Appendix S

Noise and vibration assessment

Woodlawn Advanced Energy Recovery Centre

Noise and Vibration Assessment

Prepared for Veolia Environmental Services (Australia) Pty Ltd

October 2022

Woodlawn Advanced Energy Recovery Centre

Noise and Vibration Assessment

Veolia Environmental Services (Australia) Pty Ltd

J200931 RP5

October 2022

Version	Date	Prepared by	Approved by	Comments
4	11 July 2022	Carl Fokkema	Najah Ishac	
5	5 October 2022	Carl Fokkema	Najah Ishac	

Approved by

Najah Ishac
Director - Acoustic
5 October 2022

Ground floor 20 Chandos Street
St Leonards NSW 2065
PO Box 21
St Leonards NSW 1590

Executive Summary

Veolia Environmental Services (Australia) Pty Ltd (Veolia) owns and operates the Woodlawn Eco Precinct (the Eco Precinct), located on Collector Road, approximately 6 kilometres (km) west of Tarago, approximately 50 km south of Goulburn and 70 km north of Canberra. The Eco Precinct is located in the Goulburn Mulwaree local government area (LGA). The Eco Precinct has provided sustainable and innovative waste management services since 2004.

Veolia proposes to develop and operate the Woodlawn Advanced Energy Recovery Centre (ARC) (the project), an energy recovery facility (ERF), at the Eco Precinct. This involves the development of an additional waste management technology at the Eco Precinct, treating a portion of the residual waste stream which is already approved to be received as part of integrated waste management operations, and recovering energy from the process.

The purpose of this noise and vibration impact assessment (NVIA) is to determine the extent of construction and operational noise and vibration impacts associated with the development and operation of the project on existing noise-sensitive assessment locations in the area; as well as recommending mitigation measures to be implemented during construction and operation of the project.

The existing acoustic environment is discussed in Section 3 of this report and includes existing background noise level measurements. However the noise measurement data was not considered valid and minimum background noise thresholds outlined in the NSW Noise Policy for Industry (NPfI) were conservatively adopted.

Noise source inputs for the operation of the project (including the key ARC elements) were largely based on information provided by Veolia for a similar facility located in Staffordshire, England (the reference facility) with further specific information from Veolia to encompass support operations including IBA area and APCr encapsulation cell. Additional data for source noise levels was established through EMM measurement of plant and equipment at the Woodlawn Eco Precinct, and EMM's database of similar equipment, Department of Environment, Food and Rural Affairs (DEFRA) 2005, *Update of Noise Database for Prediction of Noise on Construction and Open Sites*, manufacturer data and other equivalent facilities.

Noise modelling has predicted that operational noise contributions from the project satisfy the project noise trigger levels (PNTL's) for all assessment locations, whilst the noise contours confirm noise levels at Tarago village of $L_{Aeq,15min}$ <30dB.

Assessment of potential sleep disturbance from operation of the project has confirmed compliance for all residential assessment locations in terms of L_{Amax} 52 dB and $L_{Aeq,15min}$ 40 dB under the procedures of the NPfI. No additional mitigation measures are required.

With respect to cumulative noise level emissions, the assessment (Section 6.1.2) confirms that the operation of the project will not result in an increase in cumulative noise levels at the closest and most exposed assessment locations.

The EPA's NSW ICNG requires that construction noise levels are assessed against noise management levels (NMLs). Compliance with NMLs has been predicted for all assessment locations considering the potential for 24/7 construction activities. No noise exceedances of $L_{Aeq,15min}$ or L_{Amax} are predicted for any privately owned residence.

Based on existing traffic volumes on Collector Road and Bungendore Road and projected construction and operational traffic, the relative traffic noise increase criteria (+2 dB) are predicted to be satisfied and comply with the NSW Road Noise Policy (RNP) baseline criteria. No additional mitigation is required.

TABLE OF CONTENTS

Appendices

Tables

Figures

1 Introduction

1.1 Background

Veolia Environmental Services (Australia) Pty Ltd (Veolia) owns and operates the Woodlawn Eco Precinct (the Eco Precinct), located on Collector Road, approximately 6 kilometres (km) west of Tarago, approximately 50 km south of Goulburn and 70 km north of Canberra. The Eco Precinct is located in the Goulburn Mulwaree local government area (LGA). The Eco Precinct has provided sustainable and innovative waste management services since 2004.

The Eco Precinct comprises the following integrated waste management operations, energy recovery technologies and energy generation, and other sustainable land uses, including the following:

- Woodlawn Bioreactor (the Bioreactor) – a putrescible residual waste landfill in which leachate is recirculated to help bacteria break down the waste, enhancing the early generation, capture and extraction of landfill gas, including leachate and landfill gas management systems.
- Woodlawn BioEnergy Power Station – utilises landfill gas from the Bioreactor to generate electricity.
- Woodlawn Mechanical Biological Treatment (MBT) Facility – extracts the organic content from a portion of the municipal solid waste (MSW) for use in tailings dam remediation.
- Agriculture – includes a working farm that applies sustainable management practices.
- Aquaculture and horticulture – use of captured waste heat from the BioEnergy Power Station for use in sustainable fish farming and hydroponic horticulture at the Eco Precinct.
- Renewable energy generation – the Woodlawn Wind Farm (operated by Iberdrola) which has an installed capacity to generate up to 48.3 MW of clean energy, and a solar farm with installed capacity to produce up to 2.3 MW of clean energy.

The Eco Precinct is served by the Crisps Creek Intermodal Facility (IMF) near the village of Tarago. Crisps Creek IMF is located approximately 8.5 km to the east of the Eco Precinct (by road). Operations are augmented by two waste transfer terminals located in Sydney; the Clyde Transfer Terminal, which commenced operation in 2004 with the Bioreactor and Crisps Creek IMF, and the Banksmeadow Transfer Terminal, which commenced operating in 2016.

Waste is transported from the Sydney transfer terminals in purpose-built shipping containers by rail on the Goulburn-Bombala Railway line to the Crisps Creek IMF from the Eco Precinct. At the Crisps Creek IMF the containers are loaded on to trucks for delivery to the Eco Precinct. Regional waste is also approved to be transported to the Eco Precinct by road.

Veolia proposes to develop and operate the Woodlawn Advanced Energy Recovery Centre (ARC) (the project), an energy recovery facility (ERF), at the Eco Precinct. This involves the development of an additional waste management technology at the Eco Precinct, treating a portion of the residual waste stream which is already approved to be received as part of integrated waste management operations, and recovering energy from the process. The project is classified as a State significant development (SSD) under the *Environmental Planning and Assessment Act 1979* (EP&A Act) in accordance with clauses 20 and 23 of Schedule 1 of *State Environmental Planning Policy (Planning Systems) 2021*. The applicant for the project is Veolia.

1.2 The site

The Eco Precinct is located on Collector Road, approximately 6 km west of the village of Tarago, and 50 km south of Goulburn, NSW. The Eco Precinct includes operational areas used for waste management, energy generation and mining, as well as primary production including sustainable agriculture, aquaculture and horticulture.

The land use zoning of the Eco Precinct under the Goulburn Mulwaree LEP is predominantly IN3 Heavy Industrial, which includes the majority of the waste management, energy generation and mining activities, with the balance zoned RU2 Rural Landscape. Land immediately to the north and south is zoned RU2 Rural Landscape, land to the west is zoned RU1 Primary Production, and land to east, which incorporates the village of Tarago, is zoned a combination of RU5 Village, RU6 Transitional, RU1 Primary Production and E3 Environmental Management.

Land immediately surrounding the operational areas of the Eco Precinct is owned by Veolia, providing a buffer between operations and surrounding private properties.

1.3 Purpose of this report

The purpose of this noise and vibration impact assessment (NVIA) is to determine the extent of construction and operational noise and vibration impacts associated with the development and operation of the project on existing noise-sensitive assessment locations in the area; as well as recommending mitigation measures to be implemented during construction and operation of the project.

1.4 SEARs

This report has been prepared to address the SEARs (SSD-21184278) for the project, issued by DPIE on 2 July 2021. The requirements that are relevant to noise and vibration, and where they have been addressed in this report, are summarised in Table 1.1.

Table 1.1 Summary of SEARs for noise and vibration

Key issue	Requirements	Section(s) of this report where the requirement is addressed
Noise and Vibration	A quantitative noise and vibration impact assessment undertaken by a suitably qualified acoustic consultant in accordance with the relevant EPA guidelines and Australian Standards which includes:	
	1. the identification of impacts associated with construction, site emission and traffic generation at noise affected sensitive receivers, including the provision of operational noise contours and a detailed sleep disturbance assessment;	Section 6
	2. details of noise monitoring survey, background noise levels, noise source inventory and 'worst case' noise emission scenarios;	Section 3
	3. consideration of annoying characteristics of noise and prevailing meteorological conditions in the study area;	Section 5.2.2
	4. a cumulative impact assessment inclusive of impacts from existing site operations and other nearby developments; and	Section 6.1.2
	5. details and analysis of the effectiveness of proposed management and mitigation measures to adequately manage identified impacts, including a clear identification of residual noise and vibration following application of mitigation these measures and details of any proposed compliance monitoring programs.	Section 7

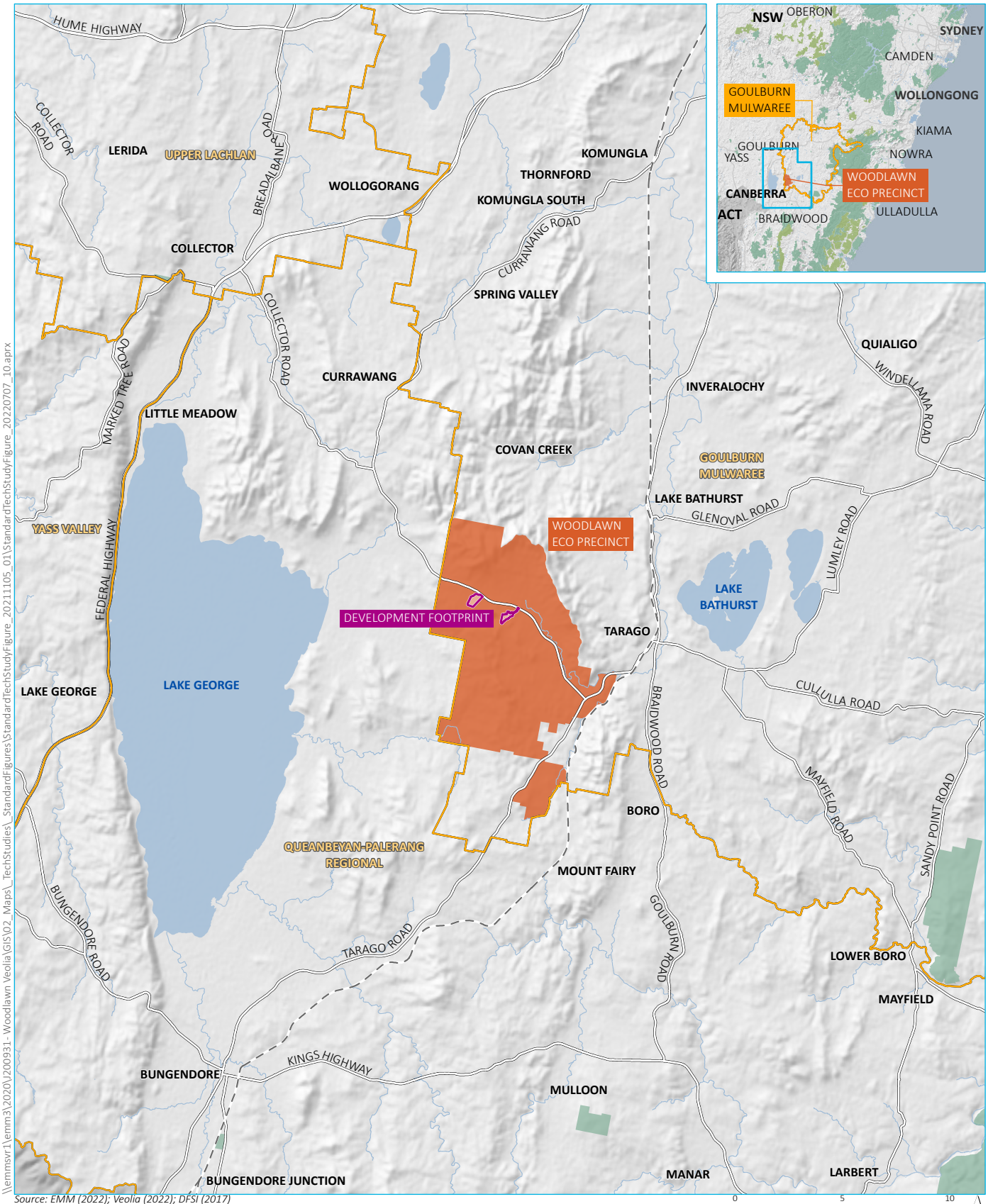
1.5 Background information

This NVIA has relied on additional background information in terms of noise and vibration relating to the existing Woodlawn Eco Precinct facilities (including Woodlawn Mine) for the cumulative noise assessment and information relating to similar ERF operations including:

- EMM (2022a) *Woodlawn Advanced Energy Recovery Centre, Traffic Impact Assessment,* prepared by EMM Consulting Pty Ltd for Veolia Environmental Services (Australia) Pty Ltd dated July 2022;
- Parsons Brinckerhoff (2012) *Environmental Assessment. TriAusMin Woodlawn Project*, Report 2162477B Revision D dated 4 April 2012;
- SLR global environmental solutions (2013) Woodlawn Mechanical Biological Treatment Facility, Noise and Vibration Impact Assessment, Report Number 610.12876R3 Revision 0; and
- SOL acoustics (2020) *Waste Energy Power Partners Ltd, Tunstall, Stoke-on-Trent, Environmental Noise Impact Assessment*, Report No P1855-REP01-REV D-BDH dated 6 February 2020.

Specific information has been sourced from the reference facility located in Staffordshire, United Kingdom to inform the noise assessment and was extracted from the following sources:

- Hepworth Acoustics (2020) *Veolia Energy Recovery Facility, Four Ashes, Staffordshire. Compliance Noise Monitoring Survey*, Report No P15-197-R43v1 dated October 2020;
- Enviros Consulting (2008) on behalf of Staffordshire County Council *Staffordshire County Council, Project W2R, Provision of a Residual Waste Treatment Facility. Environmental Statement* Reference ST0070013x dated May 2008; and
- Scott Wilson Limited (2010) *Project W2R: Development of an Energy Recovery Facility at the Dell, Four Ashes, Staffordshire. Environmental Statement* Rev 01 dated August 2010 Volume 1: Main Text and Appendix 11.4: Noise Modelling and Data Inputs.



\\emmsvr1\emm3\2020\J200931- Woodlawn Veolia\GIS\02_Maps_TechStudies_StandardFigures\StandardTechStudyFigure_20211105_01\StandardTechStudyFigure_20220707_10.aprx

Source: EMM (2022); Veolia (2022); DFSI (2017)

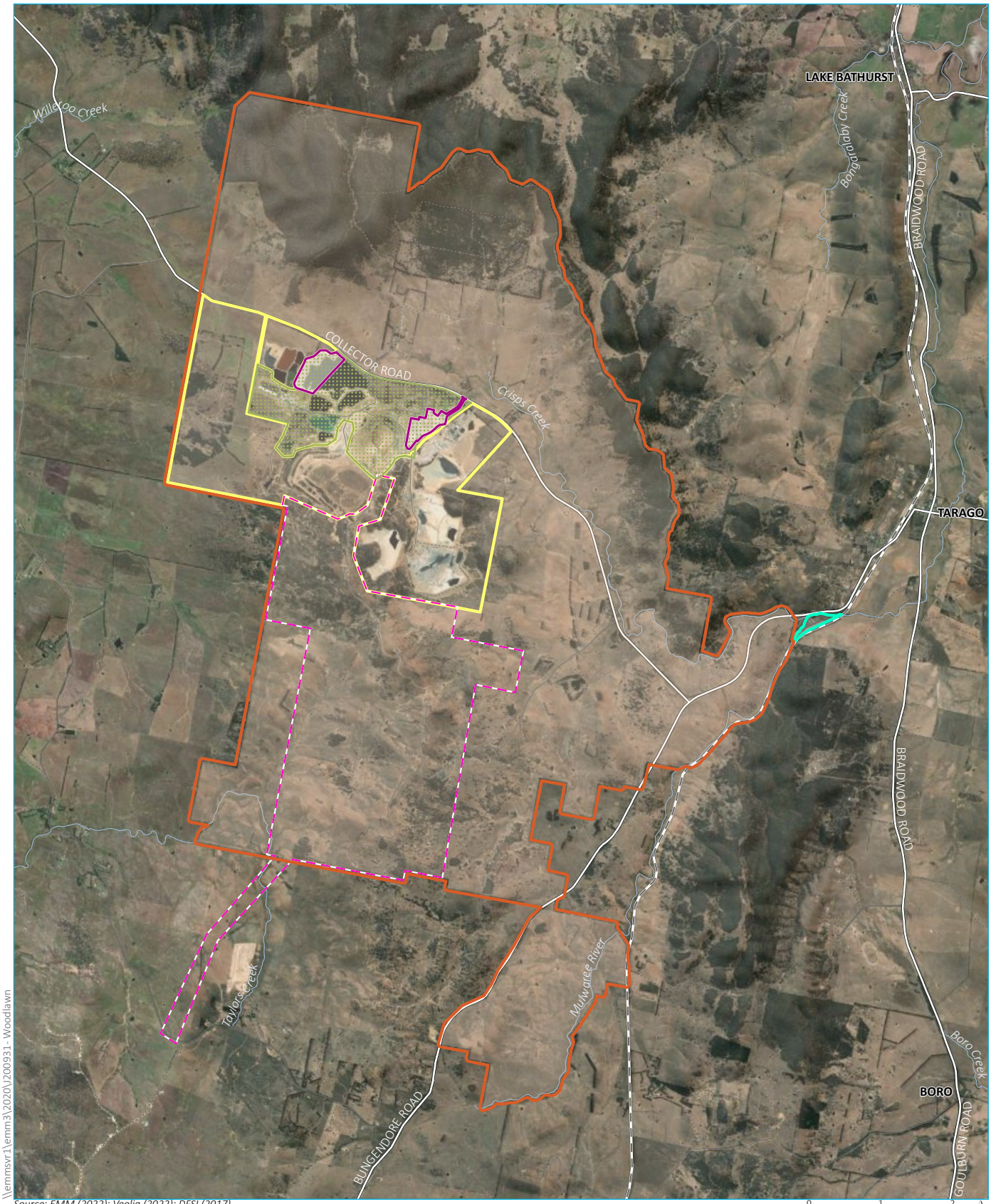
KEY

- Development footprint
- Woodlawn Eco Precinct
- Rail line
- Major road
- Watercourse
- Named waterbody
- NPWS reserve
- Local government area

Regional context

Woodlawn Advanced Energy Recovery Centre
Noise and vibration impact assessment
Figure 1.1

EMM
creating opportunities



\\emmsvr1\emm3\2020\J200931- Woodlawn

Source: EMM (2022); Veolia (2022); DFSI (2017)

0 1 2 km

GDA 1994 MGA Zone 55

N

KEY

- Development footprint
- Veolia integrated waste management operations
- Woodlawn Eco Precinct
- Crisps Creek Intermodal Facility (IMF)
- Woodlawn Mine operations area
- Woodlawn Wind Farm
- Rail line
- Major road
- Minor road
- Vehicular track
- Watercourse

Local context

Woodlawn Advanced Energy Recovery Centre
Noise and vibration impact assessment
Figure 1.2

EMM
creating opportunities

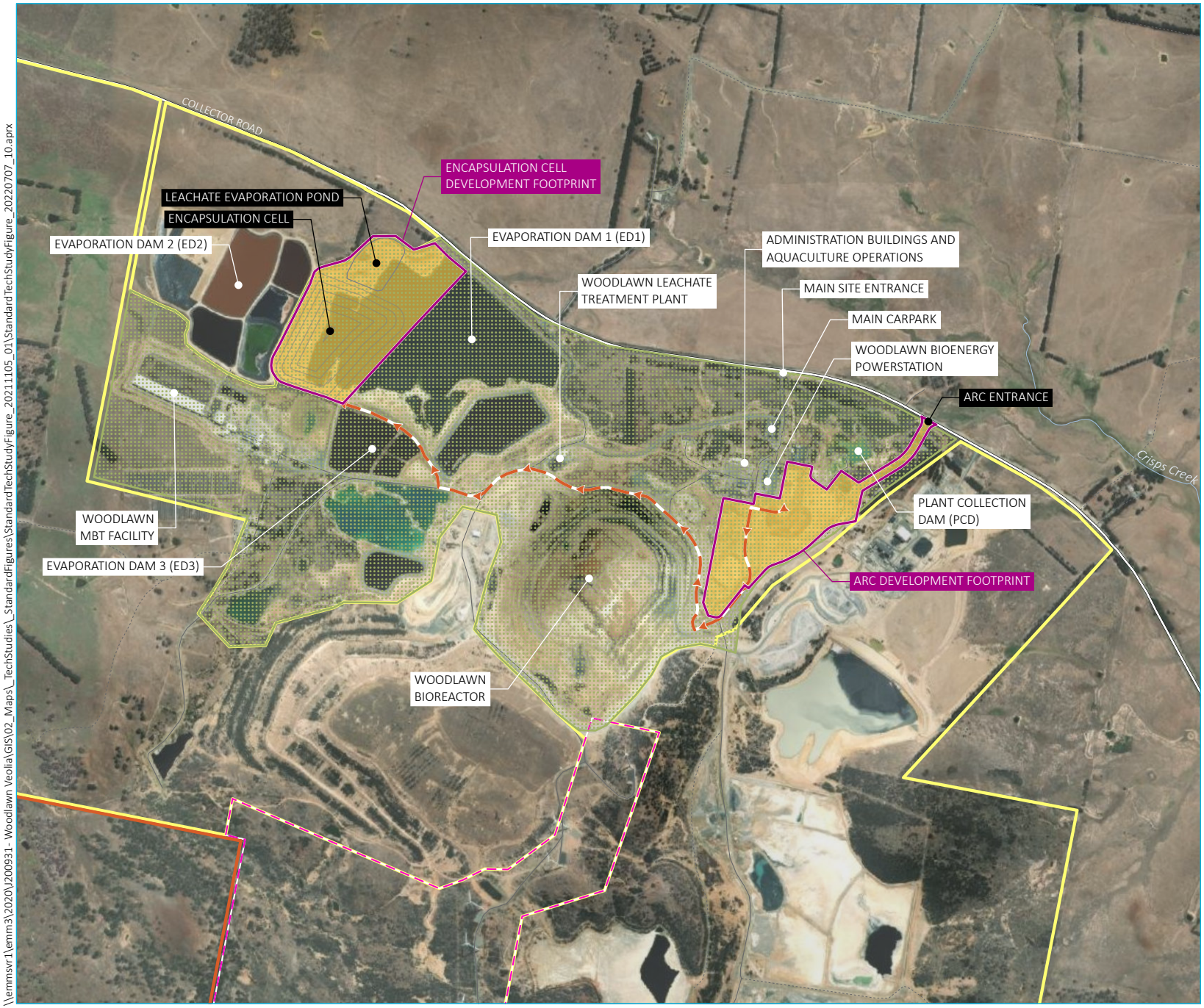
2 The Project

2.1 Project overview

The project will involve construction and operation of the following key components comprising the ARC:

- development of the ARC, comprising an ERF for the thermal treatment of residual MSW and commercial and industrial (C&I) waste (the residual waste feedstock) that will otherwise be disposed of to landfill;
- thermal treatment in the ARC of approximately 380,000 tonnes per annum (tpa) of the residual waste feedstock;
- recovery of approximately 30 megawatts (MW) of electrical energy;
- on-site management of residual by-products generated by the ARC; and
- ancillary development of site infrastructure to facilitate construction and operation of the project.

The proposed project layout is shown in Figure 2.1.



KEY

- Development footprint
- Veolia integrated waste management operations
- Woodlawn Eco Precinct
- Woodlawn Mine operations area
- Woodlawn Wind Farm
- APCr transport route
- Major road
- Minor road
- Vehicular track
- Watercourse

\\emmsvr1\emm3\2020\200931 - Woodlawn Veolia\GIS\02_Maps_TechStudies_StandardFigures\StandardTechStudyFigure_20211105_01\StandardTechStudyFigure_20220707_10.aprx

Source: EMM (2022); Veolia (2022); DFSI (2017)

0 250 500 m
GDA 1994 MGA Zone 55

N

Project layout

Woodlawn Advanced Energy Recovery Centre
Noise and vibration impact assessment
Figure 2.1

EMM
creating opportunities

3 Existing acoustic environment

This chapter identifies the noise and vibration assessment locations; and presents the measured background noise levels from unattended noise logging measurements completed, adopting the methodology described below.

3.1 Noise and vibration assessment locations

Review of aerial photography, site inspections and previous noise investigations of the Eco Precinct has identified more than eighty residential dwellings located within 15 km of the project. The nearest representative noise sensitive locations to the project have been identified for the purpose of assessing potential noise and vibration impacts from previous noise investigations of existing site operations. The nearest noise sensitive locations to the project were selected to represent the range and extent of potential noise impacts. Details are provided in Table 3.1 and their locations are shown in Figure 3.1. They are referred to in this report as 'assessment locations'.

Table 3.1 Noise assessment locations

ID	Assessment location	Classification	Distance to ARC building (m)	Easting	Northing
R1*	'Woodlawn Farm'	Residential	1100	734518	6118363
R2*	'Cowley Hills'	Residential	1100	736673	6117689
R3*	'Pylara'	Residential	3500	737493	6114373
R4	'Torokina'	Residential	4150	731287	6114653
R5	'Willeroo'	Residential	5800	730260	6120684
IN6	Woodlawn Mine Administration Offices	Industrial	350	735539	6117298

* Veolia owned

3.2 Background noise survey methodology and results

Previous noise studies have been conducted for the site to assess various aspects of the site operations. In almost all cases the previous assessments and compliance audits have confirmed that ambient background noise levels at assessment locations not owned or associated with Veolia operations were below the minimum thresholds as outlined in the NSW Noise Policy for Industry (NPfI). Notwithstanding the previous site investigations and considering the last long-term monitoring was conducted over ten years ago, unattended noise surveys and operator-attended aural observations were conducted for the project at selected monitoring locations in August 2021 as guided by the NPfI and procedures described in Australian Standard AS 1055-1997 – *Acoustics – Description and Measurement of Environmental Noise*.

Noise monitoring was conducted at three key locations considered to be representative of the noise level range likely to be experienced by residential assessment locations in the vicinity of the project. The noise logger locations were selected after inspection of the project and its surrounds, giving due consideration to other noise sources, which may influence the readings (eg domestic air-conditioners, pumps and other residential noise sources), the proximity of assessment locations to the project, security issues for the noise monitoring device and gaining permission for access from the residents or landowners. Due to Covid-19 NSW Health advice and internal work health and safety requirements, the Veolia team were utilised to assist in the deployment of noise loggers.

The monitoring locations selected are presented in Table 3.2 and shown in Figure 3.1.

Table 3.2 Noise monitoring locations

Dates	ID	Address	Instrumentation
6 September 2021 to 13 September 2021	NM1	'Torokina' [1] 1120 Taylors Creek Road, Tarago	ARL NGARA (S/N 878127)
	NM2	'Willeroo' 1197-1235 Collector Road, Tarago	ARL NGARA (S/N 878127)
	NM3	'Woodlawn Farm' 694 Collector Road, Tarago	ARL NGARA (S/N 878138)

1. Measured on common boundary with equivalent offset to Eco Precinct – See Figure 3.1

The noise loggers were programmed to record statistical noise level indices continuously in 15-minute intervals, including the L_{Amax}, L_{A1}, L_{A10}, L_{A50}, L_{A90}, L_{A99}, L_{Amin} and the L_{Aeq}. Calibration of all instrumentation was checked prior to and following monitoring. All equipment carried appropriate and current National Association of Testing Authorities (NATA) (or manufacturer) calibration certificates.

Due to equipment failure limited data was recovered from the noise loggers deployed at NM2 and NM3, and no data was salvageable. The only valid data was obtained from NM1 with six days of data recorded some of which was significantly weather affected. Ambient noise was influence by natural elements including birdlife, insects, wind in foliage and limited if any human activity. This is inconsequential to the assessment given the that the final background noise levels adopted are considered representative for the area at the NPfI minimum threshold levels.

A summary of existing background and ambient noise levels is given in Table 3.3. Results are provided for NM1 in Appendix A.

Table 3.3 Summary of existing background and ambient noise

Monitoring location	Period[1]	Rating background level (RBL), dBA	Measured $L_{Aeq, period}$ noise level[2], dBA
NM1 – Torokina[3]	Day	35[4]	53
	Evening	30	38
	Night	30[4]	35

1. Day: 7.00 am to 6.00 pm Monday to Saturday; 8.00 am to 6.00 pm Sundays and public holidays; Evening: 6.00 pm to 10.00 pm; Night: 10.00 pm to 7.00 am, Sunday to Friday and 10.00 pm to 8.00 am Saturday and public holidays.
2. The energy averaged noise level over the measurement period and representative of general ambient noise.
3. Measured on common boundary of Pylara Farm with equivalent offset to Eco Precinct – See Figure 3.1.
4. Where noise level is less than the minimum threshold of NPfI, the minimum thresholds should apply.

In the absence of sufficient extended noise monitoring data for all monitoring locations, impacts of weather affected data and consistent with assessment of noise from previous work for the Eco Precinct and Woodlawn Mine, this assessment has conservatively adopted the minimum thresholds outlined within the NPfI for the project, specifically:

- day 35 dB;
- evening 30 dB; and

- night 30 dB.

Follow up site inspection and audit measurements were conducted during the day on 4 April 2022 with Woodlawn Eco Precinct operating under normal conditions. Attended audit measurements were conducted at four key assessment locations identified and are summarised in Table 3.4.

Table 3.4 Attended noise measurements – sensitive assessment locations

Monitoring location	Time Period (Day)	Background level, L_{A90}, dB	Measured $L_{Aeq, period}$ noise level[2], dB	Observations
R1 – Woodlawn Farm	2.43 pm – 2.58 pm	34	40	Birds in trees, insects, traffic on Collector Road. Campaigned crushing activities north of Bioreactor clearly audible
R2 – Cowley Hills	2.23 pm – 2.38 pm	33	52	Trucks and traffic on Collector Road, birds in pen of residence and insects. Woodlawn Eco Precinct inaudible
R4 – Torokina*	9.22 am – 9.37 am	33	37	Natural elements, birds, insects, sheep, distant plane. Woodlawn Eco Precinct inaudible
R5 – Willeroo	3.15 pm – 3.30 pm	31	38	Local farm activities, birds in trees, insects. Woodlawn Eco Precinct inaudible

* Measured on common boundary of Pylara Farm with equivalent offset to Eco Precinct – See Figure 3.1

The results of the site attended measurements confirmed that the operations of the Woodlawn Eco Precinct were audible at R1, with a confirmed L_{Aeq} noise contribution of 40dB from campaigned crushing activities. These discrete activities were utilised to calibrate the noise model.

Noise from the Woodlawn Eco Precinct was inaudible at R2, R4 and R5 with noise contributions <30dB, and would be <30dB at all other private residential assessment locations.

\\emmsvr1\emm3\2020\J200931- Woodlawn Veolia\GIS\02_Maps_TechStudies\Noise\NoiseVibrationImpactAssessment_20210727_01\NoiseVibrationImpactAssessment_20220712_06.aprx

Source: EMM (2022); VEOLIA (2022); DFSI (2017)

0 1 2 km

GDA 1994 MGA Zone 55

N

KEY

- Development footprint
- Noise assessment location
- Noise monitoring location
- Veolia integrated waste management operations
- Woodlawn Eco Precinct
- Crisps Creek Intermodal Facility (IMF)
- Woodlawn Mine operations area
- Woodlawn Wind Farm
- Rail line
- Major road
- Minor road
- Vehicular track
- Watercourse
- Cadastral boundary

Noise monitoring and assessment locations

Woodlawn Advanced Energy Recovery Centre
Noise and vibration impact assessment
Figure 3.1

EMM
creating opportunities

3.3 Meteorology

The *Noise Policy for Industry* (NPfI) (EPA 2017) requires assessment of noise under standard and noise enhancing weather conditions. The NPfI defines these as follows:

- Standard meteorological conditions: defined by stability categories A through to D with wind speeds up to 0.5 metres per second (m/s) at 10 m above ground level (AGL) for day, evening and night periods.

- Noise-enhancing meteorological condition: defined by stability categories A through to D with light winds (up to 3 m/s at 10 m AGL) for the day and evening periods; and stability categories A through to D with light winds (up to 3 m/s at 10 m AGL) and/or stability category F with winds up to 2 m/s at 10 m AGL for night time periods.

The NPfI specifies the following two options to consider meteorological effects:

1. adopt the noise-enhancing meteorological conditions for all assessment periods for noise impact assessment purposes without an assessment of how often these conditions occur – a conservative approach that considers source-to-receiver wind vectors for all assessment locations and F class temperature inversions with wind speeds up to 2 m/s at night; or

2. determine the significance of noise-enhancing conditions. This involves assessing the significance of temperature inversions (F and G class stability categories) for the night-time period and the significance of light winds up to and including 3 m/s for all assessment periods during stability categories other than E, F or G. Significance is based on a threshold of occurrence of 30% determined in accordance with the provisions in this policy. Where noise-enhancing meteorological conditions occur for less than 30% of the time, standard meteorological conditions may be adopted for the assessment.

This assessment has assumed that noise enhancing weather conditions are a feature of the area consistent with previous noise studies.

Historic modelling and assessment of noise from activities within the Woodlawn Eco Precinct were previously conducted using the CONCAWE noise prediction algorithm within SoundPLAN.

Considering the historic noise modelling for the site, the assessment has adopted CONCAWE noise prediction algorithm within SoundPLAN for assessing noise impacts from the ARC.

4 Assessment criteria

This chapter presents the construction and operational noise assessment criteria established for the project and in accordance with the Noise Policy for Industry (NPfI), NSW Road Noise Policy (RNP), and the Interim Construction Noise Guidelines (ICNG).

4.1 Operational noise

4.1.1 Environment Protection Licences

The Eco Precinct is currently licensed by the Environment Protection Authority (EPA) under the following environmental protection licences (EPLs):

- EPL 11436: Woodlawn landfill including: waste disposal (application to land); and
- EPL 20476: Woodlawn mechanical biological treatment (MBT) facility including: composting, resource recovery, and waste storage.

Specifically for noise from the Bioreactor, the following limit (EPL 11436) is imposed:

> **L4 Noise Limits**
>
> L4.1 Noise from the premises must not exceed 35 dB(A) LAeq (15 minute) at the most affected residential receiver.
>
> Where LAeq means the equivalent continuous noise level – the level of noise equivalent to the energy-average of noise levels occurring over the measurement period.

For noise from the MBT, the following limit (EPL 20476) is imposed:

> **L4 Noise Limits**
>
> L4.1 Noise from the premises must not exceed 40 dB(A) LAeq (15 minute) at Torokina and Wileroo.

4.1.2 Noise Policy for Industry

Operational noise associated with the project will principally be from fixed plant and equipment including cooling systems, fans, pumps and mobile plant and equipment, including road trucks. The principal fixed plant and equipment and unloading of waste containers will be conducted wholly within the proposed ARC building. Additional activities associated with the project include the IBA area, and APCr encapsulation cell that will operate during daytime hours only.

Noise from development in NSW is regulated by the local council, Department of Planning and Environment (DPE) and/or the EPA, and sites generally have a licence and/or development consent conditions stipulating noise limits. These limits are typically derived from project specific trigger or operational noise levels predicted at assessment locations. They are based on EPA guidelines (eg NPfI) or noise levels that can be achieved by a specific site following the application of all reasonable and feasible noise mitigation.

The objectives of noise trigger levels established in accordance with the NPfI are to protect the community from excessive intrusive noise and preserve amenity for specific land uses. It should be noted that the audibility of a noise source does not necessarily equate to disturbance at an assessment location.

To ensure these objectives are met, the EPA provides project specific noise trigger levels, namely intrusiveness and amenity.

i Intrusiveness noise levels

The NPfI intrusiveness noise triggers require that $L_{Aeq,15min}$ noise levels (energy average noise level over a 15-minute period) from the project do not exceed the rated background level (RBL) by more than 5 dB during the relevant operational periods. The intrusiveness noise levels are only applicable at residential assessment locations.

Table 4.1 presents the intrusiveness noise levels determined for the project based on the adopted RBLs. Where assessment locations have been grouped together in the following tables, it is expected that the ambient noise environment at these assessment locations is similar.

Table 4.1 Project intrusiveness noise levels

Residential assessment location	Assessment period[1]	Adopted RBL, dBA	Project intrusiveness noise level (RBL + 5 dB), $L_{Aeq,15min}$, dB
R1 – R5	Day	35	40
	Evening	30	35
	Night	30	35

1. Day: 7.00 am to 6.00 pm Monday to Saturday; 8.00 am to 6.00 pm Sundays and public holidays; Evening: 6.00 pm to 10.00 pm; 6.00 am to 7.00 am Monday to Saturday, 6.00 am to 8.00 am Sundays and public holidays; night: remaining periods.

ii Amenity noise levels

The assessment of amenity is based on noise levels specific to the land use. The noise levels relate only to industrial noise and exclude road or rail traffic noise. Where the measured existing industrial noise approaches recommended amenity noise levels, it needs to be demonstrated that noise levels from new developments will not contribute to existing industrial noise such that amenity noise levels are exceeded.

To ensure that industrial noise levels ('existing' Eco Precinct plus the 'new' project) remain within the recommended amenity noise levels for an area, the project amenity noise level for a new industrial development is the recommended amenity noise level (outlined in Table 2.2 of the NPfI) minus 5 dB. It is noted that this approach is based on a receiver being impacted by multiple industrial sites (or noise sources).

Residential areas potentially affected by the project's operational noise are located to the north, east, south and west of the project. The project amenity noise levels for the identified assessment locations are presented in Table 4.2 based on a rural noise amenity area. The NPfI defines rural as an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic noise and generally characterised by low background noise levels. Settlement patterns would be typically sparse. Notwithstanding, R1 Woodlawn Farm and R2 Cowley Hills are exposed to existing industrial noise from the Eco Precinct including the Woodlawn Mine as outlined in Section 6.1.1.

Table 4.2 Project amenity noise levels

Assessment location	Time period[1]	Indicative area	Project amenity noise level[2] dB, $L_{Aeq,period}$
R1 – R5	Day	Rural	45 (50–5)
	Evening		40 (45–5)
	Night		35 (40–5)
IN6	When in use	Industrial	65 (70–5)

Source: NPfI (EPA 2017)

1. Day: 7.00 am to 6.00 pm Monday to Saturday; 8.00 am to 6.00 pm Sundays and public holidays; evening: 6.00 pm to 10.00 pm; night: 10.00 pm to 7.00 am Monday to Saturday; 10.00 pm to 8.00 am Sundays and public holidays.
2. Project amenity noise level is Amenity noise level (Table 2.2 of NPfI) -5 dB in accordance with NPfI Section 2.4.2.

iii Project noise trigger level

The project noise trigger level (PNTL) is the lower of the calculated intrusiveness or amenity noise levels. Taking account of the measured background noise levels, project intrusive noise levels and project amenity levels for residential assessment locations, a summary of the PNTLs for the assessment of noise from the project operations is presented in Table 4.3.

Table 4.3 Project noise trigger levels

Assessment location	Assessment period[1]	Intrusiveness noise level, $L_{Aeq,15min}$, dB	Amenity noise level[2], $L_{Aeq,15min}$, dB	PNTL[3], $L_{Aeq,15min}$, dB
R1 – R5	Day	40	48	40
	Evening	35	43	35
	Night	35	38	35
IN6	When in use	n/a	68	68

Notes: 1. Day: 7.00 am to 6.00 pm Monday to Saturday; 8.00 am to 6.00 pm Sundays and public holidays; evening: 6.00 pm to 10.00 pm; 6.00 am to 7.00 am Monday to Saturday, 6.00 am to 8.00 am Sundays and public holidays; night: remaining periods.

2. Project amenity $L_{Aeq,15min}$ noise level is the recommended amenity noise level $L_{Aeq,period}$ +3 dB as per the NPfI.

3. PNTL is the lower of the calculated intrusiveness or amenity noise levels.

iv Sleep disturbance

The NPfI suggests that a detailed maximum noise level event assessment should be undertaken where operation or construction night-time noise levels at a residential location exceed screening levels of:

- $L_{Aeq,15\ minute}$ 40 dB or the prevailing RBL plus 5 dB (whichever is the greater); and/or
- L_{Amax} 52 dB or the prevailing RBL plus 15 dB (whichever is the greater).

Guidance regarding potential for sleep disturbance is also provided in the RNP. The RNP calls upon numerous studies that have been conducted into the effect of maximum noise levels on sleep. The RNP acknowledges that, at the current (2011) level of understanding, it is not possible to establish absolute noise level criteria that will correlate to an acceptable level of sleep disturbance.

Additional information is outlined in *WHO* [World Health Organization] *Night Noise Guidelines for Europe* (WHO 2009) and the *Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Effects on Sleep* (Basner and McGuire 2018). Further guidance is also provided in the NSW RNP with reference to enHealth "as a rule for planning for short-term or transient noise events, for good sleep over 8 hours the indoor sound pressure level measured as a maximum instantaneous value should not exceed approximately 45 dB(A) L_{Amax} more than 10 or 15 times per night". It is commonly accepted by acoustic practitioners and regulatory bodies (ie EPA) that a facade including a partially open window will reduce external noise levels by 10 dB. Therefore, external noise levels in the order of 55 dB calculated at the facade of a residence is unlikely to impact sleep according to the RNP.

If noise levels over the screening criteria are identified, then additional analysis will consider factors such as:

- how often the events will occur;
- the time the events will occur;
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods); and
- current scientific literature available regarding the impact of maximum noise level events at night.

Table 4.4 provides the noise level event screening criteria for the residential assessment locations.

Table 4.4 Sleep disturbance screening criteria at residences

Assessment location	Adopted night RBL, dB	Night-time maximum noise level event screening criteria, dB	
		$L_{Aeq,15\ minute}$	L_{Amax}
R1 – R5	30	40	52

4.1.3 Mitigating noise

Where noise levels above the PNTLs are predicted, all feasible and reasonable mitigation are to be considered for the project to reduce noise levels towards the PNTLs, before any residual impacts are determined and addressed.

The significance of the residual noise impacts is generally based around the human perception to changes in noise levels as explained in the glossary of the acoustic terms. For example, a change in noise level of 1 to 2 dB is typically indiscernible to the human ear. The characterisation of a residual noise impact of 0 to 2 dB above the PNTL is therefore considered negligible. The NPfI characterisation of residual noise impact is outlined further in Table 4.5.

Table 4.5 Significance of residual noise impacts

If the predicted noise level minus the project noise trigger level is:	And the total cumulative industrial noise level is:	Then the significance of the residual noise level is:
≤2 dB	Not applicable	Negligible
≥3 but ≤5 dB	Less than recommended amenity noise level; or Greater than recommended amenity noise level, but the increase in total cumulative industrial noise level resulting from development is ≤1 dB.	Marginal
≥ 3 but ≤5 dB	Greater than recommended amenity noise level and the increase in total cumulative industrial noise level resulting from the development is >1 dB.	Moderate
>5 dB	Less than or equal to recommended amenity noise level.	Moderate
>5 dB	Greater than recommended amenity noise level.	Significant

Source: NPfI (NSW Government, 2017)

4.2 Construction noise

The *Interim Construction Noise Guideline* (ICNG) (DECC 2009) has been jointly developed by NSW Government agencies, including the NSW Environment Protection Authority (EPA) and Department of Planning (DoP) (now DPIE). The objectives of the guideline relevant to the planning process are to promote a clear understanding of ways to identify and minimise noise from construction and to identify 'feasible' and 'reasonable' work practices. The guideline recommends standard construction hours where noise from construction activities is audible at residential premises (ie assessment locations), as follows:

- Monday to Friday 7.00 am to 6.00 pm;
- Saturday 8.00 am to 1.00 pm; and
- no construction work is to take place on Sundays or public holidays.

The ICNG acknowledges that works outside standard hours may be necessary, however, justification should be provided to the relevant authorities.

The ICNG provides two methodologies to assess construction noise emissions. The first is a quantitative approach, which is suited to major construction projects with typical durations of more than three weeks. This method requires noise emission predictions from construction activities at the nearest assessment locations and assessment against ICNG recommended noise levels.

The second is a qualitative approach, which is a simplified assessment process that relies more on noise management strategies. This method is suited to short-term infrastructure and maintenance projects of less than three weeks.

This assessment has adopted a quantitative approach. The qualitative aspects of the assessment include identification of assessment locations, description of works involved including predicted noise levels and proposed management measures that include a complaints handling procedure.

4.2.1 Construction noise management levels - residents

Table 4.6 provides ICNG noise management levels (NML) which apply to residential assessment locations.

Table 4.6 ICNG construction noise management levels for residences

Time of day	NML $L_{Aeq,15min}$	Application
Recommended standard hours: Monday to Friday 7.00 am to 6.00 pm, Saturday 8.00 am to 1.00 pm, no work on Sundays or public holidays	Noise-affected RBL + 10 dB	The noise-affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{eq(15\text{-}min)}$ 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 dBA	The highly noise-affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); and 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise-affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dBA 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.

Source: ICNG (EPA, 2009).

4.2.2 Construction noise management levels – other noise sensitive land uses

Table 4.7 summarises the ICNG recommendations and provides NML for other land uses.

Table 4.7 ICNG noise levels at other land uses

Land use	Management level, $L_{Aeq,15\ minute}$
Industrial premises	External noise level 75 dB (when in use)
Offices, retail outlets	External noise level 70 dB (when in use)
Hotels[1]	External noise level 65 dB (7 am to 10 pm) 60 dB (10 pm to 7 am)
Classrooms at schools and other educational institutions	Internal noise level 45 dB (when in use)
Hospital wards and operating theatres	Internal noise level 45 dB (when in use)
Places of worship	Internal noise level 45 dB (when in use)
Active recreation areas	External noise level 65 dB (when in use)
Passive recreation areas	External noise level 60 dB (when in use)

Source: ICNG (DECC 2009).

1. NML based on AS2017 recommend maximum internal noise level and the premise that windows and doors for such development would typically remain closed, providing 20 dB of outdoor to indoor construction noise level reduction.

4.2.3 Project specific construction noise management levels

The project construction NMLs for recommended standard and out of hour periods are presented in Table 4.8 for all assessment locations. Construction activities associated with the project have been assessed based on 24 hours per day, seven days a week over approximately three years.

Table 4.8 Construction noise management levels – all assessment locations

Assessment location	Period	Adopted RBL[1]	NML $L_{Aeq,15min}$, dB
R1 – R5	Day (standard ICNG hours)	35	45
	Day (OOH)	35	40
	Evening (OOH)	30	35
	Night (OOH)	30	35
IN6	When in use	n/a	70

2. The RBLs adopted from Table 3.3.

4.3 Construction vibration

4.3.1 Human perception of vibration

Humans can detect vibration levels which are well below those causing any risk of damage to a building or its contents.

The actual perception of motion or vibration may not in itself be disturbing or annoying. An individual's response to that perception, and whether the vibration is "normal" or "abnormal", depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

Human tactile perception of random motion, as distinct from human comfort considerations, was investigated by Diekmann and subsequently updated in German Standard DIN 4150 Part 2 1999. On this basis, the resulting degrees of perception for humans are suggested by the vibration level categories given in Table 4.9.

Table 4.9 suggests that people will just be able to feel floor vibration at levels of approximately 0.15 millimetres per second (mm/s) and that the motion becomes "noticeable" at a level of approximately 1 mm/s.

Table 4.9 Peak vibration levels and human perception of motion

Approximate vibration level	Degree of perception
0.10 mm/s	Not felt
0.15 mm/s	Threshold of perception
0.35 mm/s	Barely noticeable
1 mm/s	Noticeable
2.2 mm/s	Easily noticeable
6 mm/s	Strongly noticeable
14 mm/s	Very strongly noticeable

Note: These approximate vibration levels (in floors of building) are for vibration having a frequency content in the range of 8 Hertz (Hz) to 80 Hz.

4.3.2 Assessing vibration - a technical guideline

Environmental Noise Management – Assessing Vibration: a technical guideline (DEC 2006) (the guideline) is based on BS 6472 – 2008, Evaluation of human exposure to vibration in buildings (1–80 Hz).

The guideline presents preferred and maximum vibration values for the use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended that the operator negotiate directly with the affected community.

The guideline defines three vibration types and provides direction for assessing and evaluating the applicable criteria. Table 2.1 of the guideline provides examples of the three vibration types and has been reproduced in Table 4.10.

Table 4.10 Examples of types of vibration

Continuous vibration	Impulsive vibration	Intermittent vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).	Infrequent: Activities that create up to three distinct vibration events in an assessment period, eg occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZEC (1990).	Trains, intermittent nearby 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 these would be assessed against impulsive vibration criteria.

Continuous vibration associated with compaction of road base for new site access road and hard stand areas is most relevant to the construction of the ARC.

Intermittent vibration (as defined in Section 2.1 of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time. Intermittent vibration is representative of heavy vehicle pass-bys and construction activities such as impact hammering, rolling or general excavation work.

Section 2.4 of the guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted rms (root mean square) acceleration levels over the frequency range 1 Hz to 80 Hz.

To calculate VDV the following formula is used (refer to Section 2.4.1 of the guideline):

$$VDV = \left[\int_0^T a^4(t)dt\right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, *a (t)* is the frequency-weighted rms of acceleration in m/s^2 and *T* is the total period of the day (in seconds) during which vibration may occur.

The acceptable VDV for intermittent vibration are reproduced in Table 4.11.

Table 4.11 Acceptable vibration dose values for intermittent vibration

Location	Daytime		Night time	
	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$
Critical areas	0.10	0.20	0.10	0.20
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 7.00 am to 10.00 pm and night time is 10.00 pm to 7.00 am.
2. These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The guideline recommends that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

4.3.3 Structural vibration

i Australian Standard AS 2187.2 – 2006

In terms of the most recent relevant vibration damage criteria, Australian Standard AS 2187.2 – 2006 *Explosives* – Storage *and Use - Use of Explosives* recommends that the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings Part 2* be used as they are "applicable to Australian conditions".

The standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (eg compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to manage minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 4.12 and graphically in Figure 4.1.

Table 4.12 Transient vibration guide values - minimal risk of cosmetic damage

Line[1]	Type of Building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s	50 mm/s
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Notes: Refers to the "Line" in Figure 4.1

The standard notes that the guide values in Table 4.12 relate predominantly to transient vibration which does not give rise to resonant responses in structures and 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 4.12 may need to be reduced by up to 50%.

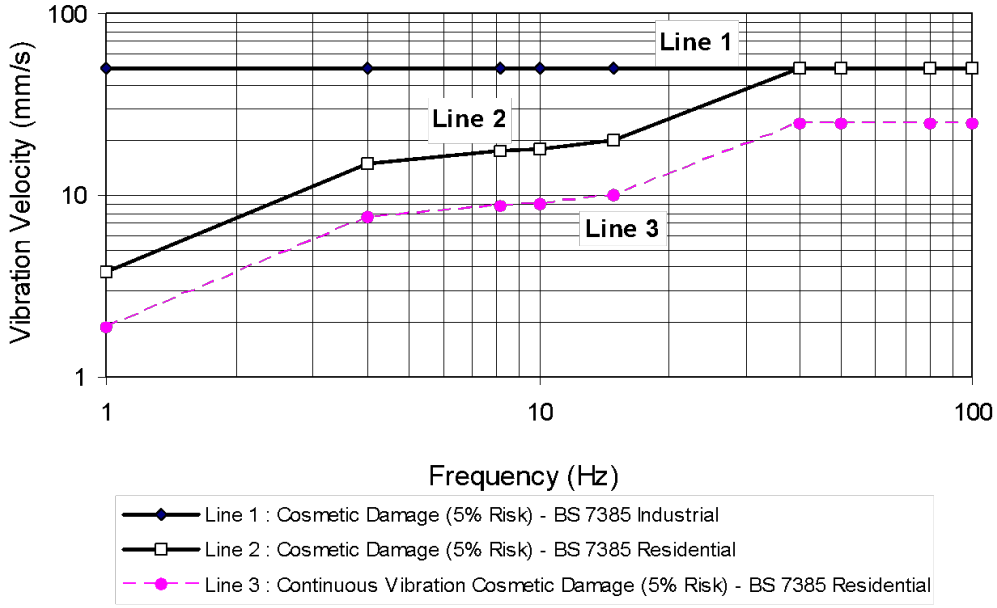


Figure 4.1 Graph of transient vibration guide values for cosmetic damage

In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for building types corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz (as shown in Figure 4.1).

Fatigue considerations are also addressed in the Standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the guide values in Table 4.12 should not be reduced for fatigue considerations.

In order to assess the likelihood of cosmetic damage due to vibration, AS2187 specifies that vibration measurements should be undertaken at the base of the building and the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) should be compared with the criteria curves presented in Table 4.12.

It is noteworthy that in addition to the guide values nominated in Table 4.12 the Standard states that:

> Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. This is not inconsistent with an extensive review of the case history information available in the UK.

4.4 Road traffic noise

Construction and operational traffic require assessment for potential noise impacts. The principal guidance to assess the impact of the road traffic noise on assessment locations is in the *NSW Road Noise Policy* (RNP) (EPA 2011) Table 4.13 presents the road noise assessment criteria for residential land uses (ie assessment locations), reproduced from Table 3 of the RNP for road categories relevant to construction and use of the project. Under the definitions of the NSW RNP, Collector Road and Bungendore Road will be sub-arterial roads.

Table 4.13 Road traffic noise assessment criteria for residential land uses

Road category	Type of project/development	Assessment criteria – dBA	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Freeway/arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeway/arterial/sub-arterial roads generated by land use developments.	$L_{eq,15hr}$ 60 (external)	$L_{eq,9hr}$ 55 (external)

Additionally, the RNP states that where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to an increase of up to 2 dB.

In addition to meeting the assessment criteria in Table 4.13 any significant increase in total traffic noise at the relevant residential assessment locations must be considered. Residential assessment locations experiencing increases in total traffic noise levels above those presented in Table 4.14 should be considered for mitigation.

Table 4.14 Road traffic relative increase criteria for residential land uses

Road category	Type of project/development	Total traffic noise level increase – dBA	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Freeway/arterial/ sub-arterial roads and transit ways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road.	Existing traffic $L_{eq(15\text{-}hr)}$+12 dB (external)	Existing traffic $L_{eq(9\text{-}hr)}$+ 12 dB (external)

Appendix B of the RNP, states that noise levels shall be rounded to the nearest integer, whilst difference between two noise levels are to be rounded to a single decimal place.

5 Noise assessment approach

5.1 Overview

This section presents the methods and base parameters used to model operational and construction noise and vibration emissions from the operation of the project. It also considers the cumulative impact of the Eco Precinct approved operations (including Woodlawn Mine).

Operational and construction noise levels were predicted using the CONCAWE algorithm as implemented within SoundPLAN. This algorithm is accepted by the EPA. Features which affect the predicted noise level that are considered in the noise modelling include:

- equipment sound power levels and locations;
- screening from structures;
- receiver locations;
- ground topography;
- noise attenuation due to geometric spreading;
- ground absorption; and
- atmospheric absorption.

The model was populated with 3-D topography of the project and surrounding area, extending past the nearest assessment locations. The model adopted concrete hardstand around the ARC buildings and IBA pad area with an absorption coefficient of 0.2 and grassland for remaining areas with absorption coefficients of 0.2 and 0.7 respectively. Plant and equipment representing the range of proposed operation and construction scenarios was modelled at locations representing the worst-case noise levels for assessment locations.

Existing noise emissions for the assessment of cumulative noise from the Eco Precinct (Bioreactor and MBT) were adopted from site attended measurements (refer to Section 5.2.2) in addition to the noise emissions extracted from previous noise studies prepared for the Eco Precinct (including mining operations at the Woodlawn Mine) and included:

- SLR global environmental solutions (2013) Woodlawn Mechanical Biological Treatment Facility, Noise and Vibration Impact Assessment, Report Number 610.12876R3 Revision 0; and
- Parsons Brinckerhoff (2012) *Environmental Assessment. TriAusMin Woodlawn Project*, Report 2162477B Revision D dated 4 April 2012.

While mining operations ceased in the late 1990s, the rights to Special Mining Lease (SML) 20, were transferred to another operator under an agreement with Veolia to determine responsibilities for the site management and rehabilitation. Mining operations at the Eco Precinct were approved and commenced in 2013 for the area covered by SML 20. Mining operations went into care and maintenance in early 2020, and the operator went into voluntary administration in July 2021.

5.2 Operational noise

The acoustic assessment of the project has been based on the concept layout (Figure 2.1), plant and equipment (Table 5.5) principally located within the ARC building with only external plant being the air cooled condensers on the northern side of the ARC building and peak hour truck movements outlined in the TIA (EMM, 2022a).

The following hours of operation will occur at the project:

- operating hours for the ARC: 24 hours per day, seven days per week;
- operating hours for the IBA area including processing and maturation and the APCr encapsulation cell: 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday and public holidays;
- annual shutdowns for maintenance will occur for approximately three weeks each year; and
- receival of residual waste feedstock at the ARC: in accordance with existing approvals, 6.00 am–10.00 pm Monday to Saturday.

5.2.1 The ARC design

The assessment of noise emissions from within the ARC building assumes the following based on construction and design adopted for the Four Ashes Energy Recovery Facility (ERF) at Staffordshire (Scott Wilson 2010), specifically:

- Wall cladding comprising Kingspan Longspan KS1000 insulated wall panels or equivalent with an insertion loss shown in Table 5.1:

Table 5.1 Wall cladding –insertion loss dB (Hz)

1/1 octave band insertion loss (dB)						Noise reduction
125	250	500	1k	2k	4k	Rw
20.1	21.1	24.6	24.9	29.6	38.0	27

- Roof system comprising Kalzip standing seam system in continuous lengths incorporating the Kalzip nature roofing system fixed directly to Kal-Dek liner sheets (1.0 mm gauge). Double layer construction to combine Rockwool Cladding Roll (110 mm) and vapour barrier or equivalent with an insertion loss shown in Table 5.2:

Table 5.2 Roof decking –insertion loss dB (Hz)

1/1 octave band insertion loss (dB)						Noise reduction
125	250	500	1k	2k	4k	Rw
12.4	20.8	24.9	35.3	43.6	-	30

- Stack silencer would have an attenuation as shown in Table 5.3:

Table 5.3 Stack silencer – attenuation dB (Hz)

1/1 octave band insertion loss (dB)							
63	125	250	500	1k	2k	4k	8k
12	24	43	39	42	42	58	40

- The IBA processing building (day use only) located on the IBA maturation pad (hardstand area) will be a three sided structure approximately 75 m long, 10 m wide and 11 m high with walls to the north, east, south and a roof over; western side of building is proposed to be open located on the south-east corner of the IBA area. The building will accommodate a trommel, vibratory screen, two magnetic over band separators and eddy current separator. The building will be clad in metal sheeting (Kliplock or equivalent min. 0.6 mm BMT) with the insertion loss shown in Table 5.4:

Table 5.4 Metal sheet –insertion loss dB (Hz)

1/1 octave band insertion loss (dB)						Noise reduction
125	250	500	1k	2k	4k	Rw
13	15	15	17	21	24	19

5.2.2 Plant and equipment

Indicative plant and equipment of acoustic significance and associated sound power levels for the project are presented in Table 5.5. The list is based on information provided by Veolia and data available for the 'reference' facility the project will be based on located in Staffordshire, United Kingdom.

The sound power levels assigned to each item have been sourced from Staffordshire Environmental Statement (Scott Wilson 2010), EMM measurement database of similar equipment, Department of Environment, Food and Rural Affairs (DEFRA) 2005, *Update of Noise Database for Prediction of Noise on Construction and Open Sites*, manufacturer data and other equivalent facilities.

Table 5.5 Operational noise sources

Noise source	No. of items	Sound power level per item (L_{Aeq}) dB	Total sound power level (L_{Aeq}) dB
Road waste trucks[1]	3	106	111
Transfer truck with crane[2]	1	105	105
Front end loader (CAT972, HL970, WA470-8 or equivalent)[3]	1	105	105
Dozer (CAT D6-D8 or equivalent)[3]	1	112	112
Excavator (20t)[3]	1	106	106
Lighting tower[3]	1	93	93
Compressor[3]	1	100	100
Aerator	1	70	70
Front end loader CAT972, HL970, WA470-8 or equivalent)[3]	2	105	108
Excavator 20t[3]	1	107	107
Waste Bunker and Tipping Hall[4]	1	80	80
Turbine Hall[4]	1	95	95
Boiler Hall, Bottom Ash outlet and conveyor[4]	1	103	103

Table 5.5 Operational noise sources

Noise source	No. of items	Sound power level per item (L_{Aeq}) dB	Total sound power level (L_{Aeq}) dB
Discharge stack[5]	1	119	119
Air Cooled Condenser	8	90	99
IBA maturation building[6]	1	84	84

Notes: 1. Trucks considered in building, traversing through site and access/egress.

2. Transfer truck with crane from ARC to APCr encapsulation cell – day only.

3. FEL's, excavator, lighting tower and compressor at IBA maturation pad windrows and APCr encapsulation cell activities – day only.

4. Equipment located within building.

5. Stack fitted with discharge silencer as per Table 5.3.

6. IBA maturation building housing trommel, vibratory screen, FE separators and eddy current separator – space averaged LAeq noise level – day only.

Plant and equipment located within the building were considered with a space averaged reverberant levels for specific areas of the building (Table 5.5) as reported for Staffordshire (Scott Wilson 2010). The calculated levels for the building considered the proposed construction materials and dimensions of the warehouse building (Section 5.2.1). These levels were utilised with the surface area of the relevant building components (roof, walls, etc.) to develop noise emitting facades for the building. The model also considered the fixed noise sources pertaining to the discharge stack and air-cooled condensers (x8).

From experience, the type of heavy machinery listed in Table 5.5 would not present tonal characteristics as defined by the NPfI. A review of the A weighted and C weighted noise levels of mobile plant confirmed that they exhibit no low frequency tonal characteristics. Review of the ARC plant as an unattenuated level and attenuated level through the façade confirmed level differences greater than 15 dB threshold for assessment of low frequency noise (LFN). Accordingly, a review of the noise levels at the assessment locations was considered and confirmed that the low frequency noise levels were significantly below the thresholds outlined in NPfI Fact Sheet C Table C2 and accordingly a low frequency penalty was not applied to the noise level contributions from the project at assessment locations.

A site attended noise audit was conducted of mobile plant and equipment that is currently used on site that is likely to be utilised for the ARC project, specifically road waste trucks, truck and dog (transfer), excavator, dozer and front end loaders. A summary of the measured sound power levels is provided in Table 5.6.

Table 5.6 Site noise sources (Audit 4 April 2022)

Noise source	Sound power level per item (L_{Aeq}) dB
Front end loader (CAT972)	105
Front end loader (Komatsu WA430)	101
Truck and Dog (transfer)	103
Dozer (Komatsu D375A)	109
Excavator (Komatsu PC200 20t)	101
Waste Container Truck (road waste truck)	106

The results of the site attended noise audits of the mobile plant and equipment at Woodlawn proposed to be utilised for the ARC confirm sound power levels (Lw) are lower than that utilised in the noise modelling (Table 5.5). Hence this has proven modelling to be conservative.

All mobile plant will use level varying broad band 'quacker' reversing alarms.

5.2.3 Night-time maximum noise level events and sleep disturbance

As outlined in Section 5.1, the ARC building will operate 24 hours per day/7 days per week, hence assessment of intermittent noise and potential for sleep disturbance at residential assessment locations during the night-time hours (10.00 pm to 7.00 am) is required by the NPfI. For assessment of sleep disturbance, a sound power level of 115 dB L_{Amax} was considered for airbrake release of site trucks (6.00 am to 7.00 am) from previous measurement data of similar trucks. Attended measurements of airbrake release of organic waste trucks on site at Woodlawn in April 2022 confirmed an unusually high L_{Amax} level of 118-119dB, and this has conservatively been adopted for assessment purposes. The area on the site with the greatest potential for this activity to occur is the weighbridges on the east and north-west of the ARC building and container storage and truck manoeuvring area.

5.2.4 Noise predictions

Noise levels at the assessment locations identified in Table 3.1 were predicted based on the noise sources outlined in Table 5.5. The overall LAeq,15min noise contribution was modelled for direct assessment against NPfI PNTLs.

5.2.5 Noise enhancing meteorology

The model considered default noise enhancing meteorological conditions comprising:

- day – 20°C, 60% humidity and 3m/s wind for all assessment locations;
- evening – 20°C, 60% humidity and 3m/s wind for all assessment locations; and
- night – 10°C, 90% humidity and 2m/s wind and temperature inversion for all assessment locations.

5.2.6 Noise model validation

At the time of attended noise monitoring completed by EMM personnel on 4 April 2022, a crushing and screening campaign operation was occurring north of the Bioreactor pit. This activity provided a key opportunity to validate the noise model and was operational during the April 2022 attended noise measurements.

Site observations confirmed that the crushing and screening process utilised the following plant and equipment:

- Komatsu PC200 20t excavator;
- PremierTrak 600 crusher;
- Terex screen, and
- Volvo L110F front end loader.

Site attended measurements confirmed the above plant and equipment resulted in a combined L_{Aeq} sound power level of 120dB. These activities were clearly audible at Woodlawn Farm where a noise contribution of $L_{Aeq,15min}$ 40dB was confirmed. Incorporation of this activity in the ARC noise model for the purpose of validation confirmed predicted noise levels within 1dB of the measured values and hence no adjustments are required to the noise model.

5.3 Construction noise

5.3.1 Times

Construction activities associated with the project have been assessed based on 24 hours per day, seven days a week over approximately three years.

5.3.2 Equipment sound power levels

i Continuous

Equipment sound power levels have been taken from the *Update of Noise Database for Prediction of Noise on Construction and Open Sites* (DEFRA 2005), where available. Otherwise, data was sourced from an EMM database of similar equipment based on measurements at other construction sites.

Acoustically significant fixed and mobile equipment items were considered in the model for the site with 100% utilisation based on information provided by Veolia to represent a key range of activities likely to be undertaken during the main construction works. A summary of the construction phases, duration, number of plant and cumulative sound power levels (Lw) are presented in Table 5.7. The model considered the cumulative plant and equipment sound power level as an area source across the project providing a potential worst-case scenario.

Table 5.7 Construction stages and equipment sound power levels

Equipment/activity	Number of items (per 15 minutes)	SWL per item, LAeq	Total SWL, LAeq	Cumulative SWL per phase, LAeq
Stage 1: Initial site preparation works/bulk earthworks				
Water cart	2	103	106	116
Roller	2	109	112	
Excavator	2	107	110	
Tracker Boring Machine	1	110	110	
Loader	1	105	105	
Stage 2: Concrete hardstand, lower walls, bunker and roadway				
Concrete agitator	3	108	113	117
Concrete pump	3	109	114	
Crane 100t	3	99	104	
Lighting tower	5	93	100	
Diesel generator	5	93	100	
Franna	1	105	105	
Stage 3: Building structure and erection				
Angle grinding	3	108	113	114
Trucks	2	103	106	
Crane 100t	3	99	104	
Elevated work platform	1	103	103	

Works associated with commissioning, landscaping and demobilisation will generate significantly lower noise levels than the key construction phases identified in Table 5.7 and have not been considered further in the assessment on the assumption that if the high noise level activities comply with the requirements, then lower intensity activities will also comply.

ii Night-time maximum noise level events and sleep disturbance

Intermittent noise and assessment of sleep disturbance at residential assessment locations has been considered. For the purpose of assessing sleep disturbance at residences, a L_{Amax} level of 118 dB was considered associated with a metal on metal impact, petrol powered concrete saw or similar high noise level event.

5.3.3 Noise predictions

To assess a potential worst-case construction scenario, the assessment has considered the identified plant and equipment in Table 5.7 operating continuously over a 15 minute period. Construction noise levels were predicted to the assessment locations listed in Table 3.1 and identified in Figure 3.1.

5.4 Construction vibration

Safe working distances for typical items of vibration intensive plant are listed in Table 5.8. The safe working distances are quoted for both “Cosmetic Damage” (refer British Standard BS 7385) and “Human Comfort” (refer British Standard BS 6472-1).

Table 5.8 Recommended safe working distances for vibration intensive plant

Plant item	Rating/description	Safe working distance	
		Cosmetic damage (BS 7385)	Human comfort (BS 6472)
Vibratory Rollers	<50 kN (typically 12 tonnes)	5 m	15 to 20 m
	<100 kN (typically 24 tonnes)	6 m	20 m
	<200 kN (typically 46 tonnes)	12 m	40 m

Source: From Transport Infrastructure Development Corporation Construction’s Construction Noise Strategy (Rail Projects), November 2007 – based on residential building.

Safe work distances relate to continuous vibration. For most construction activity, vibration emissions are intermittent in nature. The safe working distances are therefore conservative.

The safe working distances presented in Table 5.8 are indicative and will vary depending on the item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions.

The safe working distances have been used to assess the potential for construction vibration impacts based on proposed activities.

5.5 Road traffic noise

5.5.1 Overview

Access for vehicles associated with the construction and operation of the project will be from Collector Road via Bungendore Road.

Project related construction and operational traffic has the potential to impact on residential properties on these road segments. The assessment has considered existing traffic volumes and projected vehicle movements associated with the construction and operation of the facility. Note that operational vehicles on the proposed access road are treated as part of onsite noise in accordance with the NPfI.

5.5.2 Existing traffic volumes

Existing average daily traffic movements for Collector Road and Bungendore Road were established from classified tube counts conducted in August 2021 with factored traffic impacts from COVID 19 (EMM 2022a) and summarised in Table 5.9.

Table 5.9 Average existing daily traffic volumes (7 day average)

Road segment	Day 7.00 am to 10.00 pm				Night 10.00 pm to 7.00 am			
	LV[1]	HV[2]	Total	HV%	LV	HV	Total	HV%
Collector Road	244	346	590	59%	84	18	102	18%
Bungendore Road	1156	330	1486	22%	191	26	217	12%

1. LV light vehicles
2. HV heavy vehicles

5.5.3 Projected traffic volumes

Additional vehicle movements associated with the construction of the project are summarised in Table 5.10.

Table 5.10 Projected construction traffic volumes – movements

Day 7.00 am to 10.00 pm			Night 10.00 pm to 7.00 am		
LV[1]	HV[2]	Total	LV	HV	Total
25	90	115	25	58	83

1. LV light vehicles
2. HV heavy vehicles

It is noted that 50 of the 'heavy vehicles' during the day and night periods in Table 5.10 relate to movements of 22 seater mini buses transporting construction personnel to the project. For the purpose of this road traffic noise assessment for construction, these buses have been considered as a medium truck.

Vehicle movements associated with the operation of the project are summarised in Table 5.11.

Table 5.11 Operation traffic volumes – movements

Day 7.00 am to 10.00 pm			Night 10.00 pm to 7.00 am		
LV[1]	HV[2]	Total	LV	HV	Total
23	120	143	23	12	35

1. LV light vehicles
2. HV heavy vehicles

5.5.4 Methodology

Road traffic noise levels were predicted utilising the calculation procedures of US EPA Federal Highways (FHWA) Method (1996). This was considered in the assessment of road traffic noise due to low traffic flows (<200 vehicles per hour) as the calculation procedure is more sensitive to low traffic volumes compared to other methods.

Road traffic noise levels from the project have been assessed by existing traffic and plus project construction and operational traffic. The following assumptions have been adopted:

- projected traffic generation east of the ARC access as a worst-case assessment for maximum vehicle movements;
- a vehicle sign-posted speed limit for Collector Road of 100 km/h;
- a vehicle sign posted speed limit on Bungendore Road of 50 km/h in Tarago township;
- 22 seater mini buses during construction considered as medium truck (50 movements during the day, 50 at night);
- a low bund was incorporated for Collector Road providing a nominal 2dB attenuation for existing and project related traffic;
- no buildings or other intervening objects that will act as a noise barrier between the road and the noise assessment point are proposed for Bungendore Road;
- a facade reflection has been added to predicted noise levels of 2.5 dB consistent with the RNP;
- ground type absorption in the calculation allows for factors of hard = 0 and soft = 0.5. Considering the ground surrounding is predominantly grassland between roadway and residential facades the assessment considered ground type values:
  - 0.5 for facades greater than 40 m from edge of roadway; and
  - 0.2 for facades less than 40 m from roadway;
- the calculation considered full field of view to the roadway for the residential façades; and
- residential facade offsets adopted were:
  - 75 m from edge of road on Collector Road; and
  - 23 m from edge of road on Bungendore Road.

6 Impact assessment

6.1 Operational noise

6.1.1 Single point predictions

Predicted single point operational noise levels are provided in Table 6.1 for day, evening and night operations of the project. The levels presented for each assessment location represents the energy-average noise level over a 15-minute period and assumes all plant and activities operating concurrently in accordance with scenarios outlined in Section 5.2 under noise enhancing conditions.

Table 6.1 Predicted operational noise levels

Assessment location	Description	Period	PNTL, $dBL_{Aeq,15min}$	Predicted project noise level[1], dB $L_{Aeq,15min}$
R1	Woodlawn Farm*	Day	40	37
		Evening	35	<30
		Night	35	<30
R2	Cowley Hills*	Day	40	33
		Evening	35	<30
		Night	35	<30
R3	Pylara*	Day	40	<30
		Evening	35	<30
		Night	35	<30
R4	Torokina	Day	40	<30
		Evening	35	<30
		Night	35	<30
R5	Willeroo	Day	40	<30
		Evening	35	<30
		Night	35	<30
IN6	Woodlawn Mine Administration	When is use	68	42

Results of the modelling confirm compliance with the PNTL's for all referenced residential assessment locations (R1 – R5) and the industrial assessment location (IN6 Woodlawn Mine administration offices). The results also confirm compliance with the existing EPL's (EPL 11436 and 20476) for Woodlawn Eco Precinct for all privately owned residential properties.

Daytime noise levels are identified as being higher than evening and night principally as a result of the fixed and mobile plant associated with the IBA maturation area and APCr encapsulation cell activities occurring during the daytime period only.

6.1.2 Cumulative noise emissions

Section 4.1 outlines the procedures for establishing PNTL's for a specific proposed development at assessment locations. The NPfI in the application of amenity criteria also makes allowance for potential cumulative noise impacts associated with the project and any other industrial noise emitters with the potential to impact those assessment locations.

For the Eco Precinct there are a number of noise sources that contribute to noise levels at the assessment locations including:

- Mechanical Biological Treatment (MBT) Facility;
- Wind Farm;
- Bioreactor; and
- Woodlawn Mine.

Noise level contributions from these sources has been extracted from previous environmental noise assessments (Parsons Brinckerhoff 2012 and SLR 2013) in order to review the potential for cumulative noise impacts.

Simultaneous operation of the project and other approved and operating developments at the Eco Precinct (including Woodlawn Mine) were assessed as a worst-case scenario by adding the $L_{Aeq,15min}$ predicted intrusive noise level from the project to approved operations noise. In order to compare the cumulative intrusive noise level with the recommended equivalent amenity noise levels ($L_{Aeq, period}$), 3 dB must be taken away from the intrusive level.

A summary of the individual contributions, cumulative noise level and amenity noise criteria is provided in Table 6.2, Table 6.3 and Table 6.4.

Table 6.2 Cumulative amenity noise levels (day), L_{Aeq}

Assessment location	Description	Woodlawn MBT Facility	Woodlawn Wind Farm	Woodlawn Bioreactor	Woodlawn Mine	The project	Cumulative Amenity Level[1]	NPfI Recommended Amenity Level
R1	Woodlawn Farm *	<30	<30	35	40	36	40	50
R2	Cowley Hills*	<30	<30	34	44	33	42	50
R3	Pylara*	<30	<30	<30	32	<30	34	50
R4	Torokina	<30	<30	<30	<30	<30	33	50
R5	Willeroo	<30	<30	<30	<30	<30	33	50

1. Represented cumulative intrusive noise level -3dB

* Owned by Veolia

Table 6.3 Cumulative amenity noise levels (evening), L_{Aeq}

Assessment location	Description	Woodlawn MBT Facility	Woodlawn Wind Farm	Woodlawn Bioreactor	Woodlawn Mine	The project	Cumulative Amenity Level[1]	NPfI Recommended Amenity Level
R1	Woodlawn Farm*	<30	<30	35	40	<30	39	45
R2	Cowley Hills*	<30	<30	34	44	<30	42	45
R3	Pylara*	<30	<30	<30	32	<30	34	45
R4	Torokina	<30	<30	<30	<30	<30	33	45
R5	Willeroo	<30	<30	<30	<30	<30	33	45

1. Represented cumulative intrusive noise level -3dB

* Owned by Veolia

Table 6.4 Cumulative amenity noise levels (night), L_{Aeq}

Assessment location	Description	Woodlawn MBT Facility	Woodlawn Wind Farm	Woodlawn Bioreactor	Woodlawn Mine	The project	Cumulative Amenity Level[1]	NPfI Recommended Amenity Level
R1	Woodlawn Farm*	<30	<30	35	40	<30	39	40
R2	Cowley Hills*	<30	<30	33	44	<30	42	40
R3	Pylara*	<30	<30	<30	32	<30	34	40
R4	Torokina	<30	<30	<30	<30	<30	33	40
R5	Willeroo	<30	<30	<30	<30	<30	33	40

1. Represented cumulative intrusive noise level -3dB

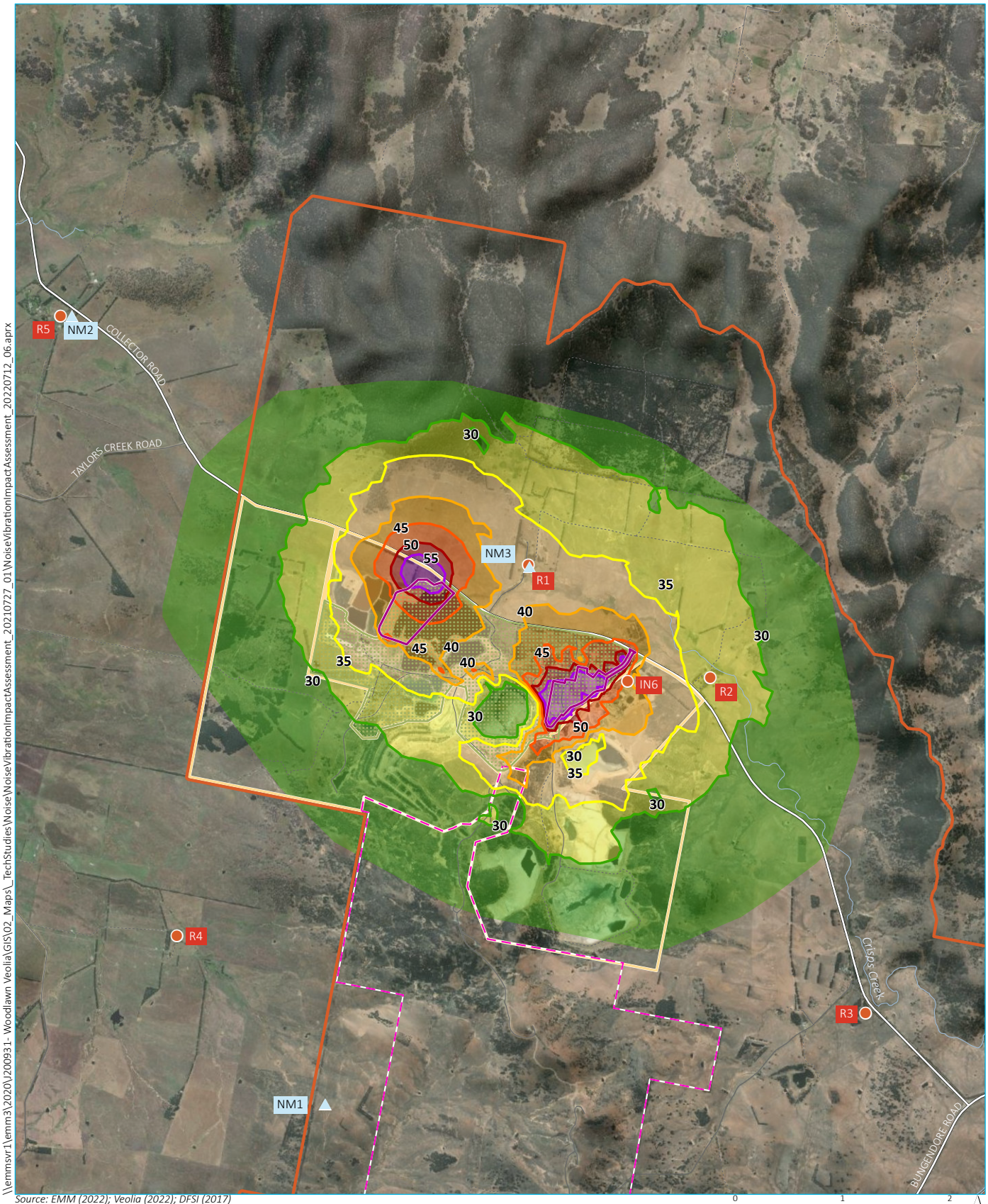
* Owned by Veolia

A review of the cumulative noise level contributions confirms the project does not contribute to overall noise levels at any of the reference sensitive assessment locations and does not require further review. The cumulative amenity noise levels are also less than the NPfI recommended amenity level for all assessment locations.

During the night period the cumulative amenity noise level exceeds the acceptable level of 40 dBA at R2 Cowley Hills and is principally controlled by noise emissions from Woodlawn Mine. R2 Cowley Hills is owned by Veolia and as such is considered project related for the purpose of this assessment.

6.1.3 Contours

Predicted $L_{Aeq,15min}$ operational noise contours representing the project only day, evening and night operations under noise enhancing conditions comprising 3 m/s wind for all locations during day and evening, and 2 m/s wind and temperature inversion during the night are provided in Figure 6.1, Figure 6.2 and Figure 6.3. The contours depict the extent of noise exposure surrounding the site including the assessment locations.



\\emmsvr1\emm3\2020\J200931- Woodlawn Veolia\GIS\02_Maps_TechStudies\Noise\NoiseVibrationImpactAssessment_20210727_01\NoiseVibrationImpactAssessment_20220712_06.aprx

Source: EMM (2022); Veolia (2022); DFSI (2017)

KEY

- Development footprint
- Noise assessment location
- Noise monitoring location
- Veolia integrated waste management operations
- Woodlawn Eco Precinct
- Crisps Creek Intermodal Facility (IMF)
- Woodlawn Mine operations area
- Woodlawn Wind Farm

Noise contours (dB_{LAeq})

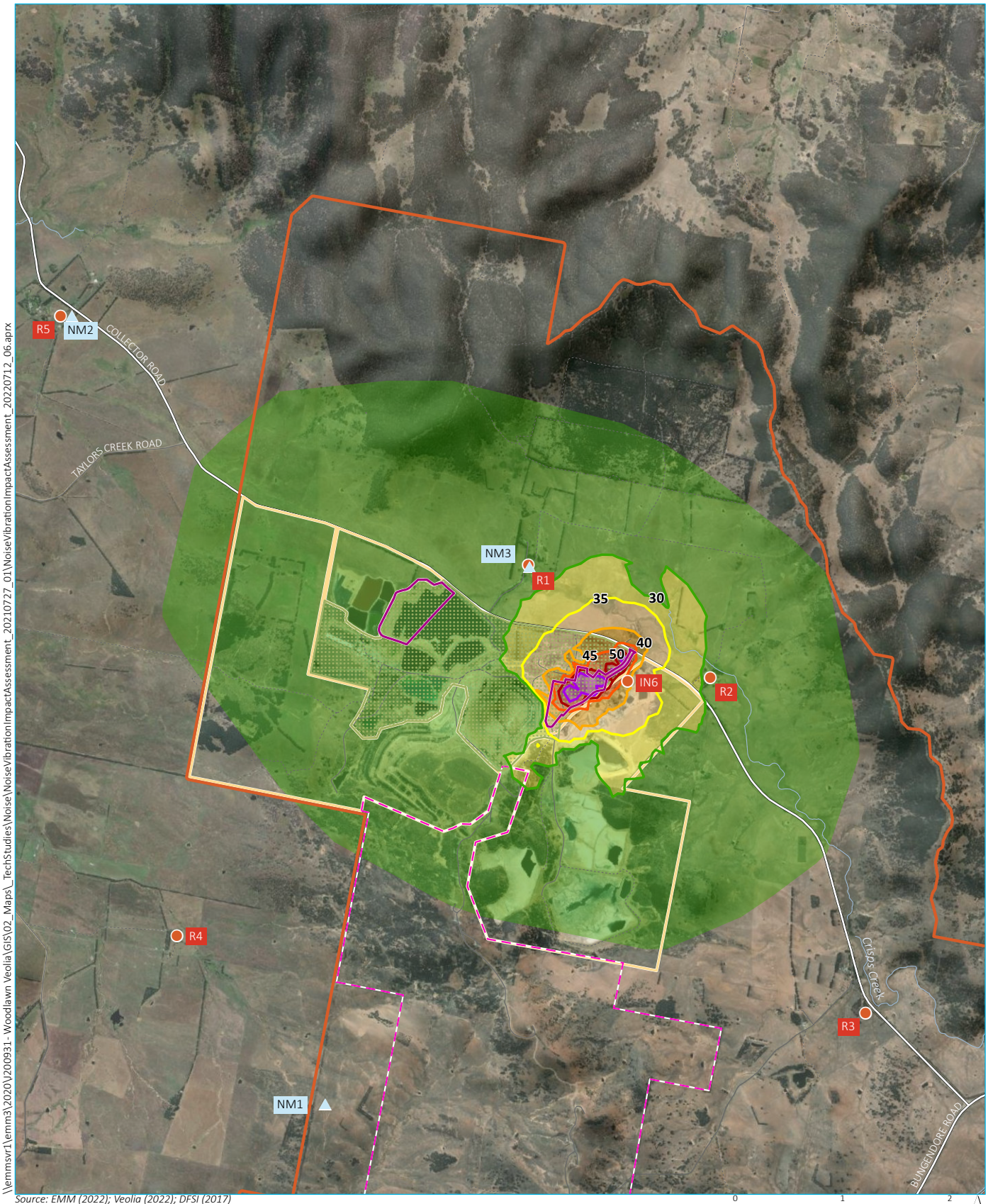
- 30
- 35
- 40
- 45
- 50
- 55

- Rail line
- Major road
- Minor road
- Vehicular track
- Watercourse

Operational noise contours, day, 3 m/s wind

Woodlawn Advanced Energy Recovery Centre
Noise and vibration impact assessment
Figure 6.1

EMM
creating opportunities



\\emmsvr1\emm3\2020\J200931 - Woodlawn Veolia\GIS\02_Maps_TechStudies\Noise\NoiseVibrationImpactAssessment_20210727_01\NoiseVibrationImpactAssessment_20220712_06.aprx

Source: EMM (2022); Veolia (2022); DFSI (2017)

KEY

- Development footprint
- Noise assessment location
- Noise monitoring location
- Veolia integrated waste management operations
- Woodlawn Eco Precinct
- Crisps Creek Intermodal Facility (IMF)
- Woodlawn Mine operations area
- Woodlawn Wind Farm

Noise contours (dB_{LAeq})

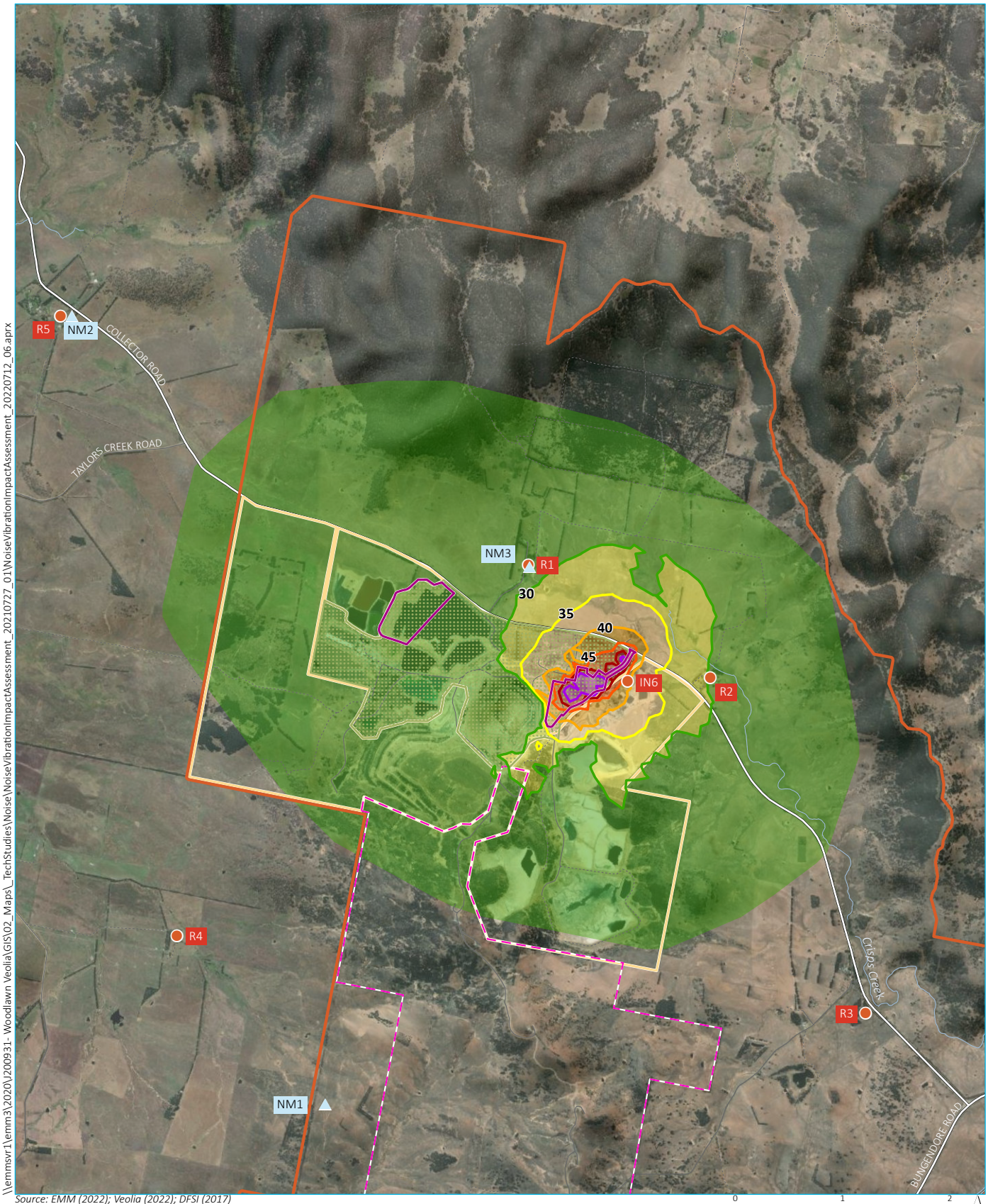
- 30
- 35
- 40
- 45
- 50
- 55

- Rail line
- Major road
- Minor road
- Vehicular track
- Watercourse

Operational noise contours, evening, 3 m/s wind

Woodlawn Advanced Energy Recovery Centre
Noise and vibration impact assessment
Figure 6.2

EMM
creating opportunities



\\emmsvr1\emm3\2020\J200931- Woodlawn Veolia\GIS\02_Maps_TechStudies\Noise\NoiseVibrationImpactAssessment_20210727_01\NoiseVibrationImpactAssessment_20220712_06.aprx

Source: EMM (2022); Veolia (2022); DFSI (2017)

0 1 2 km

GDA 1994 MGA Zone 55

N

KEY

- Development footprint
- Noise assessment location
- Noise monitoring location
- Veolia integrated waste management operations
- Woodlawn Eco Precinct
- Crisps Creek Intermodal Facility (IMF)
- Woodlawn Mine operations area
- Woodlawn Wind Farm

Noise contours (dB_{LAeq})

- 30
- 35
- 40
- 45
- 50
- 55

- Rail line
- Major road
- Minor road
- Vehicular track
- Watercourse

Operational noise contours, night, 2m/s wind and temperature inversion

Woodlawn Advanced Energy Recovery Centre
Noise and vibration impact assessment
Figure 6.3

EMM
creating opportunities

6.1.4 Intermittent noise events (sleep disturbance)

Modelling of intermittent maxima noise events at night considered a typical worst-case event for air brake release and a source sound power level of L_{Amax} 119 dB. Potential for these events were considered at the eastern and north-western weighbridges, container storage and truck manoeuvring area and predicted to the identified residential assessment locations. The results of the predictions under noise enhancing conditions are presented in Table 6.5.

Table 6.5 Predicted intermittent noise levels

Assessment location	Description	Period	Screening level, dB	Predicted intermittent noise level, dB L_{Amax}
R1	Woodlawn Farm*	Night	52	47
R2	Cowley Hills*	Night	52	48
R3	Pylara*	Night	52	<30
R4	Torokina	Night	52	<30
R5	Willeroo	Night	52	<30

* Owned by Veolia

Results of modelling confirm compliance with the L_{Amax} sleep disturbance screening level for all residential assessment locations.

In terms of the $L_{Aeq,15min}$ noise level contributions, Table 6.1 confirms all private residential assessment locations comply with a limit of 40 dB.

6.1.5 Best-achievable noise levels

The assessment has considered the latest technology plant and equipment for the project, furthermore the majority of the plant and equipment will be located wholly within a purpose designed and constructed building (the ARC building).

The ARC will implement a range of best practice noise management design and operational measures including:

- using quietest plant that can perform the required task including constant review of available technology;
- minimising the number of plant and equipment operating simultaneously while still meeting construction and processing requirements;
- switching off idle plant;
- implementing a regular maintenance schedule for all plant and equipment; and
- providing staff education and tool box talks on impacts of noise and quiet best work practices.

6.2 Construction noise

6.2.1 Single point predictions

In accordance with procedures outlined in Section 5.3.2, prediction of construction noise levels is provided in Table 6.6 for standard day periods. The level presented for each assessment location represents the energy-average noise level over a 15-minute period and assumes all plant operating concurrently. The predicted exceedance of the ICNG noise affected NML at each assessment location is also provided.

Table 6.6 Predicted construction noise levels

Assessment location	Description	Period[1]	Noise affected NML, dB	Highly noise affected NML, dB	Predicted construction noise level, dB $L_{Aeq,15min}$	Level above NML[2]
Stage 1: Initial site preparation works/bulk earthworks						
R1	Woodlawn Farm*	Standard	45	75	35	Nil
R2	Cowley Hills*	Standard	45	75	35	Nil
R3	Pylara*	Standard	45	75	<30	Nil
R4	Torokina	Standard	45	75	<30	Nil
R5	Willeroo	Standard	45	75	<30	Nil
IN1	Woodlawn Mine Administration	Any period	70	n/a	45	Nil
Stage 2: Concrete hardstand, lower walls, bunker and roadway						
R1	Woodlawn Farm*	Standard	45	75	34	Nil
R2	Cowley Hills*	Standard	45	75	35	Nil
R3	Pylara*	Standard	45	75	<30	Nil
R4	Torokina	Standard	45	75	<30	Nil
R5	Willeroo	Standard	45	75	<30	Nil
IN1	Woodlawn Mine Administration	Any period	70	n/a	45	Nil
Stage 3: Building structure and erection						
R1	Woodlawn Farm*	Standard	45	75	32	Nil
R2	Cowley Hills*	Standard	45	75	33	Nil
R3	Pylara*	Standard	45	75	<30	Nil
R4	Torokina	Standard	45	75	<30	Nil
R5	Willeroo	Standard	45	75	<30	Nil
IN1	Woodlawn Mine Administration	Any period	70	n/a	44	Nil

1. Standard hours (7.00 am to 6.00 pm Monday to Friday, 8.00 am to 1.00 pm Saturday and no work on Sunday or public holidays.
2. Level above NML for standard hours only.

* Owned by Veolia

Certain phases of the construction of the project would require 24/7 construction activities. A review of the predicted levels in Table 6.6 confirm that the night NML of 35 dB will also be satisfied for these activities and not result in any adverse noise impacts.

The results in Table 6.6 confirm that construction noise levels from the project during day, evening and night are predicted to comply with NMLs at all assessment locations and do not exceed the NML.

Residents will be notified prior to works commencing. Noise monitoring during the initial stages of construction will be undertaken to determine if actual construction noise levels are above NMLs. Construction noise will be managed in accordance with Section 7.2.

6.2.2 Intermittent noise events (sleep disturbance)

Modelling of intermittent maxima noise events from construction activities that may occasionally occur at night (typically during the morning shoulder period 6.00 am–7.00 am) considered a typical worst-case event for metal on metal impact or concrete saw cutting and a source sound power level of 118 dB L_{Amax}. Potential for these events were considered at multiple locations within the proposed hardstand and building areas and predicted to the identified residential assessment locations. The results of the predictions under noise enhancing conditions are presented in Table 6.7.

Table 6.7 Predicted intermittent noise levels

Assessment location	Description	Period	Screening level, dB	Predicted intermittent noise level, dB L_{Amax}
R1	Woodlawn Farm*	Night	52	46
R2	Cowley Hills*	Night	52	47
R3	Pylara*	Night	52	<30
R4	Torokina	Night	52	<30
R5	Willeroo	Night	52	<30

* Owned by Veolia

Results of modelling confirm compliance with the L_{Amax} sleep disturbance screening level for all residential assessment locations.

6.3 Construction vibration

In relation to human comfort response, the safe working distances in Table 5.8 relate to continuous vibration and apply to residential assessment locations. For most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods are acceptable, as discussed in BS 6472-1.

The nearest residence (R2) is located more than 800 m to the closest proposed construction activities for the new site access. This assessment location is well beyond the safe working distances for human response (Table 5.8). Vibration impacts from construction at residential assessment locations are therefore highly unlikely.

6.4 Road traffic noise

In accordance with the RNP, Collector Road and Bungendore Road are classified as sub-arterial roads. Based on existing traffic volumes (Section 5.5.2) and site construction traffic generation (Section 5.5.3), a summary of the calculated existing and future road traffic noise levels are presented for day and night in Table 6.8 and Table 6.9 respectively. This assessment assumed a scenario of all project construction and operational traffic travelling east on Collector Road and north on Bungendore Road through Tarago in order to consider a worst-case impact assessment.

6.4.1 Construction traffic

Predicted noise levels for Collector Road and Bungendore Road during the day are presented in Table 6.8.

Table 6.8 Road traffic noise calculations – Day (7.00 am to 10.00 pm)

Road segment	Approximate distance of residential façade from nearest carriageway	Existing movements	Existing plus project movements	RNP Criteria L_{Aeq}	Noise level increase due to the Project, $L_{Aeq,15hr}$
		Calculated level, $L_{Aeq,15hr}$	Predicted level, $L_{Aeq,15hr}$		
Collector Road	75 m	57.3	57.6	60	0.3
Bungendore Road	23 m	63.8	64.3	60	0.5

Predicted noise levels for Collector Road and Bungendore Road during the day confirm relative increases of 0.3 dB and 0.5 dB respectively and hence satisfy the RNP requirements of <2dB increase.

Predicted noise levels for Collector Road and Bungendore Road during the night are presented in Table 6.9.

Table 6.9 Road traffic noise calculations, Night (10.00 pm to 7.00 am)

Road segment	Approximate distance of residential façade from nearest carriageway	Existing movements	Existing plus project movements	RNP Criteria L_{Aeq}	Noise level increase due to the Project, $L_{Aeq,9hr}$
		Calculated level, $L_{Aeq,9hr}$	Predicted level, $L_{Aeq,9hr}$		
Collector Road	75 m	50.4	50.7	55	0.3
Bungendore Road	23 m	56.0	57.1	55	0.8

Predicted noise levels for Collector Road and Bungendore Road during the night confirm relative increases of 0.3 dB and 0.8 dB respectively and hence satisfy the RNP requirements of <2dB increase.

6.4.2 Operational traffic

The operational traffic assessment includes existing approved truck movements from the Crisps Creek IMF to the Woodlawn Eco Precinct in addition to traffic associated with the ARC operations, hence provides a conservative assessment of potential traffic noise impacts.

Table 6.10 Road traffic noise calculations – Day (7.00 am to 10.00 pm)

Road segment	Approximate distance of residential façade from nearest carriageway	Existing movements	Existing plus project movements	RNP Criteria L_{Aeq}	Noise level increase due to the Project, $L_{Aeq,15hr}$
		Calculated level, $L_{Aeq,15hr}$	Predicted level, $L_{Aeq,15hr}$		
Collector Road	75 m	57.3	58.5	60	1.1
Bungendore Road	23 m	63.8	64.9	60	1.1

Calculations indicate that existing traffic noise levels on Bungendore Road exceed the RNP baseline $L_{Aeq,15hr}$ 60dB. Predicted noise levels for Collector Road and Bungendore Road during the day confirm relative increases of 1.1 dB and hence satisfy the RNP requirements of a less than 2dB increase.

Table 6.11 Road traffic noise calculations, Night (10.00 pm to 7.00 am)

Road segment	Approximate distance of residential façade from nearest carriageway	Existing movements	Existing plus project movements	RNP Criteria L_{Aeq}	Noise level increase due to the Project, $L_{Aeq,9hr}$
		Calculated level, $L_{Aeq,9hr}$	Predicted level, $L_{Aeq,9hr}$		
Collector Road	75 m	50.4	51.4	55	1.0
Bungendore Road	23 m	56.0	57.1	55	1.1

Calculations confirm that existing traffic noise levels on Bungendore Road exceed the RNP baseline $L_{Aeq,9hr}$ 55 dB Predicted noise levels for Collector Road and Bungendore Road during the night confirm relative increases of 1.0 dB and 1.1 dB respectively and hence satisfy the RNP requirements of a less than 2 dB increase.

7 Noise mitigation and management

7.1 Operation

Noise modelling has predicted that operational noise contributions from the project satisfy the PNTL's for all reference assessment locations, whilst the noise contours (Figure 6.1, Figure 6.2 and Figure 6.3) confirm noise levels at Tarago village will be $L_{Aeq,15min}$ <30 dB.

Assessment of potential sleep disturbance from operation of the project has confirmed compliance for all residential assessment locations in terms of L_{Amax} 52 dB and $L_{Aeq,15min}$ 40 dB under the procedures of the NPfI. No additional mitigation measures are required.

With respect to cumulative noise level emissions, the assessment (Section 6.1.2) confirms that the operation of the project will not result in an increase in cumulative noise levels at the closest and most exposed reference assessment locations.

The project will need to be constructed in accordance with the assumptions and modelling parameters outlined in Section 5.2.1, 5.2.2 and Table 7.1:

Table 7.1 Proposed mitigation measures during operation

Requirement	Mitigation measure	Responsibility	Timing
Internal design noise levels	Space averaged internal noise levels to satisfy the assumptions presented in Table 5.5.	Veolia/Contractor	Pre-construction/ design/ Operation
Building construction	Building construction materials and specification of discharge stack silencer will be in accordance with the assumptions presented in Section 5.2.1.	Veolia/Contractor/ Designer	Pre-construction/ design
Selection of plant and equipment	Specification for all plant and equipment to be in accordance with the noise levels presented in Table 5.5.	Contractor	Design/ operation
Maintenance	Plant and equipment to be maintained to satisfy the ongoing noise levels referenced in Table 5.5.	Veolia/Operator	Operation

7.2 Construction

7.2.1 General

The EPA's NSW ICNG requires that construction noise levels are assessed against NMLs.

Compliance with NMLs has been predicted for all residential assessment locations. No noise exceedances of $L_{Aeq,15min}$ or L_{Amax} are predicted for any privately owned residence.

7.2.2 Work practices

Feasible and reasonable mitigation measures to reduce construction noise levels will be reviewed and implemented.

Work practice methods may include:

- regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration;
- avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby residents;
- develop routes for the delivery of materials and parking of vehicles to minimise noise;
- where possible, avoid the use of equipment that generates impulsive noise; and
- notify residents prior to the commencement of intensive and OOH works.

7.2.3 Plant and equipment

Additional measures for plant and equipment may include:

- where possible, choose quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks;
- operate plant and equipment in the quietest and most efficient manner;
- minimise the number of plant and equipment operating simultaneously while still meeting processing requirements;
- switch off idle plant; and
- regularly inspect and maintain plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively.

7.2.4 Noise management levels

As discussed in Section 6.1.5, Residents will be notified prior to works commencing. Noise monitoring during the initial stages of construction will be undertaken to determine if actual construction noise levels are above NMLs. If NMLs are exceeded, Veolia will:

- identify feasible and reasonable mitigation measures that reduce construction noise levels to at or below NMLs where practical.

The assessment has considered 24 hours seven days a week construction activities and predicted that the NML's and sleep disturbance criteria would be satisfied for all assessment locations, accordingly no adverse noise impacts are anticipated for 24/7 construction activities based on the assumptions of this assessment.

7.2.5 Quantifying noise reductions

Approximate noise reductions provided by some of these measures are provided in Table 7.2.

Table 7.2 Relative effectiveness of various forms of noise control

Noise control	Nominal noise reduction possible, in total A-weighted sound pressure level, dB
Increase source to receiver distance[1]	approximately 6 dB for each doubling of distance
Reduce equipment operating times or turn off idling machinery[2]	approximately 3 dB per halving of operating time
Operating training on quiet operation[2]	up to 3 to 5 dB
Screening (eg noise barrier)[1]	normally 5 dB to 10 dB, maximum 15 dB
Enclosure (eg shed/building)[1]	normally 15 dB to 25 dB, maximum 50 dB
Silencing (eg exhaust mufflers) [1]	normally 5 dB to 10 dB, maximum 20 dB

1. Sourced from AS2436-2010
2. Based on EMM's measurement experience at construction and mining sites

7.3 Traffic noise

Based on existing traffic volumes on Collector Road and Bungendore Road and projected construction traffic, the relative traffic noise increase criteria (+2 dB) are predicted to be satisfied and comply with the RNP baseline criteria. No additional mitigation is required.

8 Conclusion

This assessment has been prepared to consider the noise and vibration impacts of the project on existing noise-sensitive assessment locations in the area in terms of site operations and related traffic impacts associated with construction and to review cumulative noise associated with project operations and other Eco Precinct operations.

8.1 Operations

Assessment of operational noise associated with the project has confirmed compliance with NSW NPfI (EPA 2017) requirements for all residential assessment locations. Compliance is also predicted at the industrial assessment location (Woodlawn Mine administration offices).

Occasional night activities from truck movements are predicted to satisfy the sleep disturbance screening criteria of L_{Amax} 52 dB and $L_{Aeq,15min}$ 40 dB as defined in the NSW NPfI (EPA 2017) for all residential assessment locations.

Based on existing traffic volumes on Collector Road and Bungendore Road and projected construction and operational traffic, the relative traffic noise increase criteria (+2 dB) are predicted to be satisfied and comply with the NSW RNP baseline criteria. No additional mitigation is required.

With the effective management and incorporation of mitigation and management measures listed in Section 7.2, operational noise emissions from the project can be managed to minimise impacts.

8.2 Construction

Construction noise levels from the project are predicted to comply with noise management levels (NMLs) at all reference assessment locations. The assessment has considered 24 hours, seven days a week construction activities and predicted that the NML's and sleep disturbance criteria would be satisfied for all assessment locations, accordingly no adverse noise impacts are anticipated for 24 hours, seven days a week construction activities based on the assumptions of this assessment.

The potential for vibration impacts on residents and vibration sensitive structures near construction has been assessed. The nearest residence to construction activity is assessment location R2 which is approximately 800 m away from the closest proposed construction activities (new site access). This assessment location is well outside of the safe working distances of likely plant, required to maintain acceptable human response and structural vibration levels. Vibration impacts from construction at all assessment locations are therefore highly unlikely.

Road traffic noise levels associated with construction vehicles are predicted to satisfy RNP assessment requirements on Collector Road and Bungendore Road.

With the effective management and incorporation of mitigation and management measures listed in Section 7.2, construction noise and vibration emissions from the project can be managed to minimise impacts.

References

ARUP (2020) Western Sydney Energy and Resource Recovery Centre, Technical Report I, Noise and Vibration Impact Assessment, Report No. WSERRC-ARU-SYD-ENNV-RPT-0002 Final dated 24 August 2020;

Australian Standard AS 1055-2018 - *Acoustics - Description and Measurement of Environmental Noise*.

Australian Standard AS 2187.2-2006 *Explosives* - Storage *and Use - Use of Explosives*.

BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings Part 2*.

BS 6472 – 2008 *Evaluation of human exposure to vibration in buildings (1-80Hz).*

Department of Environment, Food and Rural Affairs (DEFRA) 2005, *Update of Noise Database for Prediction of Noise on Construction and Open Sites*.

EMM (2022a) *Woodlawn Advanced Energy Recovery Centre, Traffic Impact Assessment,* prepared by EMM Consulting Pty Ltd for Veolia Environmental Services (Australia) Pty Ltd.

Enviros Consulting (2008) on behalf of Staffordshire County Council Staffordshire County Council, Project W2R, Provision of a Residual Waste Treatment Facility. Environmental Statement Reference ST0070013x dated May 2008.

ERM (2019) Mt Piper Energy Recovery Project, Noise and Vibration Impact Assessment, Report No. 0436662 Rev 1.0 dated 4 December 2019.

German Standard DIN 4150 Part 2 1975.

Hepworth Acoustics (2020) Veolia Energy Recovery Facility, Four Ashes, Staffordshire. Compliance Noise Monitoring Survey, Report No P15-197-R43v1 dated October 2020.

NSW Environment Protection Authority (EPA) 2000, *NSW Industrial Noise Policy* (INP).

NSW Environment Protection Authority (EPA) 2017, *Noise Policy for Industry.*

NSW Department of Environment Climate Change and Water (DECCW) 2011, *Road Noise Policy* (RNP).

NSW Department of Environment and Conservation 2006, *Assessing Vibration: a technical guideline.*

NSW Department of Environment Climate Change (DECC) 2009, *Interim Construction Noise Guideline* (ICNG).

Parsons Brinckerhoff (2012) Environmental Assessment. TriAusMin Woodlawn Project, Report 2162477B Revision D dated 4 April 2012.

Scott Wilson Limited (2010) Project W2R: Development of an Energy Recovery Facility at the Dell, Four Ashes, Staffordshire. Environmental Statement Rev 01 dated August 2010 Volume 1: Main Text and Appendix 11.4: Noise Modelling and Data Inputs.

SLR global environmental solutions (2013) *Woodlawn Mechanical Biological Treatment Facility, Noise and Vibration Impact Assessment*, Report Number 610.12876R3 Revision 0.

sol acoustics (2020) Waste Energy Power Partners Ltd, Tunstall, Stoke-on-Trent, Environmental Noise Impact Assessment, Report No P1855-REP01-REV D-BDH dated 6 February 2020.

Abbreviations

Abbreviation	Term
ARL	Acoustic Research Laboratories
AGL	above ground level
ANZEC	Australian and New Zealand Environment Council
ABL	Assessment background level
BoM	Bureau of Meteorology
CSSI	Critical State significant infrastructure
CEMP	Construction Environmental Management Plan
DECC	Department of Environment and Climate Change
DEC	Department of Environment and Conservation
DEFRA	Department of Environment, Food and Rural Affairs (United Kingdom)
DP&E	Department of Planning and Environment
EPA	Environmental Protection Authority
EIS	environmental impact statement
EMM	EMM Consulting Pty Limited
FHWA	US EPA Federal Highways
HV	heavy vehicle
ICNG	Interim Construction Noise Guideline
LGAs	local government areas
LV	light vehicle
MW	megawatts
NATA	National Association of Testing Authorities
NPfI	Noise Policy for Industry
NML	noise management level
NVIA	Noise and vibration impact assessment
OOH	out of hours
PPV	peak particle velocity
POEO Act	Protection of the Environment Operations Act 1997 (NSW)
PNTL	project noise trigger level
RBL	rating background level
RNP	Road Noise Policy
RMS	root mean square
SEARs	Secretary's environmental assessment requirements

Abbreviation	Term
SSI	State significant infrastructure
VDV	vibration dose value

Glossary

Technical terms typically utilised in a noise assessment report are explained in Table G.1.

Table G.1 Glossary of acoustic terms and abbreviations

Abbreviation or term	Definition
ABL	The assessment background level (ABL) is defined in the INP as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L_{A90} statistical noise levels.
Amenity noise level	The amenity noise levels relate to the overall level of industrial noise subject to land zoning or use
A-weighting	There are several different weightings utilised for describing noise, the most common being the 'A-weighting'. This attempts to closely approximate the frequency response of the human ear.
Day period	Monday–Saturday: 7.00 am to 6.00 pm, on Sundays and public holidays: 8.00 am to 6.00 pm.
dB	Noise is measured in units called decibels (dB).
DPIE	NSW Department of Planning, Industry and Environment
EA	Environmental assessment
EMM	EMM Consulting Pty Limited
EP&A Act	NSW *Environmental and Planning Assessment Act 1979* (NSW)
EPA	NSW Environment Protection Authority (formerly the Department of Environment, Climate Change and Water).
Evening period	Monday–Saturday: 6.00 pm to 10.00 pm, on Sundays and public holidays
ICNG	Interim Construction Noise Guideline
Intrusive noise level	The intrusive noise level refers to noise that intrudes above the background level by more than 5 dB.
L_{A1}	The A-weighted noise level exceeded for 1% of the time.
L_{A10}	The A-weighted noise level which is exceeded 10% of the time. It is roughly equivalent to the average of maximum noise level.
L_{A90}	The A-weighted noise level that is exceeded 90% of the time. Commonly referred to as the background noise level.
L_{Aeq}	The A-weighted energy average noise level. This is the equivalent continuous sound pressure level over a given period. The $L_{Aeq(15\text{-}minute)}$ descriptor refers to an L_{Aeq} noise level measured over a 15 minute period.
L_{Amax}	The maximum A-weighted sound pressure level received during a measurement interval.
Night period	Monday–Saturday: 10.00 pm to 7.00 am, on Sundays and public holidays: 10.00 pm to 8.00 am.
NMP	Noise management plan
PNTL	The project noise trigger levels (PNTLs) are targets for a particular industrial noise source or industry. The PNTLs are the lower of either the project intrusive noise level or project amenity noise level.
POEO Act	NSW *Protection of the Environment Operations Act 1997* (NSW)

Table G.1 Glossary of acoustic terms and abbreviations

Abbreviation or term	Definition
RBL	The rating background level (RBL) is an overall single value background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the average background levels.
RNP	Road Noise Policy
Sound power level (L_w)	A measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.
Temperature inversion	A meteorological condition where the atmospheric temperature increases with altitude.

It is useful to have an appreciation of decibels (dB), the unit of noise measurement. Table G.2 gives an indication as to what an average person perceives about changes in noise levels. Examples of common noise levels are provided in Figure 8.1.

Table G.2 Perceived change in noise

Change in sound level (dB)	Perceived change in noise
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times (or quarter) as loud

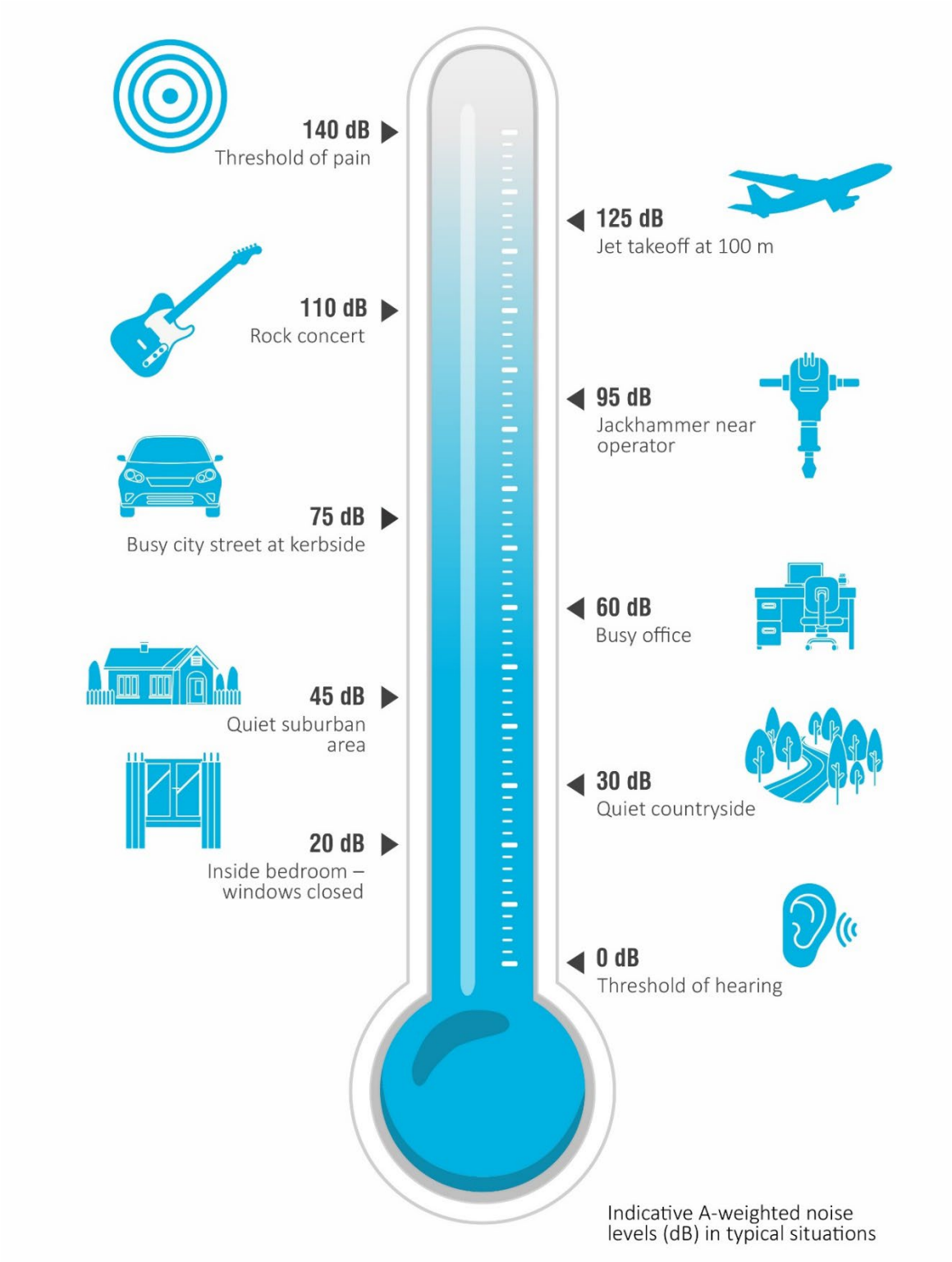
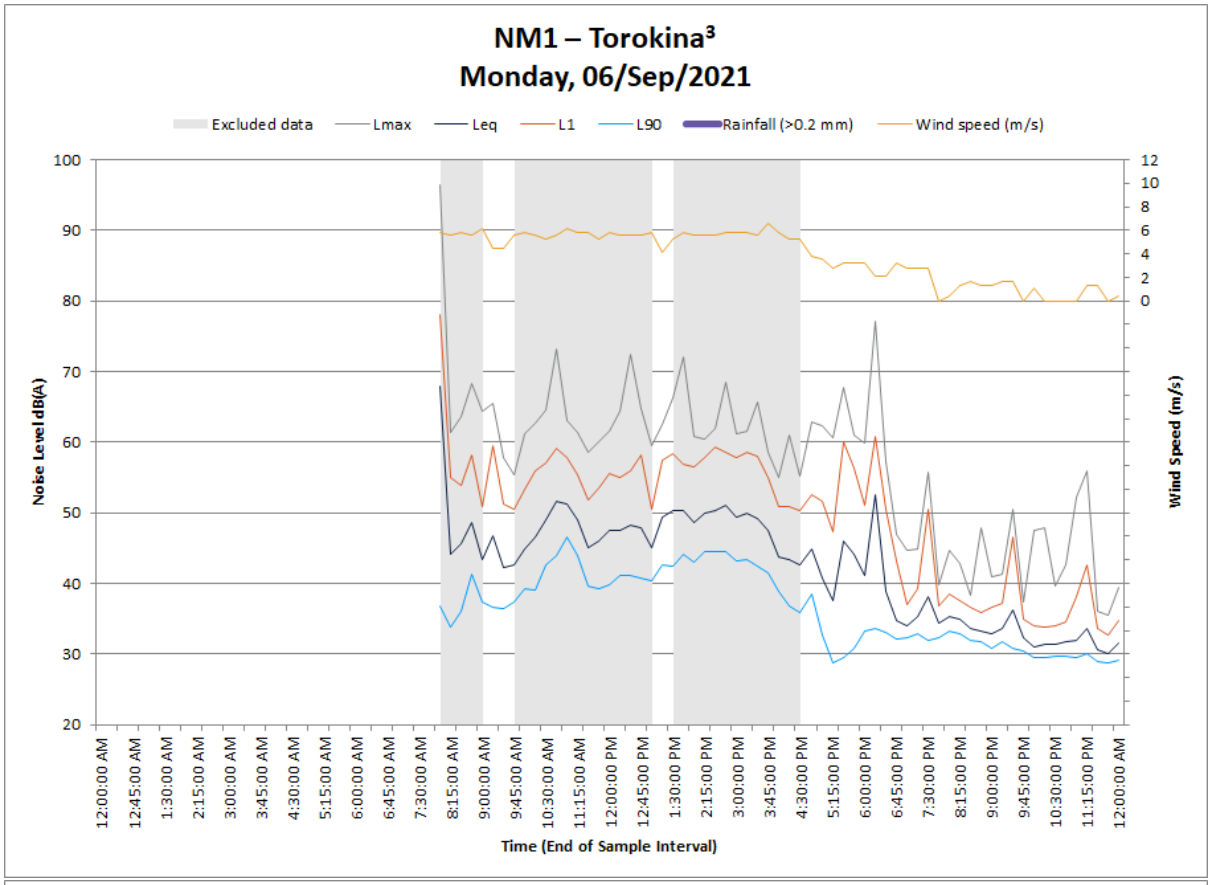


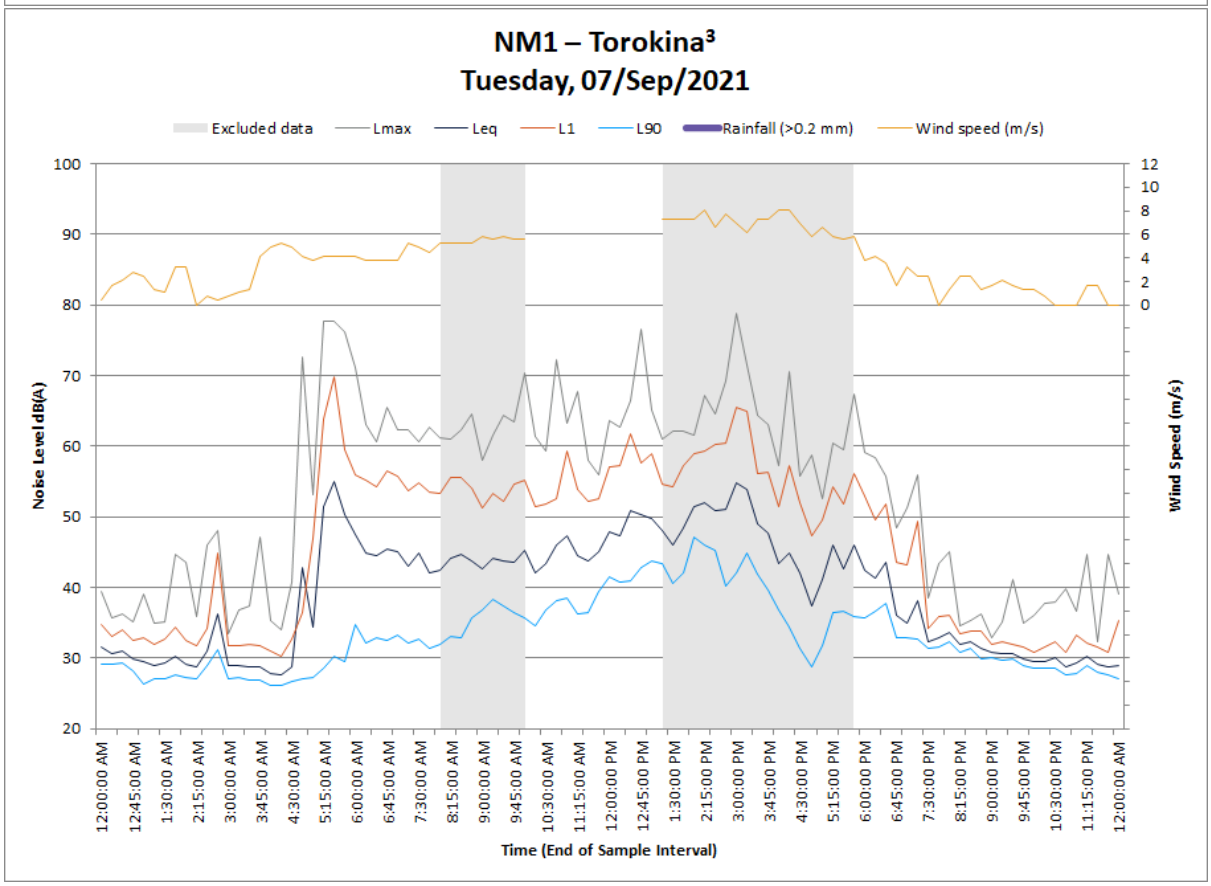
Figure 8.1 **Common noise levels**

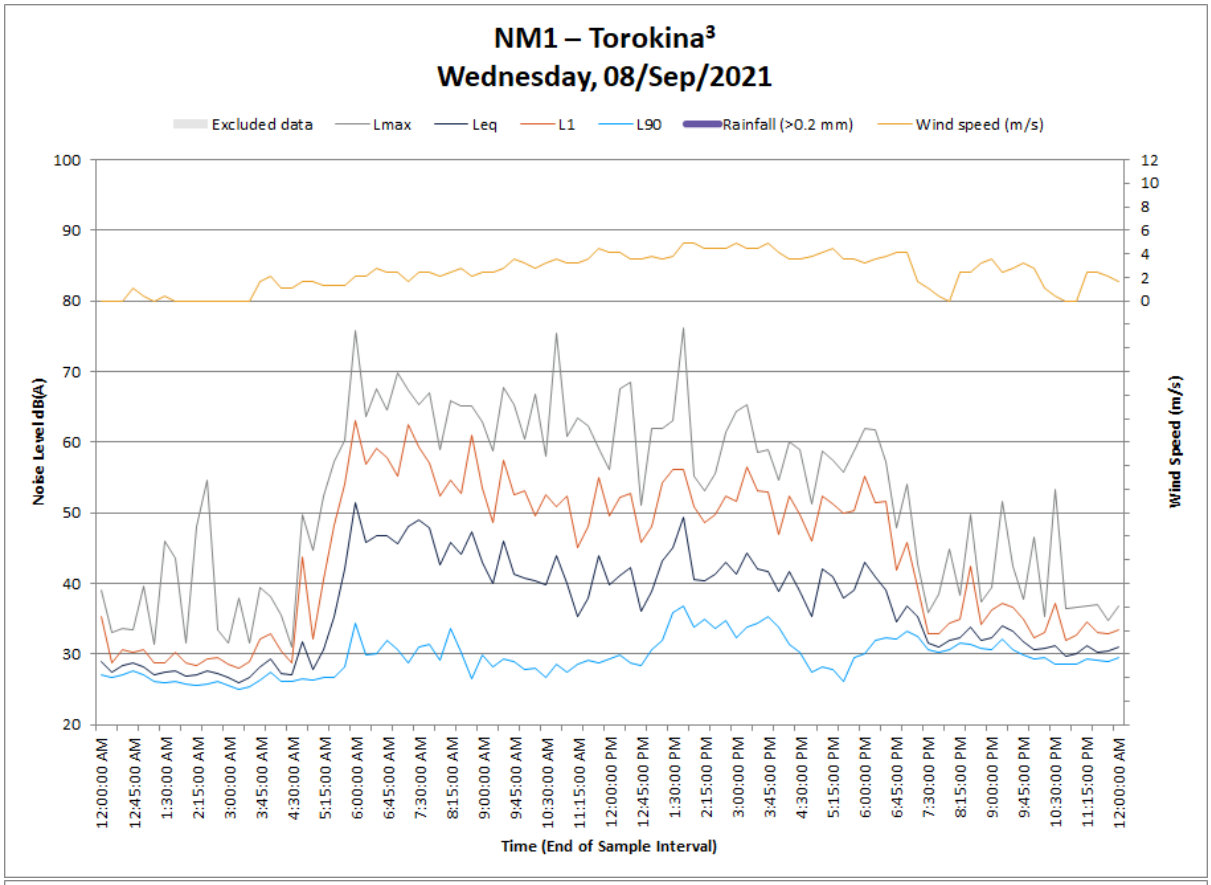
Appendix A

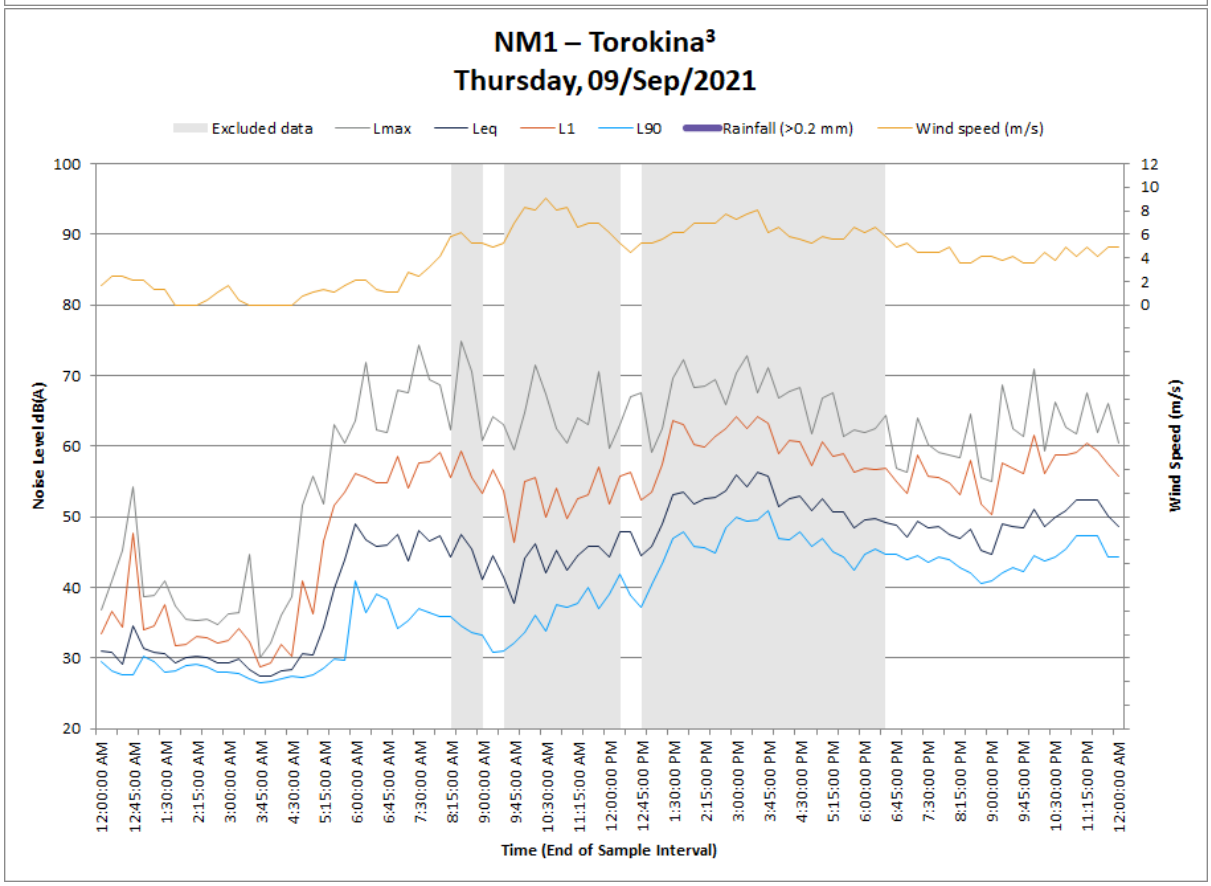
Ambient noise monitoring results and levels

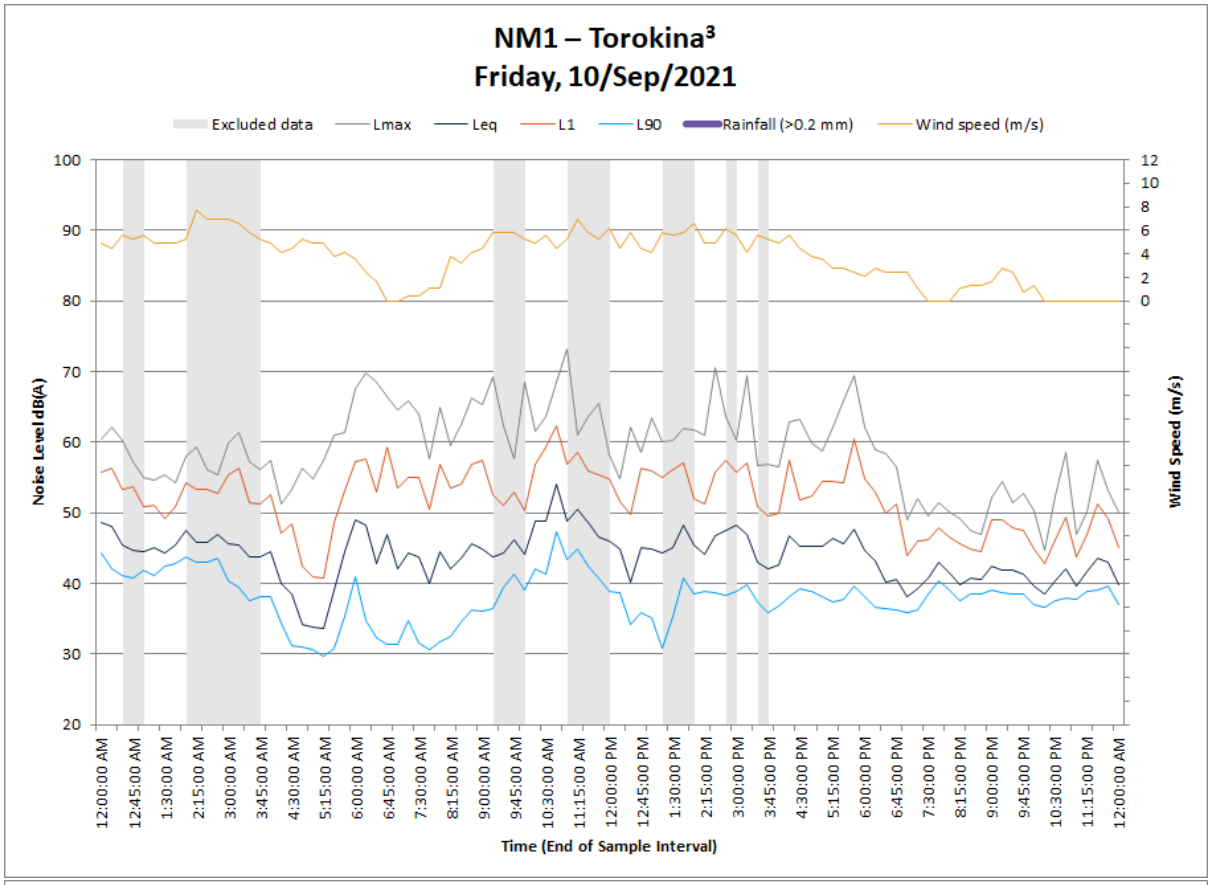
EMM
creating opportunities

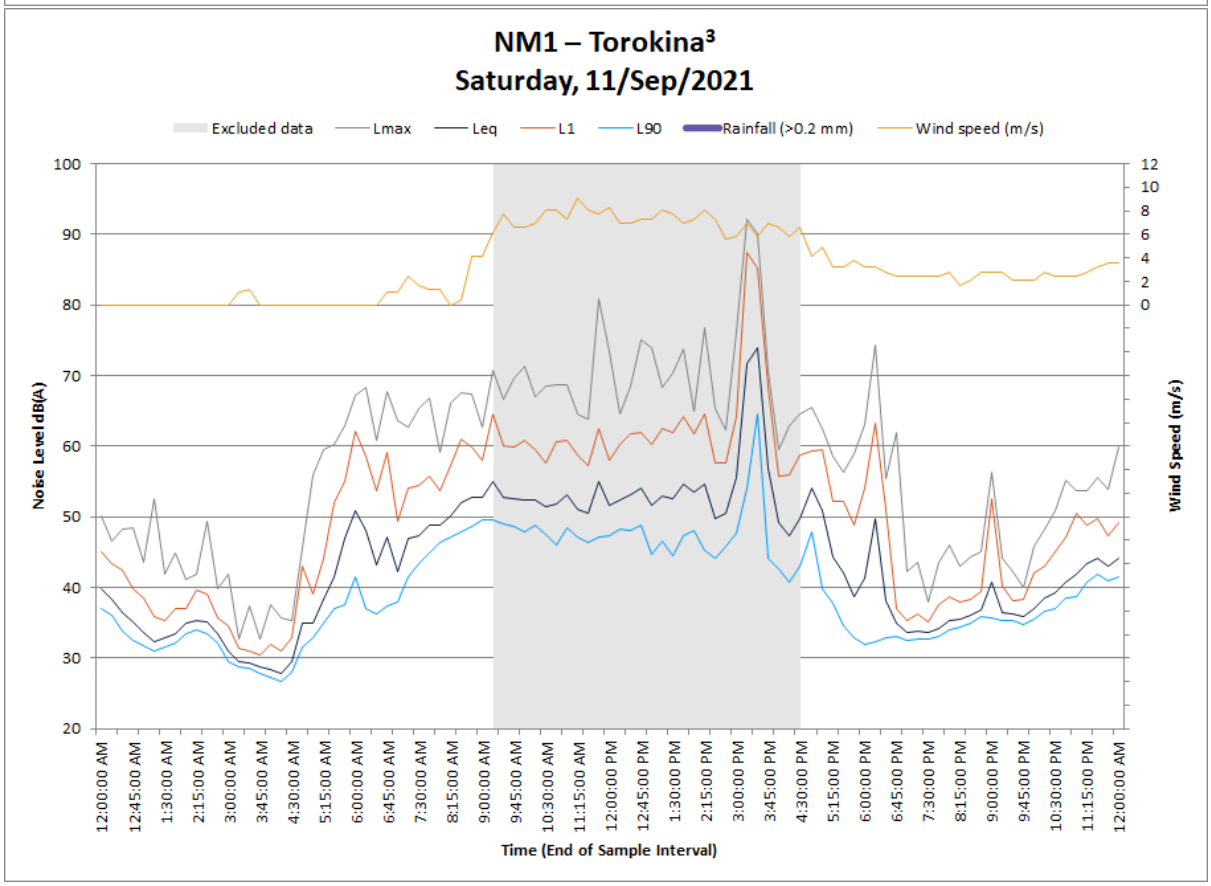

NM1 – Torokina³
Monday, 06/Sep/2021
Excluded data
Lmax
Leq
L1
L90
Rainfall (>0.2 mm)
Wind speed (m/s)
Noise Level dB(A)
Wind Speed (m/s)
Time (End of Sample Interval)

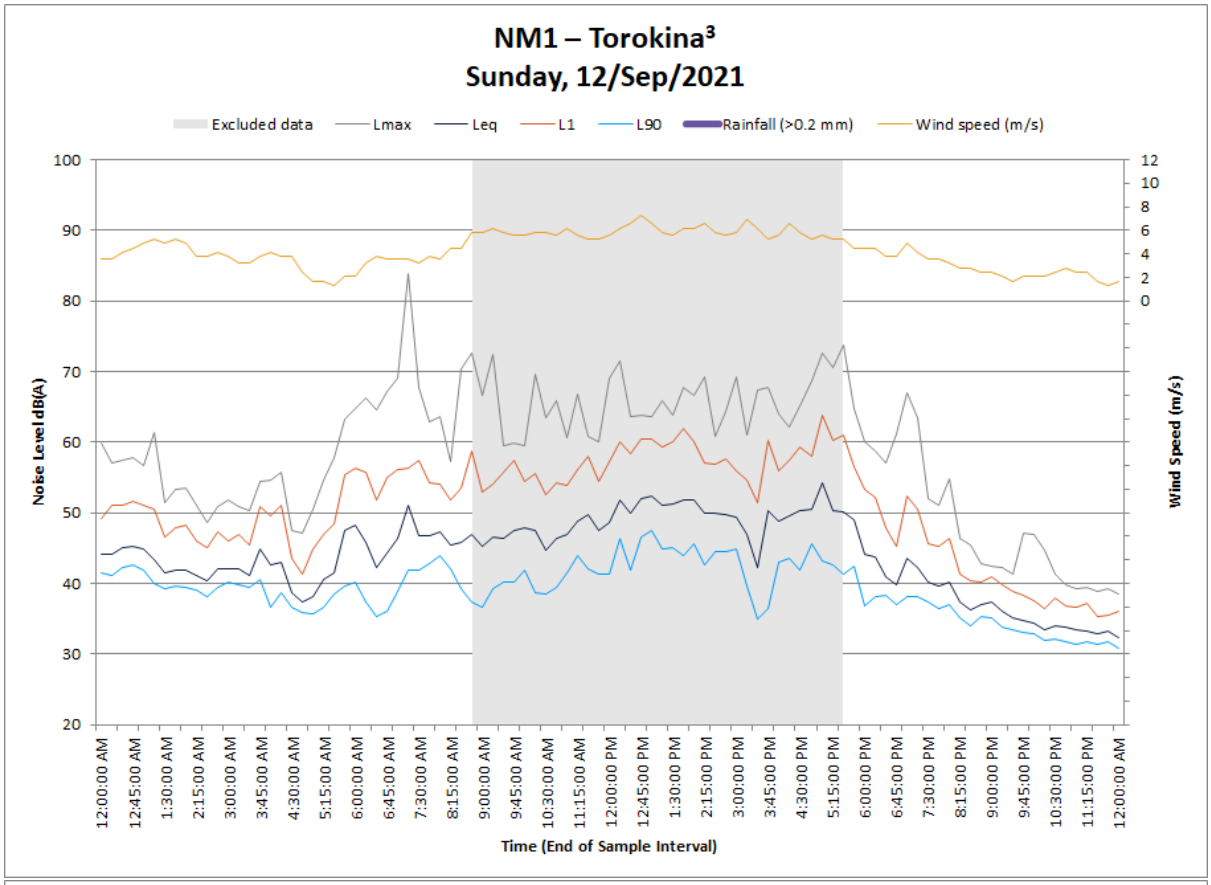

NM1 – Torokina³
Tuesday, 07/Sep/2021
Excluded data
Lmax
Leq
L1
L90
Rainfall (>0.2 mm)
Wind speed (m/s)
Noise Level dB(A)
Wind Speed (m/s)
Time (End of Sample Interval)

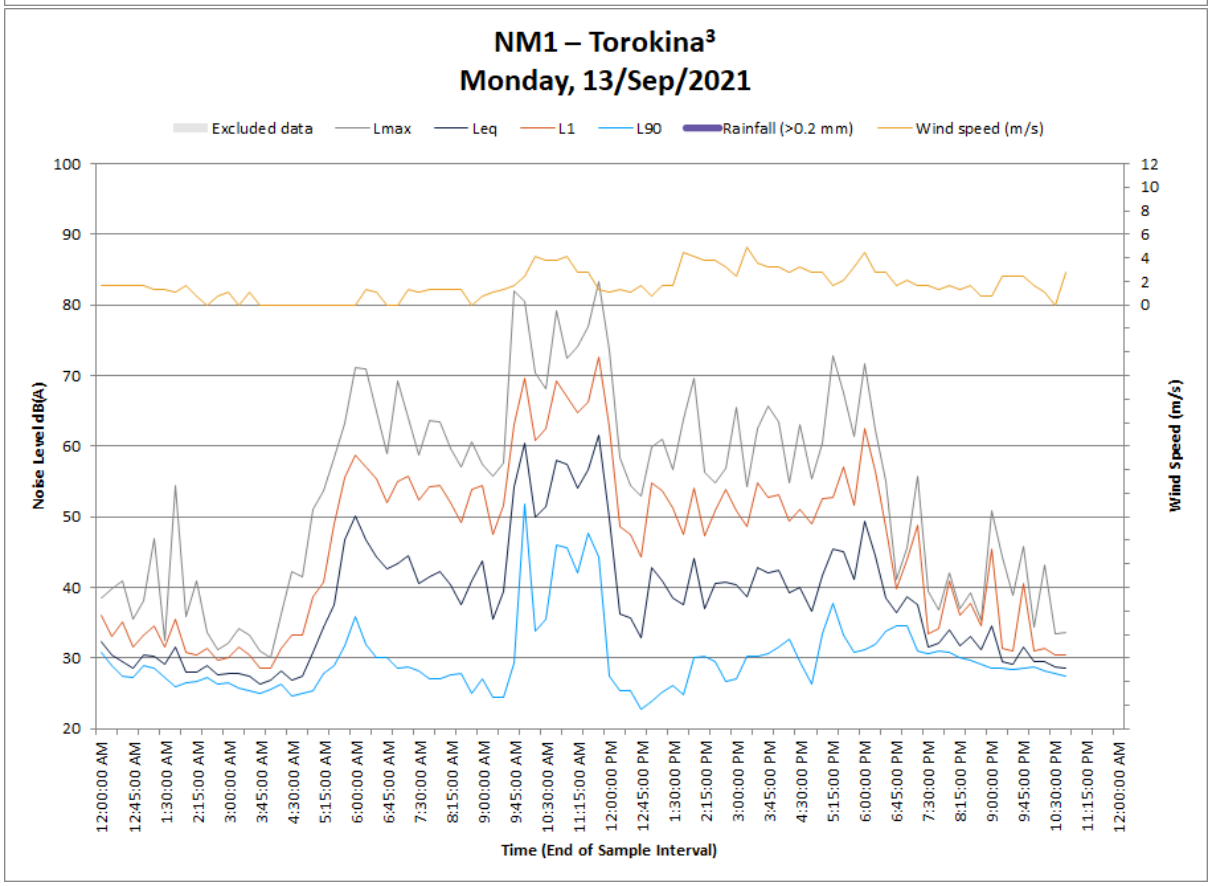

NM1 – Torokina³
Wednesday, 08/Sep/2021
Excluded data
Lmax
Leq
L1
L90
Rainfall (>0.2 mm)
Wind speed (m/s)
Noise Level dB(A)
Wind Speed (m/s)
Time (End of Sample Interval)


NM1 – Torokina³
Thursday, 09/Sep/2021
Excluded data
Lmax
Leq
L1
L90
Rainfall (>0.2 mm)
Wind speed (m/s)
Noise Level dB(A)
Wind Speed (m/s)
Time (End of Sample Interval)


NM1 – Torokina³
Friday, 10/Sep/2021
Excluded data
Lmax
Leq
L1
L90
Rainfall (>0.2 mm)
Wind speed (m/s)
Noise Level dB(A)
Wind Speed (m/s)
Time (End of Sample Interval)


NM1 – Torokina³
Saturday, 11/Sep/2021
Excluded data
Lmax
Leq
L1
L90
Rainfall (>0.2 mm)
Wind speed (m/s)
Noise Level dB(A)
Wind Speed (m/s)
Time (End of Sample Interval)


NM1 – Torokina³
Sunday, 12/Sep/2021
Excluded data
Lmax
Leq
L1
L90
Rainfall (>0.2 mm)
Wind speed (m/s)
Noise Level dB(A)
Wind Speed (m/s)
Time (End of Sample Interval)

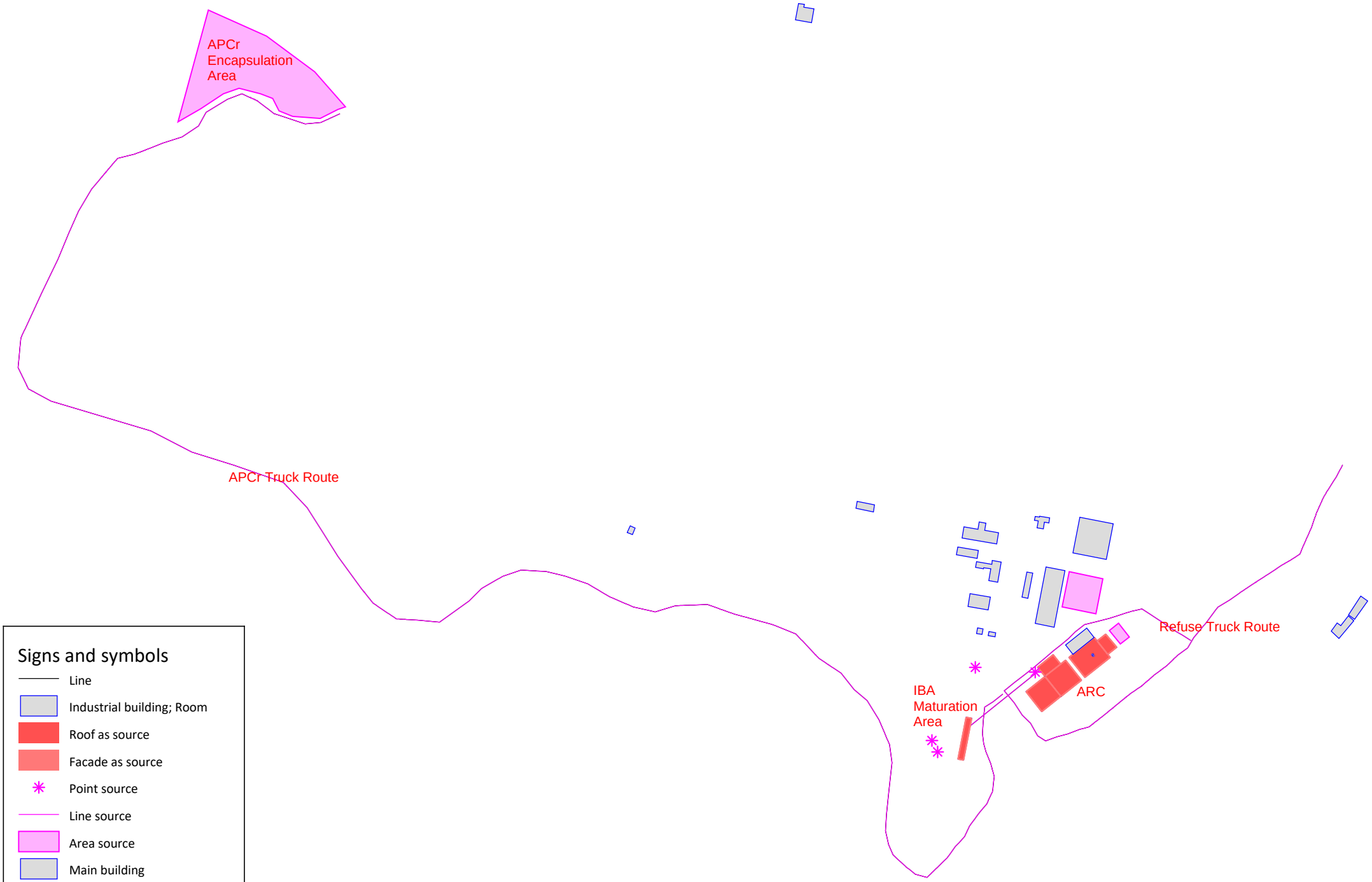

NM1 – Torokina³
Monday, 13/Sep/2021
Excluded data
Lmax
Leq
L1
L90
Rainfall (>0.2 mm)
Wind speed (m/s)
Noise Level dB(A)
Wind Speed (m/s)
Time (End of Sample Interval)

Appendix B

Noise modelling – source locations and levels

EMM
creating opportunities

Noise Source Locations



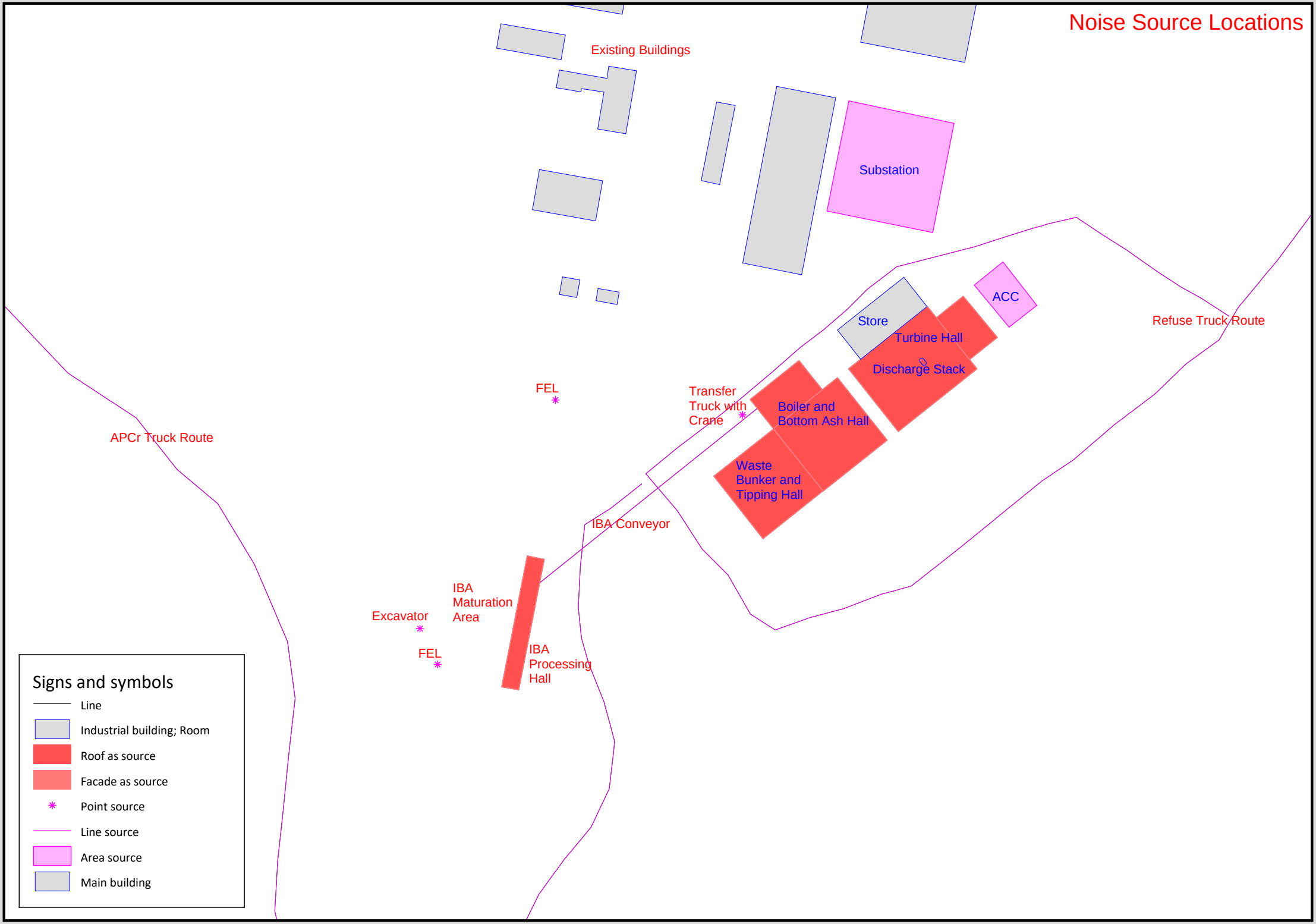

Noise Source Locations
Existing Buildings
Substation
ACC
Store
Turbine Hall
Discharge Stack
Refuse Truck Route
FEL
Transfer
Truck with
Crane
Boiler and
Bottom Ash Hall
APCr Truck Route
Waste
Bunker and
Tipping Hall
IBA Conveyor
IBA
Maturation
Area
Excavator
FEL
IBA
Processing
Hall
Signs and symbols
Line
Industrial building; Room
Roof as source
Facade as source
Point source
Line source
Area source
Main building

Table B.1 Source Noise Levels

Equipment/Activity	Source	Number of items (per 15 minutes)	SWL per item, LAeq	Total SWL, LAeq	Single Octave Band SWL per Item, LZeq								
					31.5	63	125	250	500	1000	2000	4000	8000
Area, single point and line sources													
Air Cooled Condensers	Staffordshire Noise Assessment	8	90	99	94	94	92	90	88	85	80	74	65
Refuse trucks (44t)	DEFRA – 2005 Table 8 Ref No. 19	3	106	111		116	109	107	104	100	98	92	88
Loader (30t)	DEFRA – 2006 Table 1(a) Ref No. 26	2	105	108		114	110	106	100	100	98	92	85
Conveyor (dB/m)	EMM Database - Visy Tumut	1	74	74		79	73	73	64	64	63	68	68
Conveyor Drive	EMM Database - Visy Tumut	1	88	88		82	80	79	82	86	78	74	68
APCr Encapsulation Area													
Transfer truck with crane	DEFRA – 2005 Table 4 Ref No. 53	1	105	105		109	106	104	102	100	97	92	84
Loader(30t)	DEFRA– 2006 Table 1(a) Ref No. 26	0.7*	105	104		114	110	106	100	100	98	92	85
Dozer (CAT D8)	EMM database	0.5*	113	110	118	112	122	113	107	106	107	103	94
Excavator (22t)	DEFRA – 2005 Table 2 Ref No. 3	0.7*	106	104		108	111	104	101	100	98	97	94
Lighting tower	DEFRA – 2005 Table 4 Ref No. 86	1	93	93		105	100	92	88	87	85	82	70
Compressor	DEFRA – 2005 Table 3 Ref No. 19	1	103	103		103	99	93	98	99	97	90	85
Substation (HV transformer)	EMM Database - Mornington BESS	1	86	86		80	86	89	83	80	78	74	60
Excavator(22t)	DEFRA – 2005 Table 2 Ref No. 3	1	106	106		108	111	104	101	100	98	97	94
ARC space averaged internal noise levels													
Waste Bunker and Tipping Hall	Staffordshire Noise Assessment	1	80	80	84	84	84	77	74	74	74	65	71
Turbine Hall	Staffordshire Noise Assessment	1	95	95	88	85	90	88	89	90	90	85	79

Equipment/Activity	Source	Number of items (per 15 minutes)	SWL per item, LAeq	Total SWL, LAeq	Single Octave Band SWL per Item, LZeq							
					31.5	63	125	250	500	1000	2000	4000	8000
Bottom Ash Hall	Staffordshire Noise Assessment	1	75	75	86	85	77	71	71	69	68	68	59
Boiler Hall	Staffordshire Noise Assessment	1	85	85	86	86	83	83	82	78	78	77	71
Flue Gas Treatment	Staffordshire Noise Assessment	1	85	85	86	86	83	83	82	78	78	77	71
Discharge Stack without silencer	Staffordshire Noise Assessment	1	119	119		120	118	118	112	110	106	100	95
Discharge Stack with silencer	Staffordshire Noise Assessment	1	88	88		112	98	79	77	72	68	46	59
IBA Maturation Building													
Trommel	From MBT Assessment	1	109	109	102	105	104	98	104	103	103	99	91
FE separator	From MBT Assessment	1	99	99	92	92	91	91	100	93	90	81	71
Eddy current separator	Greystone Quarry Assessment	1	101	101	100	99	97	93	93	92	94	97	92
Vibratory Screen	Noise controls for vibrating screen mechanisms	1	100	100			103	104	100	90	88	83	79
Reverberant internal noise level	**Reverberant level**		***84***			***74***	***75***	***80***	***81***	***78***	***78***	***76***	***69***

* limited operators so partial time in use as plant could not operate simultaneously

•

Table B.2 Low frequency tonality review

Attenuated levels (wall)	Single Octave Band SWL per Item, LZeq									
	31.5	63	125	250	500	1000	2000	4000	8000	C-A weight
Waste Bunker and Tipping Hall	74	69	64	56	49	49	44	27	33	19
Turbine Hall	78	70	69	66	64	65	60	47	41	9
Bottom Ash Hall	76	70	57	50	46	44	38	30	21	24
Boiler Hall	76	71	63	62	57	53	48	39	33	16

Table B.2 Low frequency tonality review

	Single Octave Band SWL per Item, LZeq									
Flue Gas Treatment	76	71	63	62	57	53	48	39	33	16
Receiver Levels at R1 Woodlawn Farm and R2 Cowley Hills										
Waste Bunker and Tipping Hall	34	29	24	16	9	9	4	-13	-7	
Turbine Hall	38	30	29	26	24	25	20	7	1	
Bottom Ash Hall	36	30	17	10	6	4	-2	-10	-19	
Boiler Hall	36	31	23	22	17	13	8	-1	-7	
Flue Gas Treatment	36	31	23	22	17	13	8	-1	-7	

No need for adjustment as noise levels at receivers below the thresholds of Table C2 of NPfI

Table C2: One-third octave low-frequency noise thresholds.

Hz/dB(Z)	One-third octave $L_{Zeq,15min}$ threshold level												
Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB(Z)	92	89	86	77	69	61	54	50	50	48	48	46	44

Notes:

- dB(Z) = decibel (Z frequency weighted).

Table B.3 Source levels and heights (points, lines and areas)

Source	Height (m)	Area m2/ lineal m	Lw
Air Cooled Condensers (total)	3	594m2	98
Refuse trucks (44t)	2	1,246m	111
Loader	2	point source	105
Conveyor (dB/m)	varies	per lineal m	74
Conveyor Drive	11	point source	88

Source		Height (m)	Area m2/ lineal m	Lw
Transfer truck with crane (APCr cells NW)		2	point source	105
Loader		2	point source	105
Dozer (CAT D8)		2	point source	113
Excavator (22t)		2	point source	106
Lighting tower		2	point source	93
Compressor		2	point source	103
Substation (HV transformer)		2	3,822m2	86
Excavator (22t)		2	point source	106
Waste Bunker and Tipping Hall (dB/m2)*				
	north (clad)	n/a	n/a	45
	east (clad)	0-25	1073m2	45
	south (clad)	0-25	1113m2	45
	west (clad)	0-25	1073m2	45
	roof (clad)	25	1922m2	45
Turbine Hall (dB/m2)*				
	north (clad)	0-12	359m2	60
	east (clad)	0-12	238m2	60
	south (clad)	n/a	n/a	60
	west (clad)	0-12	238m2	60
	roof (clad)	12	590m2	60
Bottom Ash Hall (dB/m2)*				
	north (clad)	0-25	520m2	44
	east (clad)	n/a	n/a	44
	south (clad)	0-25	520m2	44
	west (clad)	0-25	861m2	44
	roof (clad)	25	736m2	44

Source	Height (m)	Area m2/ lineal m	Lw
Boiler Hall (dB/m2)*			
north (clad)	0-45	2019m2	53
east (clad)	0-45	2059m2	53
south (clad)	0-45	2019m2	53
west (clad)	0-45	2059m2	53
roof (clad)	45	2069m2	53
Flue Gas Treatment (dB/m2)*			
north (clad)	0-25	1118m2	53
east (clad)	0-25	1410m2	53
south (clad)	0-25	1118m2	53
west (clad)	0-25	1410m2	53
roof (clad)	25	2535m2	53
Discharge Stack (with silencer)	85	point source	88
IBA Maturation Building*			
north (clad)	0-11	112m2	64
east (clad)	0-11	826m2	64
south (clad)	0-11	112m2	64
west (open)	0-11	826m2	84
roof (clad)	11	729m2	64

* Attenuated noise level from proposed cladding of building walls and roof

Australia

SYDNEY
Ground floor 20 Chandos Street
St Leonards NSW 2065
T 02 9493 9500

NEWCASTLE
Level 3 175 Scott Street
Newcastle NSW 2300
T 02 4907 4800

BRISBANE
Level 1 87 Wickham Terrace
Spring Hill QLD 4000
T 07 3648 1200

CANBERRA
Level 2 Suite 2.04
15 London Circuit
Canberra City ACT 2601

ADELAIDE
Level 4 74 Pirie Street
Adelaide SA 5000
T 08 8232 2253

MELBOURNE
Suite 8.03 Level 8 454 Collins Street
Melbourne VIC 3000
T 03 9993 1900

PERTH
Suite 9.02 Level 9 109 St Georges Terrace
Perth WA 6000

Canada

TORONTO
2345 Younge Street Suite 300
Toronto ON M4P 2E5

VANCOUVER
60 W 6th Ave Suite 200
Vancouver BC V5Y 1K1

linkedin.com/company/emm-consulting-pty-limited

emmconsulting.com.au