detail design to ensure that criteria are met. Detailed inputs used in the SoundPLAN model for this assessment is given in Appendix C.

Table 10: Noise modelling source level data

Equipment	Metric	Sound Levels - dBA
Moving sources		
Truck (7t waste/compactor) 10 km/h - L_w	$L_{eq(15minute)}$/m	64
Truck (20t semi-trailer truck and B double) – 10 km/h - L_w	$L_{eq(15minute)}$/m	70
Trucks braking - L_w	$L_{eq(15\ minute)}$	71
	L_{max}	120
Trucks idling (at weighbridges) - L_w	$L_{eq(15\ minute)}$	95
Light vehicle 10 km/h - L_w	$L_{eq(15minute)}$/m	45
Visitor Bus 10 km/h - L_w	$L_{eq(15minute)}$/m	64
Stationary sources		
ACC - L_w	$L_{eq(15minute)}$	95 (per unit)
Substation - L_w	$L_{eq(15minute)}$	86
Exhaust stack (2 flux) - L_w	$L_{eq(15minute)}$	83 (80 per flux)
Component coolers (bank of 8 fans) - (roof of Waste Bunker) - L_w	$L_{eq(15minute)}$	89 (per bank) – 80 (per fan)
Condensation pump - L_w	$L_{eq(15minute)}$	71
Buildings[1]		
A1 - Reception hall – Internal L_p	$L_{eq(15minute)}$	85
Waste Bunker – Internal L_p		
B1 – Waste Bunker	$L_{eq(15minute)}$	80
B2 – Waste Bunker	$L_{eq(15minute)}$	85
B3 – Waste Bunker (Ash Bunker)	$L_{eq(15minute)}$	80
Boiler hall – Internal L_p		
C1 – Boiler hall	$L_{eq(15minute)}$	80
C2 – Boiler hall	$L_{eq(15minute)}$	85
D1 - FGT hall – Internal L_p	Lp max internal[2]	85

Note 1: Refer to Section 4.2.4 regarding openings

Facades of the buildings will be constructed from either concrete or metal cladding. The assumed sound transmission loss for each of these materials used in this assessment are given in Table 11.

Table 11: Transmission Loss of building envelope

Material	R_w	Octave Band Centre Frequency - Transmission Loss, dB							
		63	125	250	500	1 k	2 k	4 k	8 k
Metal cladding (roofs)	18	-9	-12	-15	-15	-16	-20	-23	-23
Concrete	49	-40	-42	-37	-45	-54	-61	-69	-74
Metal Facade Cladding	29	-15	-20	-20	-28	-30	-30	-30	-30

The buildings also comprise several doors and louvres which have currently been modelled as openings:

- A1 Reception hall:
    - 2x doors for truck arrival and departure
- B1 B2 B3 Waste bunker:
    - 2x doors in ash bunker for truck arrival and departure
    - 2x doors in B2 for truck arrival and departure
- C1 Boiler Hall:
    - 1x louvre for turbine hall (approximately 20% of lower half of façade area)
    - 1x louvre for boiler hall (approximately 20% of upper half of façade area)
- C2 Boiler Hall:
    - 1x door for truck access
    - 1x louvre for turbine hall (approximately 20% of lower half of façade area)
    - 1x louvre for boiler hall (approximately 20% of upper half of façade area)
- D1 FGT Hall:
    - 2x louvres (approximately 10% of the façade area each:1x louvre located on the west façade and 1x louvre to the east façade)

4.2.5 Operational scenarios

Operational noise levels have been predicted for the following scenarios. Note the evening period has not been included as there are no trucks travelling during this period (Refer to Appendix B).

Table 12: Modelling scenarios

Noise Sources	**Number of sources/equipment per period**			
	Intrusiveness Scenarios – worst-case 15-min period)		**Amenity Scenarios – Total over period**	
	Day	**Night**	**Day**	**Night**
Vehicle movements (total two way)				
Residual waste – 20t trucks	3	2	33	9
Residual waste – 7t trucks	9	6	94	25
IBA (20t)	2	1	12	3
FGTr (20t)	1	1	2	1
Lime/Activated Carbone/Ammonia/ Sodium Hydroxide/ Diesel (20t)	2	1	5	1
Recycle materials	0	0	2	1

Noise Sources	Number of sources/equipment per period			
	Intrusiveness Scenarios – worst-case 15-min period)		Amenity Scenarios – Total over period	
	Day	Night	Day	Night
Staff/visitors (light vehicles)	2	0	71	0
Visitor bus	1	0	1	0
Plant, equipment and internal activities				
ACC unit (1 fan per unit)	12	12	12	12
Substation	1	1	1	1
Exhaust stack (2 flux)	1	1	1	1
Fan banks (on top of Waste Bunker) – 1 x Bank has 8 fans	10	10	10	10
Condensation pump	1	1	1	1
Reception hall	1	1	1	1
Waste Bunker	1	1	1	1
Boiler hall	1	1	1	1
FGT hall	1	1	1	1

Notes:

1. 1x Bank has 8 fans

4.3 Operational noise impact

Noise modelling was undertaken using SoundPlan v8.1. Environmental noise emissions were predicted using the CONCAWE algorithm.

Weather conditions have the potential to increase noise levels and therefore require to be taken into account during the impact assessment phase. The assessment has been conducted in accordance with the NPfI which includes assessment under standard meteorological conditions (Category D, no wind) and noise enhancing meteorological conditions. The enhanced meteorological conditions are defined in Fact sheet D of the NPfI as follows:

- *Meteorological Condition 1: Stability A-D class with wind up to 3 m/s at 10 m above ground level*
- *Or Meteorological Condition 2: Stability F class with wind up to 2 m/s at 10 m above ground level. – Note that stability F class represents temperature inversion*

with a conservative approach that considers source to receiver wind vectors for all receivers.

Both noise enhancing meteorological conditions were modelled and resulted in no material difference.

Predicted noise levels are shown in Table 13 for standard meteorological conditions and in Table 14 for enhanced meteorological conditions.

Table 13: Predicted operational noise levels – Standard meteorological conditions

Receiver ID	Predicted Levels					Criteria					Compliance				
	Intrusive Assessment dBA (dBC)		Amenity Assessment dBA (dBC)		Sleep Disturbance dBA	Intrusive Criteria dBA		Amenity Criteria dBA		Sleep Disturbance dBA	Complies with Intrusive criteria?		Complies with Amenity criteria?		Complies with Sleep Disturbance criteria
	Day	Night	Day	Night	Night	Day	Night	Day	Night	Night	Day	Night	Day	Night	Night
R1	41 (50)	40 (50)	40 (49)	39 (49)	40	47	47	55	40	57	YES	YES	YES	YES	YES
R2	37 (45)	36 (45)	35 (44)	35 (43)	38	47	47	55	40	57	YES	YES	YES	YES	YES
C1	52 (60)	51 (59)	51 (59)	50 (58)	56	N/A	N/A	60	60	N/A	N/A	N/A	YES	YES	N/A
C2	39 (48)	38 (48)	37 (47)	36 (46)	43	N/A	N/A	60	60	N/A	N/A	N/A	YES	YES	N/A
I1	64 (71)	63 (70)	62 (69)	62 (69)	71	N/A	N/A	65	65	N/A	N/A	N/A	YES	YES	N/A
I2	61 (66)	59 (65)	57 (63)	57 (63)	67	N/A	N/A	65	65	N/A	N/A	N/A	YES	YES	N/A
K1	39 (48)	38 (48)	37 (47)	36 (46)	43	N/A	N/A	50	50	N/A	N/A	N/A	YES	YES	N/A
P1	<30 (<30)	<30 (<30)	<30 (<30)	<30 (<30)	<30	N/A	N/A	45	45	N/A	N/A	N/A	YES	YES	N/A
A1	36 (46)	35 (45)	35 (45)	35 (45)	38	N/A	N/A	50	50	N/A	N/A	N/A	YES	YES	N/A

Note: dBC values have been provided for assessment of low frequency noise

Table 14: Predicted operational noise levels – Enhanced meteorological conditions

Receiver ID	Predicted Levels					Criteria					Compliance				
	Intrusive Assessment dBA (dBC)		Amenity Assessment dBA (dBC)		Sleep Disturbance dBA	Intrusive Criteria dBA		Amenity Criteria dBA		Sleep Disturbance dBA	Complies with Intrusive criteria?		Complies with Amenity criteria?		Complies with Sleep Disturbance criteria
	Day	Night	Day	Night	Night	Day	Night	Day	Night	Night	Day	Night	Day	Night	Night
R1	44 (52)	43 (52)	43 (51)	42 (51)	45	47	47	55	40	57	YES	YES	YES	NO	YES
R2	40 (47)	40 (47)	38 (46)	38 (45)	43	47	47	55	40	57	YES	YES	YES	YES	YES
C1	54 (62)	54 (61)	53 (60)	53 (60)	61	N/A	N/A	60	60	N/A	N/A	N/A	YES	YES	N/A
C2	43 (51)	42 (50)	41 (49)	40 (49)	48	N/A	N/A	60	60	N/A	N/A	N/A	YES	YES	N/A
I1	66 (72)	65 (71)	64 (71)	64 (71)	74	N/A	N/A	65	65	N/A	N/A	N/A	YES	YES	N/A
I2	63 (68)	62 (67)	60 (65)	60 (65)	71	N/A	N/A	65	65	N/A	N/A	N/A	YES	YES	N/A
K1	43 (51)	42 (50)	41 (49)	40 (49)	48	N/A	N/A	50	50	N/A	N/A	N/A	YES	YES	N/A
P1	<30 (<30)	<30 (<30)	<30 (<30)	<30 (<30)	<30 (<30)	N/A	N/A	45	45	N/A	N/A	N/A	YES	YES	N/A
A1	40 (48)	39 (48)	38 (47)	38 (47)	43	N/A	N/A	50	50	N/A	N/A	N/A	YES	YES	N/A

Note: dBC values have been provided for assessment of low frequency noise

A review of Table 13 and Table 14 indicates that the site is predicted to comply with noise criteria at all receivers during standard meteorological conditions. A minor exceedance (less than 2 dB) is predicted at the residential receiver R1, located to the south of the site, during night time enhanced meteorological conditions based on the preliminary noise sources and operational assumptions described in Section 4.2.4. The review of the tables also indicates that difference between dBC and dBA values is less than the 15 dB NPfI low frequency screening criterion indicating that low frequency noise is not present at the receivers.

It is noted that the current assessment has been conducted with limited detailed data (i.e no available data for sound power level of equipment under 63 Hz or third-octave data to evaluate tonality) and while low frequency noise has currently not been identified as an issue, low frequency and tonality impacts should be reviewed at detailed design when specific data for all equipment is available.

As outlined in Section 4.2.4, a review of the design of the building envelope and plant and equipment will be conducted during detail design to address predicted non-compliances.

Primary contribution of the noise sources is listed below for R1. The table below provides an understanding of what sources might require mitigations and what sources might be relaxed.

Table 15: Noise contribution at R1 (Amenity Scenario, Night, Adverse met conditions)

Noise sources	**L_{Aeq} contribution**	**Note**
C2 Breakout	39	Most of the L_{Aeq} contribution is currently influenced by the louvres in the building. – Design of the louvres will need to be reviewed at detailed design
D1 Breakout	38	Most of the L_{Aeq} contribution is currently influenced by the louvres in the building. – Design of the louvres will need to be reviewed at detailed design
ACCs	34	-
B2 Breakout	28	-
Refuse trucks	25	-
B3 Breakout	19	-
FGTr trucks	18	
C1 Breakout	17	-
IBA trucks	17	-
B1 Breakout	14	-
Waste Bunker Roof	14	-
Substation	10	-
A1 Breakout	9	-
Stack	4	-
Consumables Trucks	-4	-

Noise sources	L_{Aeq} contribution	Note
Total	**42**	
Criteria	**40**	

As further mitigation of the building envelope and equipment is possible (such as upgrade to the louvres), it is considered feasible for the EfW facility to comply with established noise goals.

5 Road traffic noise generated by the development

5.1 Operational road noise criteria

Increased traffic generated on the public road network is assessed in accordance with the Road Noise Policy (RNP) [3].

When assessing noise impact using the existing road network, an initial screening test is first undertaken by evaluating whether noise levels are expected to increase by more than 2 dBA due to the additional traffic generated by the proposed development.

Where noise levels are predicted to increase by more than 2 dBA (i.e. 2.1 dBA or greater) further assessment is required to be conducted in accordance with the RNP. Table 3 of the RNP sets out the assessment criteria for particular types of project, road category and land use. Noting that traffic generated by the proposed development will travel on Old Wallgrove Road, Wallgrove Road and the relevant section of the RNP for this project is given below in Table 16. Old Wallgrove Road, Wallgrove Road and the M7 fall into the Freeway/arterial/sub-arterial roads criteria.

Table 16: Road traffic noise criteria for residential land uses

Road category	**Type of project/land use**	**Assessment criteria - dBA**	
		Day 7 am-10 pm $L_{Aeq(15hour)}$ (external)	**Night 10 pm-7 am $L_{Aeq(9hour)}$ (external)**
Freeway/arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arteria/sub-arterial roads generated by land use developments	60	55

Notes: These criteria are for assessment against façade corrected noise levels when measured in front of a building façade.

5.2 Operational road noise assessment

Estimated number of additional vehicles travelling on the road network due to the operation of the proposed development is summarised in Table 17. Predicted noise increase due to the additional traffic travelling on the road network generated by the operation of the project has been assessed in Table 18.

Table 17: Forecast traffic generated by the operation of the proposed development

Additional vehicle movements generated by the operation of the proposed development	
Heavy vehicles	**Light vehicles**
188	96

Table 18: Forecast traffic generated by the operation of the proposed development

Road	**Road Category**	**Current traffic AADT (% heavy vehicles)**	**Additional traffic generated by the development (vehicle movements)**	**% increase of total traffic**	**dB increase**
Old Wallgrove Road	Sub-arterial Road	13,500 (25%)[1]	472	3.5%	0.15
Wallgrove Road	Sub-arterial Road	16,906 (25%)[2]	472	2.8%	0.12
M7	Motorway	70,000 (5%)[3]	472	0.7%	0.03

Note 1: Data from "Archbold Road Upgrade and Extension, Review of Environmental Factors, Volume 1, prepared by WSP and Roads and Maritime Services, dated May 2017

Note 2: AADT year 2008, percentage of heavy vehicles estimated based on percentage of heavy vehicles travelling on Old Wallgrove Road

Note 3: Number of vehicles estimated based on data on M4 from "Archbold Road Upgrade and Extension, Review of Environmental Factors, Volume 1, prepared by WSP and Roads and Maritime Services, dated May 2017

Review of Table 18: indicates that predicted increase in noise levels is below the RNP screening criterion and therefore no further assessment is warranted. The predicted increase is negligible and would not be perceived as a noticeable increase in noise.

6 Operational vibration assessment

Several vibration generating items will be installed on site such as the turbine and the ACCs.

While details regarding the items is not yet known, mitigation measures through appropriate construction to limit vibration transmission through ground will be put in place.

Mitigation measures will include assessment of natural frequencies of footings to ensure resonant response does not occur during ramp up, operation and ramp down of the generator turbine. The turbine will be founded on a piled raft which will incorporate a spring damper system to reduce the vibration effect of the equipment. The turbine and ACCs are to be founded on piles with loads transferred to the underlying shale rock well below the level of Warragamba Pipelines.

Operational vibration impacts at surrounding receivers and sensitive structures (such as the Water NSW Warragamba Pipeline) are therefore expected to be negligible.

7 Construction noise and vibration

Noise and vibration impacts from construction of the proposed development will be discussed in this section.

7.1 Construction noise criteria

The ICNG [1] provides guidelines for the assessment and management of construction noise. The ICNG focuses on applying a range of work practices to minimise construction noise impacts rather than focusing on achieving numeric noise levels.

The main objectives of the ICNG are to:

- Identify and minimise noise from construction works
- Focus on applying all ‘feasible’ and ‘reasonable’ work practices to minimise construction noise impacts
- Construction must only occur during recommended standard hours, unless works cannot be undertaken during normal work hours and appropriate approval is given.
- Reduce time spent dealing with complaints at the project implementation stage
- Provide flexibility in selecting site-specific feasible and reasonable work practices to minimise noise impacts.

The ICNG provides two methods for assessing construction noise, varying typically on the basis of the project duration, being either a quantitative or a qualitative assessment. A quantitative assessment is recommended for major construction projects of significant duration and involves the measurement of background noise levels for determination of management levels and prediction of construction noise levels. A qualitative assessment is recommended for small projects with a duration of less than three weeks and focuses on minimising noise disturbance through the implementation of reasonable and feasible work practices, and community notification. The proposed scheme is expected to warrant a quantitative assessment due to its size.

Quantitative noise assessment criteria

Recommended hours for construction work are set in the ICNG as noise management levels can differ based on time of day.

The recommended standard construction hours stated in the ICNG are:

- Monday to Friday: 7 am to 6 pm
- Saturday: 8 am to 1 pm
- No work on Sunday or public holidays.

The ICNG acknowledges that the following activities have justification to be undertaken outside the standard recommended construction hours assuming all

feasible and reasonable mitigation measures are implemented to minimise the impacts to the surrounding sensitive land uses.

- the delivery of oversized plant or structures that police or other authorities determine to require special arrangements to transport along public roads;
- emergency work to avoid the loss of life or damage to property, or to prevent environmental harm;
- works where a proponent demonstrates and justifies a need to operate outside the recommended standard construction hours.

It is anticipated that construction activities would take place during standard construction hours.

The ICNG outlines a method to determine the construction noise management levels for residential premises. Residential noise management levels guidelines for works during standard construction hours and works outside of standard construction hours are considered separately and are provided in Table 19.

Table 19: Construction noise management levels at residential receivers

Time of day	**Management level[1]** $L_{Aeq\ (15\ min)}$	**How to apply**
Recommended standard hours: Monday to Friday: 7 am to 6 pm Saturday: 8 am to 1 pm No work on Sunday 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 $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted 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: • times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Time of day	Management level[1] $L_{Aeq\ (15\ min)}$	How to apply
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 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

1 - 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 of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Table 20: Construction noise management levels at relevant other noise sensitive land uses

Land use	Where objective applies	Management level $L_{Aeq(15\ min)}$[1]
Classrooms at schools and other educational institutions	Internal noise level External noise level[2]	45 dB(A) 65 dB(A)[2]
Active recreation areas	External noise level	65 dB(A)
Passive recreation areas	External noise level	60 dB(A)
Commercial premises	External noise level	70 dB(A)
Industrial premises	External noise level	75 dB(A)

Notes:

1 - Noise management levels apply when receiver areas are in use only.

2 - For predictive assessment and where noise monitoring is required, it is often more practical to assess at external locations. For purpose, external management levels have been established assuming premises have closed windows with a nominal noise reduction of 20 dB(A). Where monitoring occurs, this noise reduction will be verified on site.

For work within standard construction hours, if after implementing all 'feasible and reasonable' noise levels the site still exceeds the noise affected level, the ICNG does not require any further action – since there is no further scope for noise mitigation.

Project construction NMLs

Based on the ICNG and the noise monitoring results presented in Section 3.2, construction noise management levels relevant to the project are presented in Table 21.

Table 21: ICNG Construction NMLs

Receiver	Standard hours $L_{Aeq(15\ min)}$[1]		Outside standard hours
	Noise affected	Highly noise affected[2]	
R01	52	75	47 (Day) /47 (Evening) / 47 (Night)
R02	52	75	47 (Day) /47 (Evening) / 47 (Night)
C1	70	-	70 (when in use)
C2	70	-	70 (when in use)
I1	75	-	75 (when in use)
I2	75	-	75 (when in use)
K1	65	-	65 (when in use)
P1	60	-	60 (when in use)
A1	65	-	65 (when in use)

Notes:

1 – 7 am to 6 pm Monday to Friday, 8 am to 1 pm Saturday, no work on Sunday or public holidays Refer to Section 5.1

2 – Applies to residential receivers only as defined in the ICNG

7.2 Construction vibration criteria

7.2.1 Disturbance to buildings occupants

Potential vibration disturbance to human occupants of buildings is made in accordance with the NSW DEC ‘Assessing Vibration; a technical guideline’ (DEC, 2006). The criteria outlined in the guideline is based on the British Standard BS 6472-1992 ‘Evaluation of human exposure to vibration in buildings (1-80Hz)’. Sources of vibration are defined as either 'Continuous', 'Impulsive' or 'Intermittent', as described in Table 22.

Table 22: Types of vibration - Definition

Type of vibration	Definition	Examples
Continuous vibration	Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time)	Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).
Impulsive vibration	A rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.

Type of vibration	Definition	Examples
Intermittent vibration	Can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer, this would be assessed against impulsive vibration criteria.

Table 23 reproduces the 'Preferred' and 'Maximum' values for continuous and impulsive vibration from Table 2.2 of the Guideline.

Table 23: Preferred and maximum vibration acceleration levels for human comfort, m/s^2

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis	x- and y-axes	z-axis	x- and y-axes
Continuous vibration (weighted RMS acceleration, m/s^2, 1-80Hz)					
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day- or night-time	0.020	0.014	0.040	0.028
Workshops	Day- or night-time	0.04	0.029	0.080	0.058
Impulsive vibration (weighted RMS acceleration, m/s^2, 1-80Hz)					
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day- or night-time	0.64	0.46	1.28	0.92

1 - Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am

Table 24 reproduces the 'Preferred' and 'Maximum' values for intermittent vibration from Table 2.4 of the Guideline. The VDV is dependent upon the level and duration of the vibration episode and the number of vibration episodes occurring during the assessment period; a higher vibration level is permitted if the total duration of the vibration event(s) is small.

Table 24: Acceptable vibration dose values (VDV) for intermittent vibration ($m/s^{1.75}$)

Location	Daytime[1]		Night-time	
	Preferred value	Maximum value	Preferred value	Maximum value
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

1- Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am

7.2.2 Structural damage

Potential structural or cosmetic damage to buildings as a result of vibration is typically assessed in accordance with British Standard 7385 Part 2 [6] and/or German Standard DIN4150-3 [7].

7.2.2.1 Standard structures

British Standard 7385 Part 1: 1990, defines different levels of structural damage as:

- *Cosmetic - The formation of hairline cracks on drywall surfaces, or the growth of existing cracks in plaster or drywall surfaces; in addition, the formation of hairline cracks in mortar joints of brick/concrete block construction.*
- *Minor - The formation of large cracks or loosening of plaster or drywall surfaces, or cracks through bricks/concrete blocks.*
- *Major - Damage to structural elements of the building, cracks in supporting columns, loosening of joints, splaying of masonry cracks, etc.*

Table 1 and Section 7.4.2 of BS7385-2 sets limits for the protection against the different levels of structural damage and those levels are reproduced below.

Table 25: BS 7385-2 Structural damage criteria

Group	Type of structure	Damage level	Peak component particle velocity, mm/s[1]		
			4 Hz to 15 Hz	15 Hz to 40 Hz	40 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	Cosmetic	50		
		Minor[2]	100		
		Major[2]	200		
2	Un-reinforced or light framed structures Residential or light commercial type buildings	Cosmetic	15 to 20	20 to 50	50
		Minor[2]	30 to 40	40 to 100	100
		Major[2]	60 to 80	80 to 200	200

1 - Peak Component Particle Velocity is the maximum Peak particle velocity in any one direction (x, y, z) as measured by a tri-axial vibration transducer.

2 - Minor and major damage criteria established based on British Standard 7385 Part 2 (1993) Section 7.4.2

All levels relate to transient vibrations in low-rise buildings. Continuous vibration can give rise to dynamic magnifications that may require levels to be reduced by up to 50%.

The guide values in Table 25 relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low rise buildings. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 25 may need to be reduced by up to 50%.

7.2.2.2 Sensitive structures (including Warragamba Pipeline)

German Standard DIN 4150 - Part 3 'Structural vibration in buildings - Effects on Structure' [7] are generally recognised to be conservative and is often referred to for the purpose of assessing structurally sensitive buildings.

For the subject site, surrounding buildings are not deemed structurally sensitive and therefore the British Standard is considered appropriate for vibration management.

Regarding the Warragamba Pipeline, WaterNSW '*Guidelines for Development Adjacent to the Upper Canal and Warragamba Pipelines*' [8], outlines that the pipeline is fragile due to its inner concrete lining, footings and expansion joints. In the absence of an Australian Standard, WaterNSW accepts Line 3 of Table 1 from DIN4150-3 2016 [7].

Table 26: DIN 4150-3 structural damage criteria

Line	Type of structure	Guideline values for velocity, mm/s				
		Vibration at the foundation at a frequency of			At horizontal plane of highest floor	In the vertical direction, at floor slabs
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz*	All frequencies	All frequencies
3	Structures that because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (eg listed buildings under a preservation order)	3	3 to 8	8 to 10	8	20

* At frequencies above 100 Hz, the values given in this column may be used as minimum values.

** Guideline value might have to be lowered to prevent minor damage

7.2.2.3 Buried services

DIN 4150-3:2016 sets out guideline values for vibration effects on buried pipework (see Table 27).

Table 27: Guideline values for short-term vibration impacts on buried pipework

Line	Pipe material	Guideline values for vibration velocity measured on the pipe, mm/s
1	Steel (including welded pipes)	100
2	Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80
3	Masonry, plastic	50

Line	Pipe material	Guideline values for vibration velocity measured on the pipe, mm/s

Note: For gas and water supply pipes within 2m of buildings, the levels given in DIN4150-3 [7] should be applied. Consideration must also be given to pipe junctions with the building structure as potential significant changes in mechanical loads on the pipe must be considered.

Note: Rock breaking/hammering and sheet piling activities are considered to have the potential to cause dynamic loading in some structures and it may therefore be appropriate to reduce the transient values by 50%.

Other services that maybe encountered include electrical cables and telecommunication services such as fibre optic cables. While these may sustain vibration velocity levels from between 50 mm/s and 100 mm/s, the connected services such as transformers and switchgear, may not. Where encountered, site specific vibration assessment in consultation with the utility provider should be carried out.

7.3 Construction Noise and Vibration Assessment

A detailed construction program is not yet known. The following assessment has been based on preliminary information provided by the project team (Refer to Chapter 3 Proposal Description of the EIS). Construction works have been broadly broken down into four phases:

- Phase 1: Demolition (including Initial establishment works then demolition and removal of the existing structures and facilities on the site)
- Phase 2: Site establishment and enabling works
- Phase 3: Main construction works
- Phase 4: Testing and commissioning
- Phase 5: Finishing and landscaping

The overall construction timeframe is expected to be approximately 3.5 years. Activities within the phases might be conducted concurrently. An indicative timeframe is provided below in Table 28.

Table 28: Indicative construction timeline

Phase	Duration	Months																													
		3		6		9		12		15		18		21		24		27		30		33		36		39		42			
Phase 1 – Demolition	6 months																														
Phase 2 – Site establishment and Enabling Works	9 months																														
Phase 3 – Main Construction	26 months																														
Phase 4 – Testing and Commissioning	8 months																														
Phase 5 – Finishing and Landscaping	6 months																														

An indicative list of plant and equipment has been provided by the project team (Refer to Chapter 3 Proposal Description of the EIS) and is reproduced in Table 29, noting however that it is unlikely that the number of equipment outlined in Table 29 will be operating concurrently during each stage.

Table 29: Construction Stages and Corresponding Plant and Equipment

Plant description	**Main Works (Number of each equipment)**		
	Phase 1 Demolition	**Phase 2 Earthworks & Piling**	**Phase 3 to Phase 5 Construction (including roads & landscaping)**
Asphalt paver			
Backhoe loader	2	2	1
Bulldozer (CATD8 to CATD10 or similar)	1	2	
Chain saw	2	2	
Compactor (CAT835 or similar)		2	2
Concrete Boom Pump		1	2
Concrete saw	2		
Concrete truck		2	2
Concrete vibrator		2	4
Crawler Crane >200t			1
Delivery Truck		2	
Delivery Truck (incl low loader)			2
Diesel generator	2	2	4
Dump truck	2	2	2
Excavator (>25t)	1	2	
Excavator (<25t)	1		
Excavator hammer	2		
Forklift			2
Front end loader (FEL)		2	2
Grader (CAT14G to CAT16G or similar)		2	1
Hand tools	2	2	4
Manitou			2
Mobile crane (<50t)	1		1
Mobile crane (50t to 200t)			2
Padfoot roller		2	2
Piling rig (bored pile)		2	
Pump	4	2	4

Plant description	Main Works (Number of each equipment)		
	Phase 1 Demolition	Phase 2 Earthworks & Piling	Phase 3 to Phase 5 Construction (including roads & landscaping)
Road profiler			1
Roller		2	2
Scraper		2	
Semi-trailer		2	
Truck and dog (trailer)	2		2
Trucks (water cart)	1	2	1
Vibration roller		2	2

Equipment sound power levels (L_w) have been sourced from AS2436 – 2010 (R2016) [9], BS 5228-1:2009+A1:2014 [10] and Transport for New South Wales 'Construction Noise and Vibration Strategy' (CNVS) [11]. It should be noted that during the different construction stages, it is unlikely that all machinery would be operating at the same time (like the modelling assumes), but taking a 'worst-case' scenario approach helps to identify where noise impacts could be a concern and assists in the design of mitigation measures.

Table 30: Construction scenarios and equipment

Equipment	$L_{Aeq(15\ min)}$ Sound power level (per unit), dB(A)
Asphalt paver	112
Backhoe loader	108
Bulldozer (CATD8 to CATD10 or similar)	114
Chain saw	119[1]
Compactor (CAT835 or similar)	120[1]
Concrete Boom Pump	106
Concrete saw	127[1]
Concrete truck	113
Concrete vibrator	110[1]
Crawler Crane >200t	113
Delivery Truck	107
Delivery Truck (incl low loader)	108
Diesel generator	113
Dump truck	117
Excavator (>25t)	106
Excavator (<25t)	95
Excavator hammer	129[1]

Equipment	$L_{Aeq(15\ min)}$ Sound power level (per unit), dB(A)
Forklift	106
Front end loader (FEL)	115
Grader (CAT14G to CAT16G or similar)	115
Hand tools (pneumatic)	117
Manitou	106
Mobile crane (<50t)	113
Mobile crane (50t to 200t)	113
Padfoot roller	109
Piling rig (bored pile)	111
Pump (water)	100
Road profiler	117
Roller	99
Scraper	116
Semi-trailer	108
Truck and dog (trailer)	108
Trucks (water cart)	108
Vibration roller[1]	117[1]
Note: 1. Includes 5 dB penalty in accordance with the ICNG	

7.3.1 Construction noise impacts

Predicted construction noise levels during and outside standard construction hours are tabulated in Table 31. Noise levels have been compared to the receiver's Noise Management Level and exceedances have been highlighted. It should be noted that in general, construction works are temporary in nature therefore any potential noise impact on the community and the surrounding environment will not be permanent. However, where possible the impacts due to construction noise should be minimised.

Where the predicted $L_{Aeq(15min)}$ noise level is greater than the noise management levels all feasible and reasonable work practices should be applied, however it is unlikely mitigation measures would reduce the received noise levels below the noise management levels.

The magnitude of construction noise impacts is dependent upon a number of aspects including the intensity and location of activities, the type of equipment used, background noise levels during the construction period. Based on these, the predicted construction noise levels are generally conservative and do not represent a constant noise emission that would be experienced by the community on a daily basis throughout the project construction period. The predicted noise levels would only be experienced for limited periods of time when works are occurring and should not be experienced for full daytime, evening or night time periods. It is also emphasised that all the equipment listed in Table 29 is very unlikely to

operate continuously for 15-minutes and concurrently (no adjustment for duration has been made in the predicted construction noise levels).

Table 31: Predicted construction noise levels at sensitive receivers, dB(A)

Rec ID	Receiver type	Predicted Noise Level, $L_{Aeq,15min}$			Noise Affected NMLs – Standard hours $L_{Aeq,15min}$	Highly noise affected NMLs
		Construction Phases				
		Phase 1 Demolition	Phase 2 Earthworks & Piling	Phase 3, 4 and Phase 5 Construction (including roads & landscaping)		
R1	Residential	68	63	63	52	75
R2	Residential	67	63	63	52	75
C1	Commercial	79	74	74	70	-
C2	Commercial	67	63	63	70	-
I1	Industrial	90	86	85	75	-
I2	Industrial	86	82	82	75	-
K1	Child Care	67	63	63	65	-
P1	Passive recreation area	57	52	52	60	-
A1	Active recreation area	64	60	60	65	-

7.3.2 Construction noise and vibration mitigation

Noise mitigation measures for each major construction activity are discussed in the following sections. These mitigation measures are considered to represent all ‘feasible and reasonable’ mitigation measures suitable for implementation during construction of the project. As noted previously, this is a preliminary study, therefore selection of equipment and noise management plan should be implemented by the successful contractor once further information is available.

7.3.3 Construction noise and vibration management plan

For all construction works, the contractor would be expected to prepare a detailed Construction Noise and Vibration Management Plan (CNVMP). This plan should include, but not be limited to the following:

- Roles and responsibilities
- Noise sensitive receiver locations
- Areas of potential impact
- Mitigation strategy
- Monitoring methodology
- Community engagement strategy.

General guidance on the control of construction noise and vibration impacts relevant to this study are discussed in the following sections.

7.3.4 General

In general, practices to reduce construction noise impacts will be required, and may include;

- Adherence to the standard approved working hours as outlined in the Project Approval.
- Manage noise from construction work that might be undertaken outside the recommended standard hours.
- The location of stationary plant (concrete pumps, air-compressors, generators, etc.) as far away as possible from sensitive receivers.
- Using site sheds and other temporary structures or screens to limit noise exposure where possible.
- The appropriate choice of low-noise construction equipment and/or methods
- Modifications to construction equipment or the construction methodology or programme. This may entail programming activities to occur concurrently where a noisy activity will mask a less noisy activity, or, at different times where more than one noisy activity will significantly increase the noise. The programming should also consider the location of the activities due to occur concurrently.
- Carry out consultation with the community and surrounding building owners/occupants during construction including, but not limited to; advance notification of planned activities and expected disruption/effects, construction noise complaints handling procedures.

7.3.5 Universal work practices

The following noise mitigation work practices are recommended to be adopted at all times on site:

- Regularly train workers and contractors (such as at toolbox talks) to use equipment in ways to minimise noise.
- Site managers to periodically check the site and nearby residences for noise problems so that solutions can be quickly applied.
- Avoid the use of radios or stereos outdoors.
- Avoid the overuse of public address systems.
- Avoid shouting and minimise talking loudly and slamming vehicle doors.
- Turn off all plant and equipment when not in use.

7.3.6 Vibration – minimum working distances

Recommended minimum working distances for vibration intensive plant, which are based on international standards and guidance and reproduced in Table 32 for reference. Note that minimum working distance in accordance to the DIN criteria

(for sensitive structure) which is applicable to the WaterNSW Warragamba Pipeline.

Table 32: Recommended minimum working distances for vibration intensive plant

Plant Item	**Rating / Description**	**Minimum working distance**		
		Cosmetic damage (BS 7385)	**Cosmetic damage (3mm/s ppv – DIN 4150-3 sensitive structure)***	**Human response (OH&E Vibration Guideline)**
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5 m	11 m	15 m to 20 m
	< 100 kN (Typically 2-4 tonnes)	6 m	13 m	20 m
	< 200 kN (Typically 4-6 tonnes)	12 m	26 m	40 m
	< 300 kN (Typically 7-13 tonnes)	15 m	31 m	100 m
	> 300 kN (Typically 13-18 tonnes)	20 m	40 m	100 m
	> 300 kN (> 18 tonnes)	25 m	50 m	100 m
Small Hydraulic Hammer	(300 kg - 5 to 12t excavator)	2 m	5 m	7 m
Medium Hydraulic Hammer	(900 kg – 12 to 18t excavator)	7 m	15 m	23 m
Large Hydraulic Hammer	(1600 kg – 18 to 34t excavator)	22 m	44 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	5 m	20 m
Pile Boring	≤ 800 mm	2 m (nominal)	5 m	N/A
Jackhammer	Hand held	1 m (nominal)	3 m	Avoid contact with structure

Note *: Applies to the WaterNSW Warragamba Pipeline

The minimum working distances are indicative only and will vary depending on the item of plant and local geotechnical conditions.

With regard to the WaterNSW Warragamba Pipeline it is located approximately 18 m of the proposed site boundary. Plant and equipment to be used for construction of the project will be chosen carefully to minimise potential vibrations impact in accordance with WaterNSW requirements, with low vibration generating items of excavation plant and equipment chosen such as use of smaller excavator hammers, use of bore piling or CFA piling for piling works.

Furthermore, attended vibration monitoring will be conducted at the beginning of any vibration generating activities to confirm minimum working distances. If

vibration monitoring has established risk of exceedances of the criteria defined in Section 7.2.2.3, extended monitoring will be carried out and equipment selection and/or method of construction will potentially be reviewed. Monitoring for the establishment of minimum working distances shall commence with plant operating well outside the anticipated minimum working distances. Criteria as defined in the 7.2.2.3 will be used during monitoring to comply with WaterNSW guidelines.

7.4 Construction traffic

A mix of vehicles (heavy and light) will be needed to build and service the construction works.

Trucks will be used to remove demolition and construction waste from the site and deliver material to the site.

Construction related traffic is anticipated to access the site via the roads listed in Section 5.2.

Estimated peak and average numbers of additional vehicles travelling on the road network for the construction of the project have been provided by the project team (refer to Chapter 3 Proposal Description of the EIS) and are reproduced in Table 33. Predicted noise increase due to the additional traffic travelling on the road network generated by the construction of the project has been assessed in Table 34 and Table 35.

Table 33: Forecast construction traffic generated by the construction of the proposed development

Additional vehicle movements generated by the construction of the proposed development			
Peak		**Average**	
Heavy vehicles	**Light vehicles**	**Heavy vehicles**	**Light vehicles**
150	800	88	400

Table 34: Predicted noise increase due to the additional traffic travelling on the road network generated by the construction of the project - Peak

Road	**Road Category**	**Current traffic AADT (% heavy vehicles)**	**Additional traffic generated by the development (vehicle movements)**	**% increase of total traffic**	**dB increase**
Old Wallgrove Road	Sub-arterial Road	13,500 (25%)[1]	950	7.0%	0.3
Wallgrove Road	Sub-arterial Road	16,906 (25%)[2]	950	5.6%	0.24
M7	Motorway	70,000 (5%)[3]	950	1.4%	0.06

Note 1: Data from "Archbold Road Upgrade and Extension, Review of Environmental Factors, Volume 1, prepared by WSP and Roads and Maritime Services, dated May 2017

Note 2: AADT year 2008, percentage of heavy vehicles estimated based on percentage of heavy vehicles travelling on Old Wallgrove Road

Note 3: Number of vehicles estimated based on data on M4 from "Archbold Road Upgrade and Extension, Review of Environmental Factors, Volume 1, prepared by WSP and Roads and Maritime Services, dated May 2017

Table 35: Predicted noise increase due to the additional traffic travelling on the road network generated by the construction of the project - Average

Road	**Road Category**	**Current traffic AADT (% heavy vehicles)**	**Additional traffic generated by the development (vehicle movements)**	**% increase of total traffic**	**dB increase**
Old Wallgrove Road	Sub-arterial Road	13,500 (25%)[1]	488	3.6%	0.15
Wallgrove Road	Sub-arterial Road	16,906 (25%)[2]	488	2.9%	0.12
M7	Motorway	70,000 (5%)[3]	488	0.7%	0.03

Note 1: Data from "Archbold Road Upgrade and Extension, Review of Environmental Factors, Volume 1, prepared by WSP and Roads and Maritime Services, dated May 2017

Note 2: AADT year 2008, percentage of heavy vehicles estimated based on percentage of heavy vehicles travelling on Old Wallgrove Road

Note 3: Number of vehicles estimated based on data on M4 from "Archbold Road Upgrade and Extension, Review of Environmental Factors, Volume 1, prepared by WSP and Roads and Maritime Services, dated May 2017

Review of Table 34 and Table 35 indicates that predicted increase in noise levels is below the RNP screening criterion and therefore no further assessment is warranted (Refer to Section 5.1). The predicted increase is negligible and would not be perceived as a noticeable increase in noise.

8 Conclusion

An acoustic assessment has been carried out for the EfW facility in accordance with the SEARs, which included assessment of the noise and vibration impacts from the EfW facility onto the nearby receivers.

The operational assessment showed that while the detailed information regarding plant and equipment is not fully known at this stage, all plant and equipment can be designed to comply with established criteria. It is recommended that a 6 month post commissioning assessment be conducted to confirm alignment with criteria.

The construction assessment showed that while specific activities and work schedules are not yet known, noise management levels might be exceeded, and that mitigation and management measures are expected to be developed further in a formal Construction Noise and Vibration Management Plan, to be prepared prior to commencement of works. The construction assessment identifies that vibration monitoring should be conducted at the Water NSW Warragamba Pipeline.

References

[1] Department of Environment and Climate Change NSW, “Interim Construction Noise Guideline,” Department of Environment and Climate Change NSW, Sydney, 2009.

[2] NSW Environment Protection Authority, “NSW Noise Policy for Industry,” NSW Environment Protection Authority , Sydney, 2017.

[3] NSW Environmental Protection Authority, “NSW Road Noise Policy,” NSW Environmental Protection Authority, Sydney, 2012.

[4] Environment Protection Authority, “Envrionmental Criteria for Road Traffic Noise,” Environment Protection Authority, Sydney, 1999.

[5] Department of Environment and Conservation (NSW), “Assessing Vibration: A technical guideline,” Department of Environment and Conservation (NSW), Sydney, 2006.

[6] Bristish Standard Institution, “BS 7385-2: 1993 Evaluation and measurement for vibration in buildings - Pt 2: Guide to damage levels from groundborne vibration,” Bristish Standard Institution, London, 1993.

[7] Deustsches Institut fur Normung, “DIN4150-3 (2016) Vibrations in buildings - Part 3: Effects on structures, English translation,” DIN-Normen, Berlin, 2016.

[8] WaterNSW, “Guidelines for Development Adjacent to the Upper Canal and Warragamba Pipelines v3,” WaterNSW, Sydney, 2020.

[9] Standards Australia, “AS2436-2010 (R2016) Guide to noise and vibration control on construction, demolition and maintenance sites,” Standards Australia (AS), Sydney, 2016.

[10] British Standards Institution, “BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Noise,” British Standards Institution (BSI), London, 2014.

[11] Transport for New South Wales, “ ST-157/4.1 Construction Noise and Vibration Strategy,” Transport for New South Wales (TfNSW), Sydney, 2019.

Appendix A

Unattended Noise Monitoring

A1 Noise monitoring equipment

Unattended monitoring was carried out using the following equipment:

Measurement location	Equipment/model	Serial No.	SLM Type
ML1	ARL Ngara	878061	Type 1

Notes:

All meters comply with AS IEC 61672.1 2004 “Electroacoustics - Sound Level Meters” and designated either Type 1 as per table, and are suitable for field use.

The equipment was calibrated prior and subsequent to the measurement period using a Bruel & Kjaer Type 4231 calibrator. No significant drift in calibration was observed.

A2 Extraneous/weather affected data

Measurement samples affected by extraneous noise, wind (greater than 5m/s) or rain were excluded from the recorded data in accordance with the procedures outlined in the NSW Noise Policy for Industry (NPfI).

Data provided by the Bureau of Meteorology (BOM), for the nearest representative weather station (Horsley Park Equestrian Centre) to noise monitoring location. Wind speed data was adjusted to account for the difference in measurement height and surrounding environment between the BOM weather station (measured 10 m above ground) and the microphone location based on Table C.1 of ISO 4354:2009 '*Wind actions on structures*'.

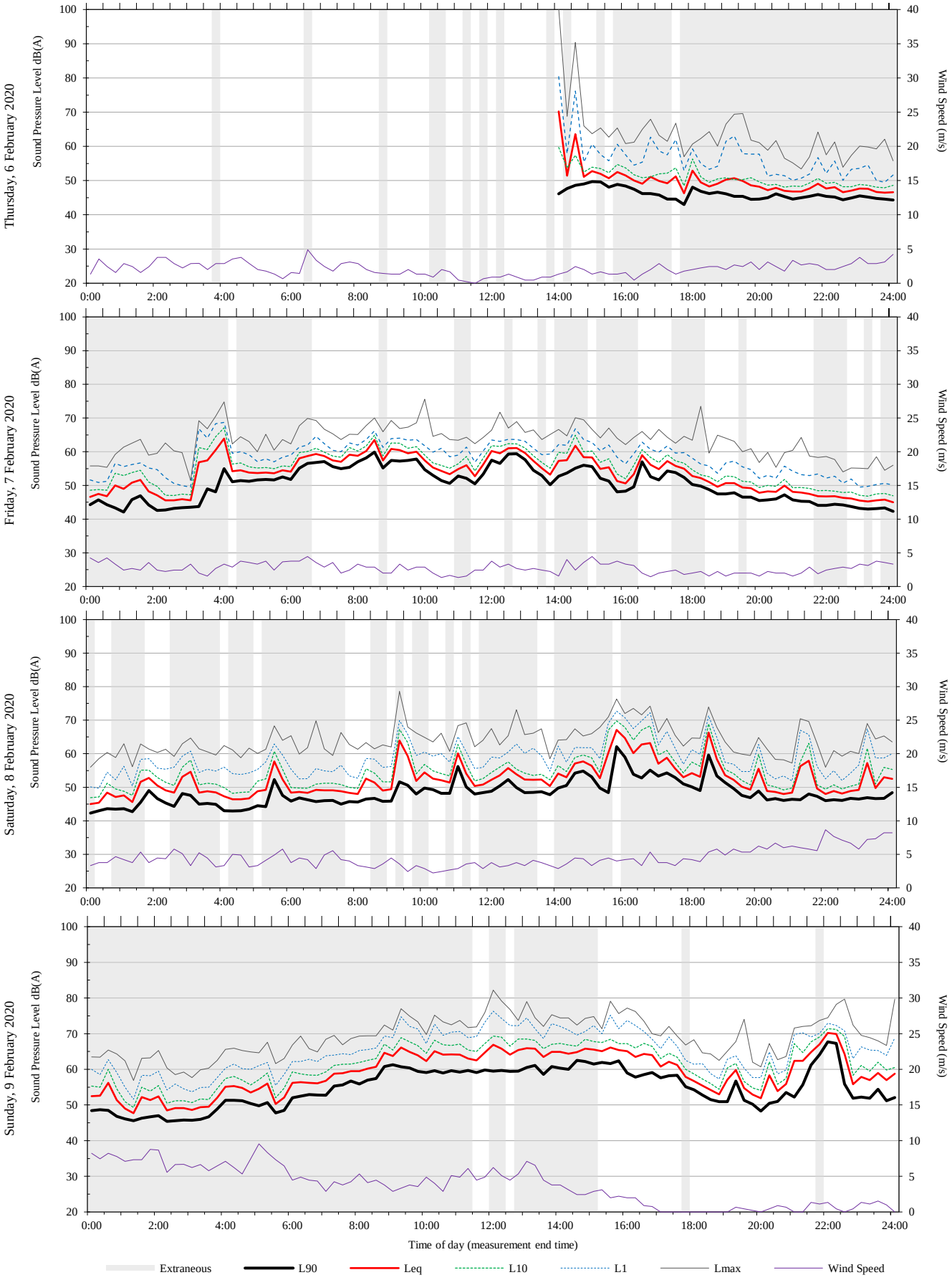
A3 Logger graphs

The following noise level vs time graphs present overall dB(A) levels recorded by the unattended logger(s) for a range of noise descriptors, including L_{Aeq}, L_{A90}, L_{A10} and L_{Amax}. While line graphs are presented, sampling is typically at 15-minute intervals.

Wind speeds are also shown where relevant, and periods of excluded data are shaded grey.

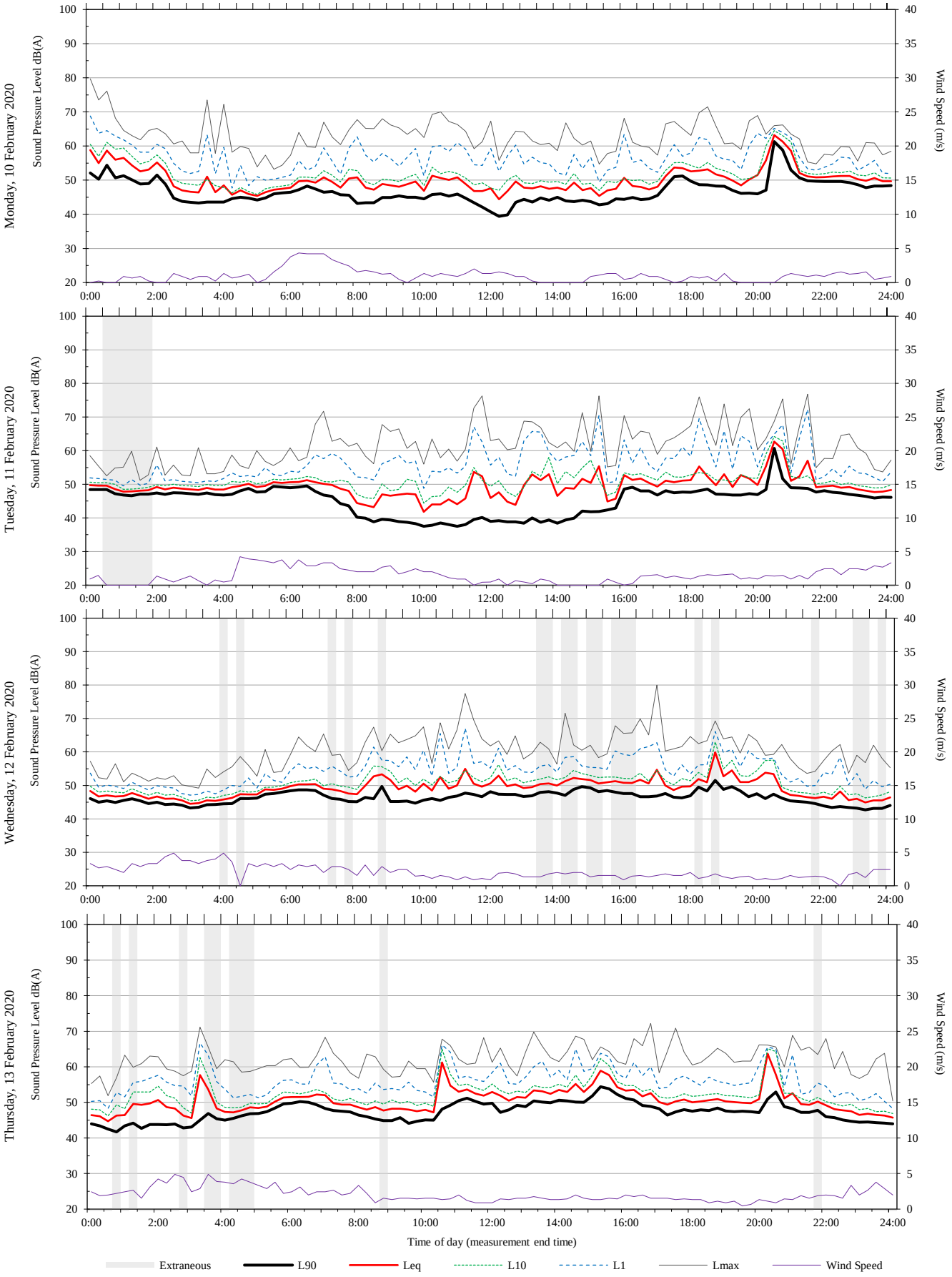
Unattended monitoring: Burley Rd., Horsley Park, NSW 2175 (Free Field)

ARUP



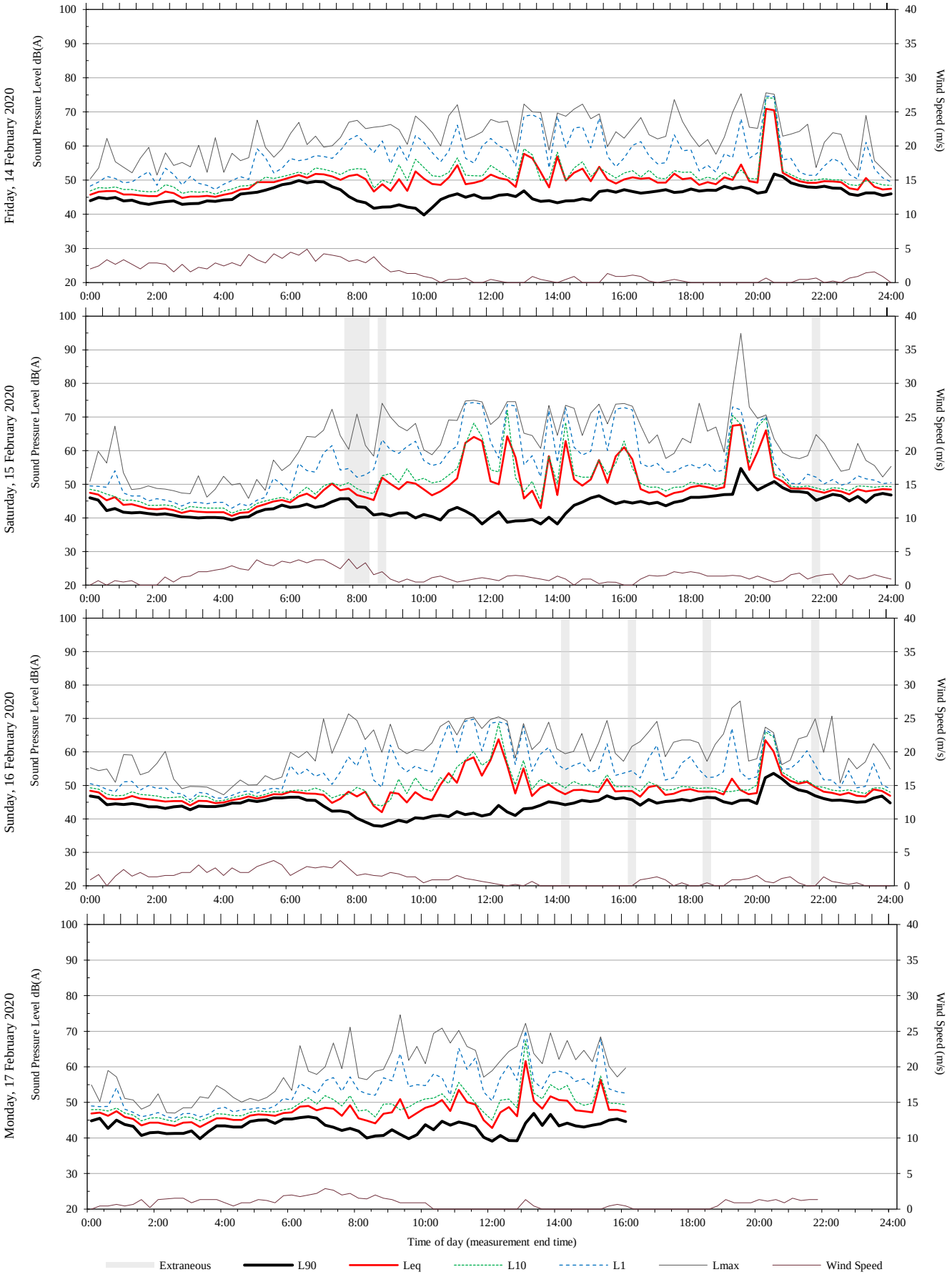
Unattended monitoring: Burley Rd., Horsley Park, NSW 2175 (Free Field)

ARUP



Unattended monitoring: Burley Rd., Horsley Park, NSW 2175 (Free Field)

ARUP



Appendix B

Operational traffic data

Table B1.1: Indicative Breakdown of heavy and light vehicles throughout the day

Hour starting	**Total number of trucks (two-ways trips)[1]**	**Total number of light vehicles movements (one-way trip)[2]**	**Estimated breakdown of heavy trucks for assessment purpose – per hour**					
			Waste (residual)		**IBA trucks (residuals)**	**FGTr trucks (residuals)**	**Lime/ activated Carbone/ Ammonia /Diesel /Sodium Hydroxide (consumables)**	**Recycled materials**
			20t	**7t**	**20t**	**20t**	**20t**	**20t**
0:00	0	0	0	0	0			
1:00	0	0	0	0	0			
2:00	0	0	0	0	0			
3:00	0	0	0	0	0			
4:00	8	0	2	5	1			
5:00	**18**	0	4	11	1	1	1	
6:00	14	0	3	9	1			1
7:00	8	7.5	2	5	1			
8:00	2	15	0	1	0			1
9:00	23	9.5	5	15	2		1	
10:00	20	5	4	13	1	1	1	
11:00	14	5	3	9	1			1
12:00	**29**	5	6	18	2	1	2	
13:00	20	5	5	13	2			
14:00	19	5	4	12	2		1	
15:00	8	5	2	5	1			
16:00	5	9.5	2	3	0			
17:00	0	17	0	0	0			
18:00	0	7.5	0	0	0			
19:00	0	0	0	0	0			
20:00	0	0	0	0	0			
21:00	0	0	0	0	0			
22:00	0	0	0	0	0			
23:00	0	0	0	0	0			
Total	**188** (equivalent to 376 truck movements)	**96**	**42**	**119**	**15**	**3**	**6**	**3**

Notes:

In blue – night-time

In yellow – daytime

In green – evening

In bold – peak night-time and daytime

1. Assuming trucks coming in and out within the hour
2. Assuming employees coming in in the morning and out during the late afternoon

Appendix C

Operational sound level data

C1 Sound levels used in noise model

Table C1.1: Internal sound pressure levels within buildings

Item	Broadband $dBL_{Aeq15minute)}$	Octave Band Centre Frequency Hz (dB)							
		63	125	250	500	1 k	2 k	4 k	8 k
A1 - Reception Hall	85	92	84	83	81	81	77	71	65
B1 - Waste bunker	80	87	79	78	76	76	72	66	60
B2 - Waste bunker	85	92	84	83	81	81	77	71	65
B3 - Waste bunker (Ash Bunker)	80	87	79	78	76	76	72	66	60
C1 - Boiler Hall	80	83	80	81	77	74	71	68	63
C2 - Boiler Hall	85	88	85	86	82	79	76	73	68
D1 - FGT hall	85	84	81	81	78	82	77	75	66

Table C1.2 External building surface – Sound power per unit area – L_w/m^2

Building	Façade	Surface	Surface area (m^2)	Broadband $dBL_{Aeq(15minute)^2}$	Octave Band Centre Frequency Hz $(dB)^2$							
					63	125	250	500	1 k	2 k	4 k	8 k
A1 - Reception Hall	East	Walls	859	34	46	36	40	30	22	10	0	0
A1 - Reception Hall	East	Opening for trucks	20	79	86	78	77	75	75	71	65	59
A1 - Reception Hall	North	Walls	1230	34	46	36	40	30	22	10	0	0
A1 - Reception Hall	Roof	Roof	3491	63	77	66	62	60	59	51	42	36
A1 - Reception Hall	West	Walls	851	34	46	36	40	30	22	10	0	0
A1 - Reception Hall	West	Opening for trucks	31	79	86	78	77	75	75	71	65	59
B1 B3 - Waste bunker	East	Walls	297	48	66	53	52	42	40	36	30	24

Building	Façade	Surface	Surface area (m^2)	Broadband $dBL_{Aeq(15minute)}$[2]	Octave Band Centre Frequency Hz (dB)[2]							
					63	125	250	500	1 k	2 k	4 k	8 k
B1 B3 - Waste bunker	North	Walls	2079	48	66	53	52	42	40	36	30	24
B1 B3 - Waste bunker	Roof	Roof	3992	58	72	61	57	55	54	46	37	31
B1 B3 - Waste bunker	South	Walls	351	48	66	53	52	42	40	36	30	24
B1 B3 - Waste bunker	West	Walls	1562	48	66	53	52	42	40	36	30	24
B2 - Waste bunker	East	Walls	674	53	71	58	57	47	45	41	35	29
B2 - Waste bunker	East	Opening for trucks	26	79	86	78	77	75	75	71	65	59
B2 - Waste bunker	North	Walls	1508	53	71	58	57	47	45	41	35	29
B2 - Waste bunker	Roof	Roof	1252	63	77	66	62	60	59	51	42	36
B2 - Waste bunker	West	Walls	1011	53	71	58	57	47	45	41	35	29
B2 - Waste bunker	West	Opening for trucks	25	79	86	78	77	75	75	71	65	59
B3 - Waste bunker (Ash Bunker)	East	Walls	768	48	66	53	52	42	40	36	30	24
B3 - Waste bunker (Ash Bunker)	North	Walls	206	48	66	53	52	42	40	36	30	24
B3 - Waste bunker (Ash Bunker)	North	Opening for trucks	28	74	81	73	72	70	70	66	60	54
B3 - Waste bunker (Ash Bunker)	South	Walls	207	48	66	53	52	42	40	36	30	24
B3 - Waste bunker (Ash Bunker)	South	Opening for trucks	28	74	81	73	72	70	70	66	60	54
C1 - Boiler Hall	Roof	Roof	1112	58	68	62	60	56	52	45	39	34
C1 - Boiler Hall	South	Walls	1221	49	62	54	55	43	38	35	32	27
C1 - Boiler Hall	West	Walls	1468	49	62	54	55	43	38	35	32	27

Building	Façade	Surface	Surface area (m^2)	Broadband $dBL_{Aeq(15minute)}$[2]	Octave Band Centre Frequency Hz (dB)[2]							
					63	125	250	500	1 k	2 k	4 k	8 k
C1 - Boiler Hall	West	Louvres	367	74	77	74	75	71	68	65	62	57
C2 - Boiler Hall	East	Walls	1385	54	67	59	60	48	43	40	37	32
C2 - Boiler Hall	East	Louvres	332	79	82	79	80	76	73	70	67	62
C2 - Boiler Hall	East	Opening for trucks	43	79	82	79	80	76	73	70	67	62
C2 - Boiler Hall	Roof	Roof	1116	63	73	67	65	61	57	50	44	39
C2 - Boiler Hall	South	Walls	1224	54	67	59	60	48	43	40	37	32
D1 - FGT hall	East	Walls	2724	51	63	55	55	44	46	41	39	30
D1 - FGT hall	East	Opening for trucks	63	79	78	75	75	72	76	71	69	60
D1 - FGT hall	East	Louvres	310	79	78	75	75	72	76	71	69	60
D1 - FGT hall	Roof	Roof	3876	62	69	63	60	57	60	51	46	37
D1 - FGT hall	South	Walls	2864	51	63	55	55	44	46	41	39	30
D1 - FGT hall	South	Opening for trucks	20	79	78	75	75	72	76	71	69	60
D1 - FGT hall	West	Walls	2771	51	63	55	55	44	46	41	39	30
D1 - FGT hall	West	Opening for trucks	20	79	78	75	75	72	76	71	69	60
D1 - FGT hall	West	Louvres	310	79	78	75	75	72	76	71	69	60

Notes:

1. Refer to Building identification in Figure 3.
2. Noise levels take into account transmission loss of elements (Refer to Table 11)

Table C1.3: Sound Power Levels used in the model – others

Item	Quantity	Location	Broadband $dBL_{Aeq(15minute)}$	Octave Band Centre Frequency Hz (dB)							
				63	125	250	500	1 k	2 k	4 k	8 k
Exhaust stack flue	2	Exhaust stack, south end of EfW facility	80	89	87	79	77	74	72	64	59
Air cooled condenser (ACC)	12	Outside facility buildings, eastern side	95	90	100	94	92	90	85	77	77
Component coolers (bank of 8 fans)	10	Roof of Waste Bunker	89	88	88	88	85	84	82	78	73
Condensation Pump	1	Below ACCs	71	81	71	67	62	65	65	63	59
Substation	1	Outside facility buildings, south eastern corner	86	86	98	78	69	63	60	53	86