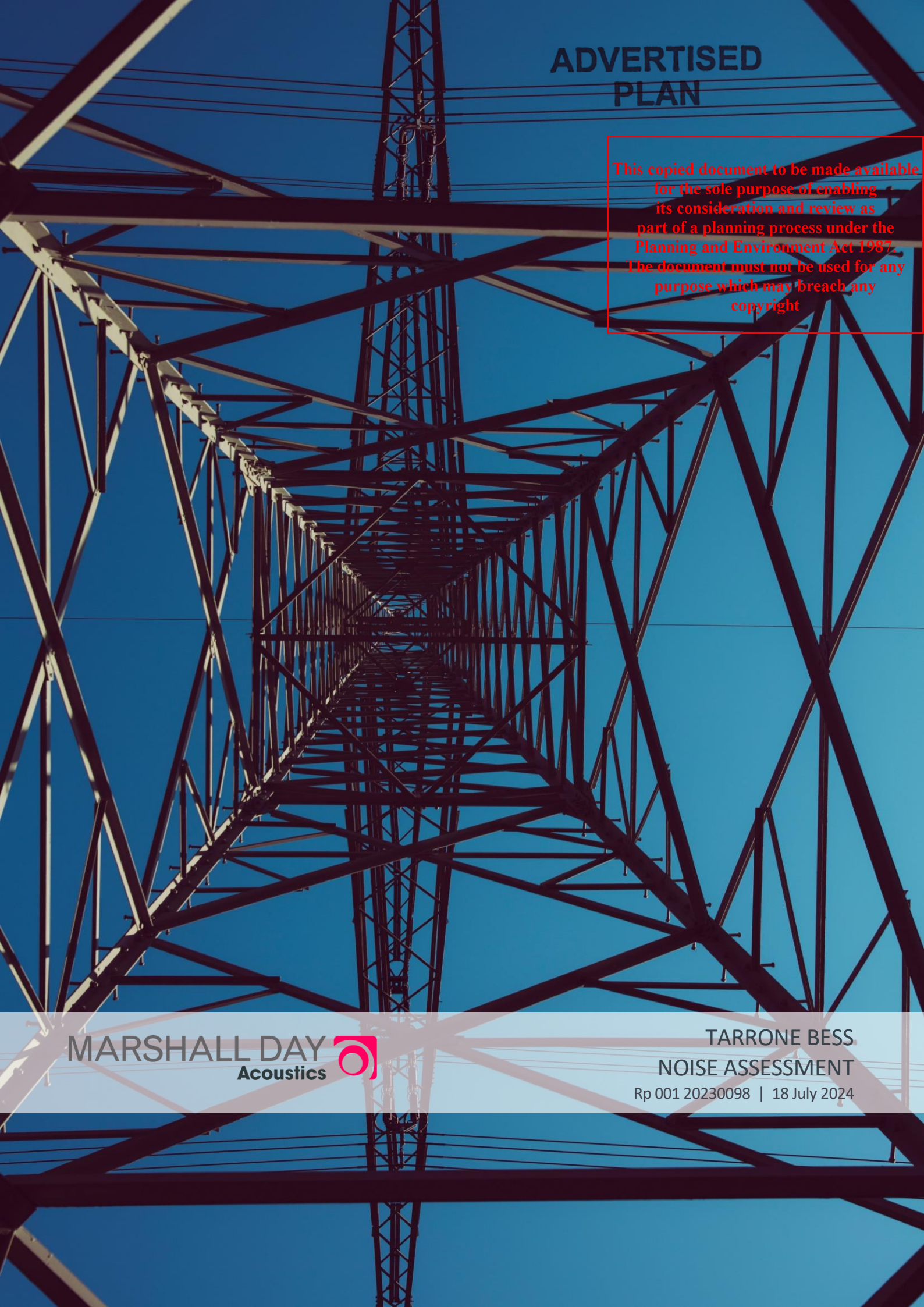

MARSHALL DAY Acoustics

TARRONE BESS
NOISE ASSESSMENT

Rp 001 20230098 | 18 July 2024

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EXECUTIVE SUMMARY

Marshall Day Acoustics Pty Ltd (MDA) has been engaged to prepare an environmental noise and vibration assessment for a proposed grid-scale battery energy storage system (BESS) referred to as Tarrone BESS (the Project). The Project is proposed to be located adjacent to the existing Tarrone Terminal Station, approximately 12 km southeast of the township of Broadwater, within the Moyne Shire Council local government area in Victoria.

The following has been considered:

- Operational noise from the project
- Noise and vibration during the construction of the project
- Cumulative operational noise considering other nearby premises.

MDA has been provided with inputs for the assessment by the proponent, Global Power Generation Australia Pty Ltd (GPGA), as far as they are available at this stage of the development process. Where relevant noise data or input information could not be provided, MDA has developed this information from previous project experience, relevant standards, and typical noise assessment assumptions. The developed data has been reviewed by GPGA and approved as being representative of the types and specification of equipment items likely to be used for the Project.

The assessment, summarised in this report, represents a 'proof of concept' based on the specific site layout and nominal equipment selections available at this stage, and summarises the noise and vibration assessment for the Project. It contains details of the current project layout, proposed project infrastructure and associated noise data, and evaluation of predicted noise levels against the relevant environmental noise criteria.

Where changes from any aspect of the assessment detailed in this report occur, e.g. during design development, tender or procurement, the changes should be reviewed to verify continued compliance of this Project. In particular, given the early stage of project design development it is expected that further noise assessment should be conducted once a finalised project design, equipment selections and associated manufacturer's noise data are determined

Operational noise associated with the Project is predicted to be below the noise limits derived in accordance with EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* published May 2021 (the Noise Protocol), when considered individually.

Cumulative considerations of noise for the Project are complex and have been reviewed in detail as part of the assessment. Other projects in the area include the existing Tarrone Terminal Station, and the proposed and approved Tarrone Power Station and Willatook substation and BESS.

The two proposed and approved projects are known to have significant development delays and challenges. Tarrone Power Station received EPA Works Approval in 2010, with a facilitating Amendment C47 to the Moyne Planning Scheme being approved by the Minister for Planning in 2012. No construction has commenced since, or is planned by the developer AGL Energy Ltd. Willatook substation and BESS is associated with the wider Willatook Wind Farm which is subject to a Ministers Assessment significantly restricting the scale of the development.

In addition, the published noise assessments associated with the projects demonstrate that even in the absence of the Project, cumulative predicted noise levels will be above the Noise Protocol noise limits at nearby receivers.

On this basis the cumulative noise assessment detailed in this report is capable of demonstrating compliance with the Noise Protocol noise limits provided:

- An equal sharing principle is adopted for noise budget distribution for component commercial, industrial and trade (CIT) premises i.e. Tarrone Terminal Station, Tarrone Power Station, Willatook substation and BESS, and the Project
- The Project is developed during detailed design such that predicted noise levels are at or below the equal sharing noise limit – preliminary noise control analysis indicates that there is likely to be sufficient engineering noise controls available that this is achievable
- Noise associated with Tarrone Power Station and Willatook substation and BESS is controlled by their respective developers such that the equal sharing noise limit is achieved individually, and therefore the Noise Protocol noise limit is achieved cumulatively (noting that this is a legal obligation for any and all premises that may be developed in the area).

Construction noise levels have been estimated under typical worst-case scenarios (i.e. with equipment working closest to receivers) to inform best practice noise controls that should be incorporated into a Construction Noise and Vibration management plan at the detailed design phase of the project.

Peak vibration levels due to construction plant are expected to be well below the most stringent peak vibration criteria.

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1.0 INTRODUCTION

Global Power Generation Australia Pty Ltd (GPGA) are proposing to develop a grid-scale battery energy storage system (BESS) referred to as Tarrone BESS (the Project). The Project is proposed to be located adjacent to the existing Tarrone Terminal Station, approximately 12 km southeast of the township of Broadwater.

The Project is a grid-scale battery energy storage facility to have a storage capacity of 200-megawatt AC (MWac) / 400-megawatt hour (MWh), which will utilise the latest in grid forming inverter and Lithium Ion (Li-Ion) battery storage technologies.

Umwelt (Australia) Pty Ltd (Umwelt) are assisting GPGA with the planning submission for the Project. Marshall Day Acoustics Pty Ltd (MDA) has been engaged by Umwelt to undertake an environmental noise and vibration assessment suitable for inclusion in the planning permit application (PPA) to be submitted to the Department of Transport and Planning (DTP).

The assessment, summarised in this report, represents a 'proof of concept' based on the specific site layout and nominal equipment selections available at this stage, and summarises the noise and vibration assessment for the Project. It contains details of the current project layout, proposed project infrastructure and associated noise data, and evaluation of predicted noise levels against the relevant environmental noise criteria.

Where changes from any aspect of the assessment detailed in this report occur, e.g. during design development, tender or procurement, the changes should be reviewed to verify continued compliance of this Project. In particular, given the early stage of project design development it is expected that further noise assessment should be conducted once a finalised project design, equipment selections and associated manufacturer's noise data are determined

The primary requirements for the Project are governed by the *Environment Protection Act 2017* (EP Act) and its subordinate legislation, including:

- *Environment Protection Regulations 2021* (EP Regulations)
- EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* published May 2021 (Noise Protocol)
- *Environment Reference Standard* published 25 May 2021, and as amended by Environment Reference Standard No. S158 Gazette 29 March 2022 (ERS).

In addition to these documents, several EPA publications provide the methodologies and guidance required to complete a noise assessment, including EPA Publication 1834.1 *Civil construction, building and demolition guide* (EPA Publication 1834.1), which address construction noise and vibration.

A glossary of acoustic terminology used throughout this report is provided in Appendix A.

2.0 PROJECT OVERVIEW

2.1 Project description

The Project is a grid-scale battery energy storages system (BESS) proposed by GPGA in Tarrone, Victoria. The BESS is anticipated to have a storage capacity of 200-megawatt AC (MWac) / 400-megawatt hour (MWh), which will utilise the latest in grid forming inverter and Lithium Ion (Li-Ion) battery storage technologies.

The purpose of the Project is to install battery storage capacity connecting to the existing Tarrone Terminal Station located to the west of the Project site. The Project aims to connect to and make use of the existing Tarrone Terminal Station. An underground transmission line will stretch from the power transformer within the BESS to a recently built 132kV switchyard at the Tarrone Terminal Station. This switchyard is crucial for facilitating the connection of GPGA's Ryan Corner Wind Farm and Hawkesdale Wind Farm projects.

The Project is located within Moyne Shire Council local government area, approximately 7.5 km east of the township of Orford, 14.5 km west of Hawkesdale, 23 km north of Port Fairy and 250 km west of Melbourne CBD.

The Project site is located at 574 Tarrone North Road, Tarrone, VIC 3283 on land formally known as Lot 7~A PP2835, which is proposed to be subdivided into Lot 2 PS 918386 and Lot 2 LP218923. The Project site is owned by Ryan Corner Development Pty Ltd, a wholly owned subsidiary of GPGA.

The Project site is approximately six hectares, inclusive of the underground transmission connection to the National Energy Market (NEM) at Tarrone Terminal Station. An existing 500kV transmission line extends generally north of the Project site from the east and connects to the Tarrone Terminal Station. The Project site is generally bound by Riordans Road to the south, Tarrone Terminal Station to the west, a private road to the north (utilised to access the Tarrone Terminal Station) and Tarrone North Road to the east.

The primary land use within the Project site is agriculture, i.e. pasture and grassland, and has historically been used for domestic stock grazing. Under the Moyne Planning Scheme, the Project site is predominantly zoned Farming Zone (FZ). There are no crown land or public land sites present within the Project site. A land zoning map is provided in Appendix B.

Limited Project infrastructure, primarily related to transmission connection, is proposed to be located within Special Use Zone – Schedule 6 (SUZ6). This is a specific zone established in relation to the proposed Tarrone Power Station. Tarrone Power Station is addressed in more detail in later sections of this report.

Based on information provided by the GPGA, the Project is proposed to comprise:

- A BESS including battery enclosures and inverters, with a capacity of up to 200 MW / 400 MWh
- A HV collector substation
- Ancillary elements including but not limited to internal access roads and parking, site office and control room, fencing, and security systems.

A preliminary Project design has been supplied by GPGA and is described as:

- Sixty (60) inverters
- Ninety-two (92) battery units
- One (1) HV transformer
- Eight (8) auxiliary transformers.

The assessment in this report has been based on equipment layouts, confirmed by GPGA to be representative of the proposed size of the Project.

2.2 Project layout

The Project design referred to for the purposes of the noise assessment was provided to MDA by Umwelt / GPGA in email correspondence dated 6 May 2024.

Appendix C details the general arrangement provided by GPGA alongside figures depicting the Project layout within the context of the Project site.

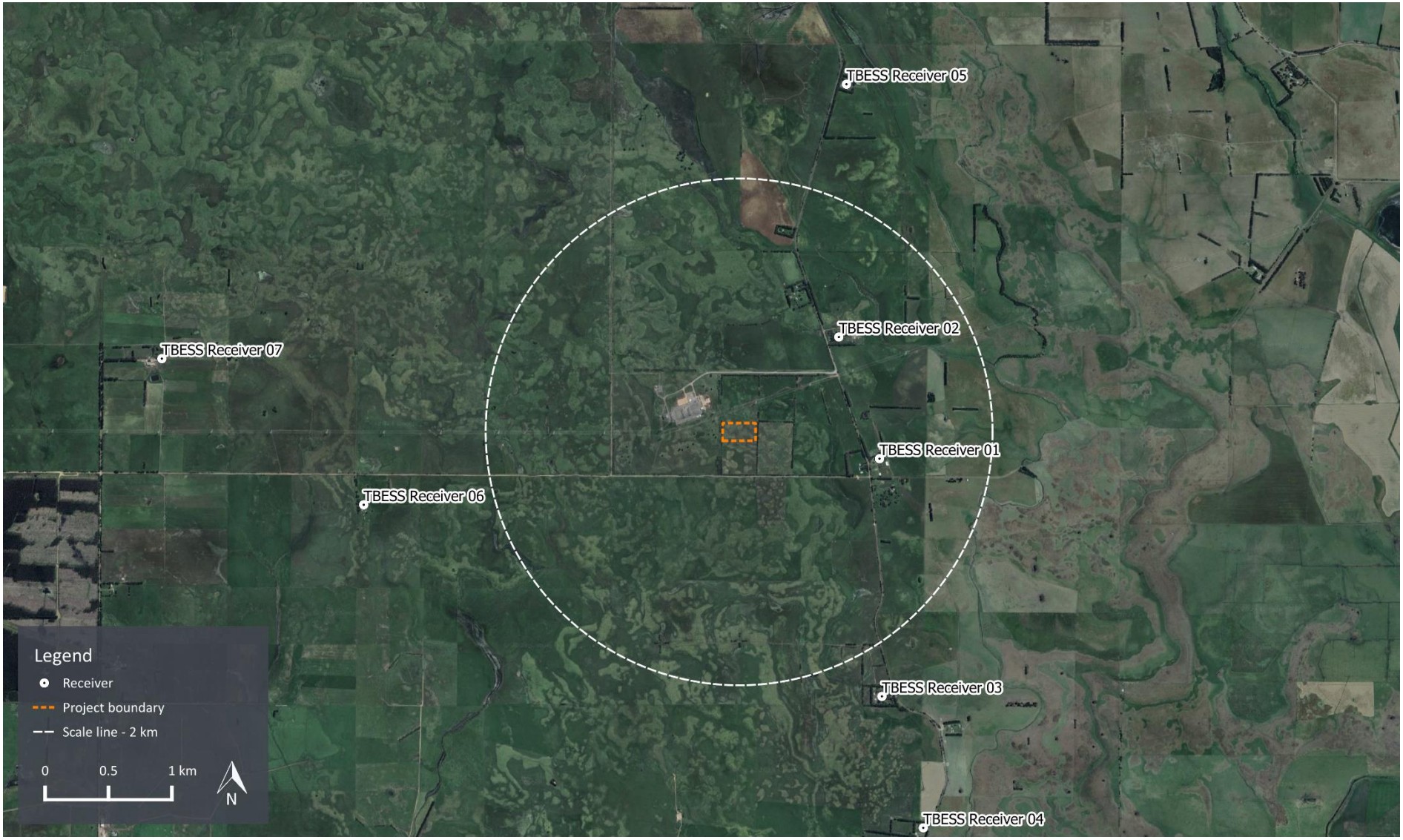
2.3 Noise sensitive receivers

The nearest noise sensitive areas to the Project comprise dwellings identified by Umwelt / GPGA and provided to MDA via correspondence dated 29 May 2024. The co-ordinates of these dwellings, described as receivers throughout this report, are provided in Appendix D.

For the purposes of this assessment receivers within 2 km of the Project have been considered. Compliance at these receivers will indicate compliance at other receivers, further away.

The locations of the receivers in relation to the Project is depicted graphically in Figure 1

Figure 1: Site and receiver layout



3.0 LEGISLATION AND GUIDELINES

3.1 Summary of applicable documents

A summary of the relevant Victorian legislation and guidelines is provided in Table 1. Further details are provided in Appendix E.

Table 1: Noise legislation and guidelines

Document	Overview
Environment Protection Act 2017 (EP Act)	The EP Act provides the overarching legislative framework for the protection of the environment in Victoria. The EP Act does not specify noise limit values but prohibits the emission of unreasonable or aggravated noise from non-residential premises. The EP Act provides general definitions of unreasonable and aggravated noise; definitions that are specific to commercial, industrial and trade premises are provided in supporting publications (see below). Part 3.2 of the EP Act outlines the general environmental duty (GED), which requires anyone engaging in an activity posing a risk of harm to human health and/or the environment from pollution to minimise those risks to prevent harm as far as reasonably practicable. Section 93 of the EP Act provides for the creation of an environmental reference standard to be used to assess and report on environmental conditions in the whole or any part of Victoria (see below).
Environment Protection Regulations 2021 (EP Regulations)	The objectives of the EP Regulations are to further the purposes of, and give effect to, the EP Act. The EP Regulations also define outdoor sensitive areas, commercial, industrial and trade premises. Part 5.3 of the EP Regulations sets out requirements that are specific to environmental noise. Division 1 states that the prediction, measurement, assessment, or analysis of noise within a noise sensitive area for the purposes of the EP Act or the EP Regulations must be conducted in accordance with the Noise Protocol (see below). Division 3 stipulates requirements that are specific to commercial, industrial and trade premises. In particular, noise from these types of premises is prescribed as unreasonable if it exceeds a noise limit or alternative criterion determined in accordance with the Noise Protocol (see below). Additional matters addressed in Divisions 3 and 4 include assessment time periods, minimum noise limit values, management of cumulative noise from multiple premises, noise sensitive areas where assessment requirements apply, definition of frequency spectrum as a prescribed factor, and a definition for aggravated noise.
EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*, dated May 2021 (Noise Protocol)	The Noise Protocol defines the method for setting the noise limits for new and existing commercial, industrial and trade premises and entertainment venues in Victoria. It also outlines the steps that must be followed to undertake an assessment (measurement or prediction) of the effective noise level within a noise sensitive area or at an alternative assessment location. A comparison between the effective noise level and the relevant noise limit or the relevant alternative assessment criterion will determine whether the noise that is emitted from the premises is unreasonable under the EP Regulations. The noise limits for commercial, industrial and trade premises are determined on the basis of land zoning and background noise levels, and are separately designated for day, evening, and night periods.

Document	Overview
Environment Reference Standard dated 25 May 2021 (ERS)	The ERS is made under Section 93 of the EP Act. The ERS sets out environmental values for ambient sound that are sought to be achieved and maintained in Victoria and standards to support those values. The indicators and objectives within the standard provide a benchmark for comparing desired outcomes to the actual state of the environment and a basis for assessing actual and potential risks to the environmental values. The ERS is not a compliance standard, and the values listed within the ERS for different land uses are explicitly not noise limits nor design criteria. The primary function of the ERS is to provide assessment and reporting benchmarks for environmental values. EPA Publication 1992 *Guide to the Environment Reference Standard* states: *Indicators and objectives within the ERS are generally not relevant considerations where they relate to an aspect of the environment that is the subject of prescriptive regulation.* Therefore, we expect that compliance with the objective noise limits determined in accordance with the Noise Protocol would satisfy the environmental noise obligations of the current proposal.
EPA Publication 1834.1 *Civil construction, building and demolition guide*	EPA Publication 1834.1 describes measures for managing noise and vibration from construction and decommissioning of a project. The guidance relates to: • Normal working hours, including scheduling works during normal hours, consultation with affected people and managing noise; • Justified unavoidable works that need to be conducted outside of normal working hours; and • Managing noise and vibration that cannot be eliminated or minimised by source control.
EPA Publication 1997 *Technical guide: Measuring and analysing industry noise and music noise*	Technical guide to assist in the assessment of noise including measurement, prediction, analysis, and reporting conducted in accordance with Part 5.3 of the EP Regulations.
ISO 2631-2:2003 *Mechanical vibration and shock - Evaluation of human exposure to whole-body vibration - Part 2: Vibration in buildings (1 Hz to 80 Hz)*	Provides guidelines for structural vibration for different building usage ranging from critical working areas such as laboratories and operating theatres to residences and workshops
ISO 10137 Annex C Second edition 2007 *Bases for design of structures – Serviceability of buildings and walkways against vibrations*	Provides structural vibration criteria for different building usage based on guidelines consistent with ISO 2631-2

Document	Overview
DIN 4150-3 :2016-12 *Vibration in Buildings - Part 3: Effects on Structures*	Assessment of vibration on structures with respect to the probability of building damage

A central element of the environmental management framework in Victoria is the general environmental duty (GED) under the EP Act. The GED requires all reasonably practicable measures to be implemented to reduce the risk of harm to human health and / or the environment from pollution, including risks associated with potential annoyance from noise. The GED applies wherever there is a risk of harm, regardless of whether the noise emitted has caused complaints or caused harm to people or the environment.

The GED requires the subject site operators to continue to review and eliminate or reduce the risk of harm from any emission of noise as far as reasonably practicable, even if they are compliant with the Noise Protocol.

The GED is applied first to eliminate or reduce the risk of harm to human health and the environment from noise so far as reasonably practicable. Any residual noise remaining after actions are taken to meet the GED is then managed as per the unreasonable noise definitions in Section 166 of the EP Act, i.e. complying with the Noise Protocol. Accordingly, risks of harm to human health and the environment must be considered for the Project.

3.1.1 Operational noise

The noise limits for the Project, applicable at the receivers considered for assessment, are:

- Day 45 dB ENL
- Evening 38 dB ENL
- Night 34 dB ENL

A detailed derivation is provided in Appendix E.

3.1.2 Construction noise

EPA Publication 1834.1 states that noise and vibration is to be minimised at all times, and that project developers should aim to constrain works to normal working hours. Where necessary, and subject to the approval of the relevant authority, construction activities outside normal working hours may occur for:

- Low-noise impact works: inherently quiet or unobtrusive activities that do not have intrusive noise characteristics
- Managed-impact works: activities where the noise emissions are managed through actions specified in a noise and vibration management plan, and which do not have intrusive noise characteristics
- Unavoidable works: activities that need to occur outside of normal working hours due to risks to life or property, potential traffic hazards, e.g. oversized deliveries, or certain types of construction work that cannot be stopped midway through the process, e.g. concrete pours, and tunnelling works.

The EPA Publication 1834.1 time periods that must be accounted for when scheduling construction activities for large industry projects are summarised in Table 2.

Table 2: EPA Publication 1834.1 time period designations

Period	Days	Hours	Note
Normal working hours	Monday to Friday Saturday	0700 – 1800 hrs 0700 – 1300 hrs	All construction activity should occur during these hours unless the activity is justified as 'low-noise impact works', 'managed impact works' or 'unavoidable works'. Noise control requirements for this period are defined in terms of mitigation and management measures; noise limits are not defined for this period.
Evenings and weekend	Monday to Friday Saturdays Sunday & public holidays	1800 – 2200 hrs 1300 – 2200 hrs 0700 – 2200 hrs	Construction noise is not to exceed the background noise by: • 10 dB or more for up to 18 months after project commencement • 5 dB or more after 18 months.
Night	Any day	2200 – 0700 hrs	Noise must be inaudible within a habitable room of any residential premises (referenced in relation to 'low-noise impact works' and 'managed impact works').

The summary includes the noise requirements specified in Table 4.3 of EPA Publication 1834.1. The following aspects of the noise requirements for evenings, weekends and night periods are noted:

- The noise requirements are only intended to be applied to construction activities that are justified to occur outside of hours. Importantly, the noise requirements are not intended as the basis for determining whether works outside of normal working hours is justified.
- The background noise levels used for defining the noise requirements should represent the background sound environment at the time of impact

The noise levels of construction are to be assessed using the A-weighted equivalent noise level, (dB L_{Aeq}) plus character adjustments when tonality or impulsiveness is present, i.e. + 2 dB each for just perceptible tonality and impulsiveness or +5 dB each for prominently audible tonality and readily detectible impulsiveness.

This assessment assumes that the identified construction activities take place during normal working hours only. Construction outside of normal working hours would only be conducted for unavoidable works which meet the definitions and requirements of EPA Publication 1834.1, i.e. it would need to be demonstrated that the works cannot be reasonably moved to normal work hours. Justified unavoidable works would require additional consideration of potential noise and vibration generating activities, and controls to minimise noise and vibration.

3.1.3 Project vibration criteria

There is no standard or regulation that specifies criteria for the control of construction vibration levels in Victoria.

In lieu of Victorian guidance for construction vibration, reference is made to the NSW Roads and Maritime Service's publication *Construction Noise and Vibration Guideline* dated August 2016 (NSW RMS Construction Noise & Vibration Guideline).

Section 7.1 of the NSW RMS Construction Noise & Vibration Guideline sets out minimum working distances from sensitive receivers for typical items of vibration intensive plant. The minimum distances are quoted for effects relating to cosmetic damage and human comfort, based on guidance contained in BS 7385-2:1993[1] and the NSW Department of Environment and Conservation publication *Assessing Vibration: A Technical Guideline* dated February 2006 (NSW DEC Vibration Guideline), respectively.

The minimum working distances reproduced from Table 2 of Section 7.1 of the NSW RMS Construction Noise & Vibration Guidelines are detailed in Table 3.

Table 3: Recommended minimum working distances for vibration intensive plant from sensitive receivers

Plant item	Rating / Description	Minimum working distance, m	
		Cosmetic damage	Human response
Vibratory roller	< 50 kN (typically 1-2 tonnes)	5	15 - 20
	< 100 kN (typically 2-4 tonnes)	6	20
	< 200 kN (typically 4-6 tonnes)	12	40
	< 300 kN (typically 7-13 tonnes)	15	100
	> 300 kN (typically 13-18 tonnes)	20	100
	> 300 kN (> 18 tonnes)	25	100
Small hydraulic hammer	300 kg (5 - 12t excavator)	2	7
Medium hydraulic hammer	900 kg (12 - 18t excavator)	7	23
Large hydraulic hammer	1600 kg (18 - 34t excavator)	22	73
Vibratory pile driver	Sheet piles	2 - 20	20
Pile boring	≤ 800 mm	2 (nominal)	4
Jackhammer	Handheld	1 (nominal)	2

The NSW RMS Construction Noise & Vibration Guideline notes that the minimum working distances are indicative and will vary depending on the particular item of plant and local geotechnical conditions.

In relation to human comfort, the NSW RMS Construction Noise & Vibration Guideline notes that the minimum working distances relate to continuous vibration. The guideline further notes that for most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods are allowed.

[1] BS 7385-2:1993 *Evaluation and measurement for vibration in buildings - Guide to damage levels from groundborne vibration*

The data in Table 3 indicates that the minimum working distances for human comfort are significantly greater for than for the avoidance of cosmetic damage. This is based on the thresholds for human exposure to vibration being generally well below accepted thresholds for minor cosmetic damage to lightweight structures.

The NSW DEC Vibration Guideline presents preferred and maximum vibration criteria for use in assessing human response to vibration.

The acceptable values of human exposure to vibration are dependent on, among other things, the time of day. This assessment only considers the period in which construction is expected to normally occur, i.e. 0700-1800 hrs Monday to Friday and 0700-1300 hrs on Saturday.

The vibration criteria are separately specified for the following types of vibration characteristics:

- *Continuous*: vibration that continues uninterrupted for a period such as the duration of a day
- *Impulsive*: vibration that comprises a rapid build up to a peak followed by several cycles of progressively reducing vibration
- *Intermittent*: vibration that comprises interrupted periods of continuous, e.g. a drill, or repeated periods of impulsive vibration, e.g. a pile driver, or continuous vibration that varies significantly.

The types of activities associated with the construction of a BESS may include both continuous and impulsive vibration sources operating over interrupted periods of a working day. It is therefore expected that vibration would be typically classified as intermittent according to the NSW DEC Vibration Guideline but may be continuous or impulsive on occasion.

Table 4 summarises the preferred and maximum values for acceptable human exposure to continuous and impulsive vibration. It is noted that the NSW DEC Vibration Guideline provides criteria for the assessment of continuous and impulsive vibration in the form of the weighted acceleration values. Given that empirical vibration data is more readily available in the form peak particle velocity (PPV) data, the criteria are reproduced here in the form of equivalent PPV values sourced from Appendix C of the NSW DEC Vibration Guideline. This is consistent with related guidance contained in BS 5228-2:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Vibration* (BS 5228-2) which states:

> *… for construction, it is considered more appropriate to provide guidance in terms of the PPV, since this parameter is likely to be more routinely measured based upon the more usual concern over potential building damage. Furthermore, since many of the empirical vibration predictors yield a result in terms of PPV, it is necessary to understand what the consequences might be of any predicted levels in terms of human perception and disturbance.*

Table 4: Preferred and maximum values for vibration during daytime (mm/s) 1-80Hz (PPV) – Residences

Type	Preferred Values	Maximum Values
Continuous	0.28	0.56
Impulsive	8.6	17

Table 5 summarises the preferred and maximum values for acceptable human exposure to intermittent vibration. The NSW DEC Vibration Guideline recommends the assessment of intermittent vibration on the basis of a more complex parameter referred to as the vibration dose value (VDV) which relates vibration magnitude to the duration of exposure.

Table 5: Vibration dose values for intermittent vibration during daytime ($m/s^{1.75}$) 1-80Hz

Location	Preferred Values	Maximum Values
Residences	0.2	0.4

4.0 NOISE PREDICTION METHOD

Operational noise levels associated with the Project is predicted using:

- noise emission data for the battery units and transformers;
- a 3D digital model of the Project and the surrounding environment using proprietary noise modelling software SoundPLANnoise (version 9.0); and
- implementation of the environmental sound propagation method specified in International Standard ISO 9613-2: 1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* (ISO 9613-2).

The implementation of ISO 9613-2 within proprietary noise modelling software enables multiple sound transmission paths, including reflected and screened paths, to be accounted for in the calculated noise levels. ISO 9613-2 was designed to assume conditions that favour the propagation of noise from meteorological effects, described as a slight wind (1 to 5 m/s) blowing from source to receiver, or a well-developed moderate ground-based temperature inversion.

A digital terrain map with a cell size of 10 m for the Project site and surrounds has been sourced from ELVIS[2] and is considered appropriate for noise modelling purposes.

All equipment items are modelled as omnidirectional point sources of noise with associated octave band sound power level noise emissions. Further details regarding equipment noise levels are provided in Section 5.1.

The ground factor, G, representing the ground attenuation as a result of sound reflected by the ground surface interfering with the sound propagating directly from source to receiver is variable throughout the model being:

- G = 0.1 i.e. hard ground, within the Project boundary to represent an expected gravel mulch footing
- G = 0.5 i.e. mixed hard / soft ground outside the Project boundary to represent surrounding existing landscape between the Project and noise sensitive receivers.

Additional information with respect to noise modelling is provided in Appendix F.

[2] https://elevation.fsdf.org.au/

5.0 OPERATIONAL NOISE ASSESSMENT

5.1 Operational noise sources

At this stage of the Project, equipment selections have not been conclusively determined and final selections will be established following detailed design and tender. The project design and equipment selections detailed in this report have been used for the purpose of noise assessment and have been reviewed by GPGA and approved as being representative.

Where available, GPGA has provided detailed third octave noise data from the corresponding manufacturer. Where this data is not available MDA has established approximations or assumptions based on comparable data or existing acoustic literature.

Where project design, equipment selections and associated noise data or any other aspect of the noise assessment detailed in this report change, additional noise modelling and assessment should be conducted to verify continued compliance.

Sound power levels for individual equipment items, as used in the noise model, are detailed in Table 6. Data is provided as un-weighted (linear) octave band spectra and A-weighted overall sound power level.

Table 6: Sound power levels for Project equipment items, dB L_W

Item	Octave band centre frequency, Hz							
	63	125	250	500	1000	2000	4000	L_{WA}
Inverter	90	91	94	82	83	80	81	90
Battery unit	77	90	84	81	80	80	76	86
HV transformer	94	96	91	91	85	80	75	91
Auxiliary transformer	77	79	74	74	68	63	58	75

The noise data above aligns with the typical worst case operating conditions for the Project being:

- The maximum effective sound power level associated with each individual equipment item i.e. maximum fan duty due to the most significant charge / discharge conditions and / or elevated ambient temperature
- All equipment operating concurrently for the entirety of the 30-minute assessment period.

Whilst the above operating condition represents a typical worst case, for a large majority of the time the Project will be subject to reduced demand and ambient temperature, resulting in reduced individual equipment noise levels, and thus during these conditions, overall noise levels at receivers, will be lower than that predicted by this assessment.

Based on information provided by GPGA it is understood that while the above typical worst case operating condition has the potential to occur at any time during a typical 24 hr period, it is much less likely to occur in the night-time period, than the day or evening period.

Generally, noise data for the inverter and battery unit represent the mid to lower end of the range of noise levels exhibited on the market, for comparable ambient temperatures and equipment duties, based on MDA's knowledge and research.

Additional information with respect to the source of the data is provided in Table 7.

Due to commercial sensitivities the specific inverter and battery unit manufacturer and model is not detailed in this report but has been confirmed by GPGA to be representative of the specification required for the Project.

Table 7: Noise data descriptions

Item	Description
Inverter	Manufacturer third octave band sound power levels measured in accordance with ISO 3744:2010[3] have been provided by GPGA. Extensive specific operating conditions for the equipment were described in the supplied datasheet, including operation with and without a manufacturer designed and provided attenuation kit. For the purposes of this assessment noise data associated with 80 % fan speed including the manufacturer's attenuation kit has been adopted, being the sound power level of greatest magnitude in the provided datasheet, with the attenuation kit applied. Based on information provided by the manufacturer it is understood that 100 % apparent power is feasible with fan speeds of 80 % up to a temperature of 40°C.
Battery unit	Manufacturer sound power levels measured in accordance with ISO 3746:2010[4] have been provided to MDA by GPGA. The datasheet provided by GPGA includes overall sound power levels derived in accordance with the standard, however corresponding third octave band sound power levels are not provided MDA have derived a spectrum based on the third octave band sound pressure level measurements provided by the manufacturer within the datasheet. The sound pressure level spectrum was then normalised to the overall sound power level specified by the manufacturer. It is expected that this approach is sufficiently robust and representative in the context of the assessment.
Auxiliary/HV transformers	At this stage of the project, specific details for transformer makes and models have not been determined. The Proponent has advised that the transformers would have a capacity of up to 240 MVA for the HV transformer and 4.2 MVA for the auxiliary transformer. In the absence of measured sound power level data for a specific transformer model, reference has been made to the method for estimating overall transformer sound power levels for a given power rating described in AS 60076-10:2009 [5]. The *"reduced maximum"* sound power level indicated in the standard has been adopted for the HV transformer. Auxiliary transformer sound power levels have been based on the *"standard maximum"* sound power level. Spectral data for each transformer was then estimated by applying Bies & Hansen[6] corrections from Table 11.27, (Location 1a for outdoor transformer noise) to the determined overall sound power level.

[3] ISO 3744:2010 *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane*

[4] ISO 3746:2010 *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane*

[5] AS 60076-10:2009 *Power transformers – Part 10: Determination of sound levels*

[6] *Bies, D. H. & Hansen, C. H. (2009). Engineering noise control: theory and practice (Fourth edition.). p. 601*

5.2 Tonality

Noise associated with the operation of inverters and transformers has the potential to be tonal in nature.

Section 3.4 of the Noise Protocol provides a mechanism by which the characteristics of a noise source, such as tonality, may attract the application of a modifying factor adjustment if deemed to meet the prescribed criteria. The Noise Protocol states that:

> *The following adjustments apply –*
>
> *a. when the tonal character of the noise is just detectable then Atone = +2 dB;*
>
> *b. when the tonal character of the noise is prominent then Atone = +5 dB.*
>
> *When a tone is present, but observations do not provide certainty with regards to the value to apply for the tonal adjustment, the adjustment may be determined using the objective tonal method in accordance with Annex C.*

Tonality has been evaluated by reviewing the predicted third-octave band noise levels at the subject receivers in the context of the objective method detailed in Annex C of the Noise Protocol. This method indicates that a tonality adjustment of +2 dB is appropriate for predicted noise levels for the Project at the relevant receivers.

5.3 Predicted noise levels

Operational noise at receivers identified by GPGA within 2 km of the Project has been predicted based on the method detailed in Section 4.0, the Project design described in Section 2.0, and the operational noise source information detailed in Section 5.1.

The predicted noise levels are summarised in Table 8.

Table 8: Predicted noise levels for the Project, dB ENL

Receiver ID	Predicted ENL [1]	Noise limit	Compliance? (margin)
Day			
TBESS Receiver 01	31	45	✓ (-14 dB)
TBESS Receiver 02	32	45	✓ (-13 dB)
Evening			
TBESS Receiver 01	31	38	✓ (-7 dB)
TBESS Receiver 02	32	38	✓ (-6 dB)
Night			
TBESS Receiver 01	31	34	✓ (-3 dB)
TBESS Receiver 02	32	34	✓ (-2 dB)

1 Includes a +2 dB A_{tone} adjustment as detailed in Section 5.2. ENL applies over a 30 minute assessment period.

Based on the results shown in Table 8, the predicted noise levels associated with the Project are below the day, evening and night noise limits ranging from 14 dB to a minimum margin of 2 dB.

5.4 Cumulative noise

EPA Publication 1997 states that noise limits determined in accordance with the Noise Protocol:

> *apply to the cumulative noise from all industry impacting on noise sensitive areas (Regulation 119)*

and:

> *each industry must take all reasonable steps, including working with other industries to reduce their emissions, to ensure that the contribution from each of the premises, when combined, does not exceed the noise limit for the noise sensitive area.*

The following commentary is also provided:

> *In other words, the noise limit must be 'shared' between all premises contributing to the noise within the noise sensitive area. To achieve this, the noise emissions of each individual industry should be controlled to meet noise levels lower than the noise limits.*

The EPA Publication 1997 then further defines the equal sharing principle:

> *When assessing the emissions of a single premises within several industry premises, the noise level to meet is reduced by an amount calculated from the number of premises contributing to the noise, where N is the total number of industry premises.*
>
> *A value of 10 x log10(N) is subtracted from the noise limit to establish the assessment criteria that applies to each individual premises.*

With respect to cumulative noise assessment GPGA and Umwelt have identified the following existing or proposed commercial, industrial and trade (CIT) premises close to the Project:

- Tarrone Terminal Station – existing electrical facility related to the nearby Macarthur Wind Farm, Hawkesdale Wind Farm and Ryan Corner Wind Farm
- Tarrone Power Station – proposed gas fired power station with legacy approval
- Willatook Substation and BESS – proposed electrical infrastructure related to Willatook Wind Farm.

These projects are shown in relation to the Project and surrounds graphically in Figure 2 with further information with respect to these projects provided in the following sections.

Based on the equal sharing principle, and the four (4) projects either existing or proposed in the area, the following adjusted noise limits have been developed, applying to each of the three projects above and the Project:

- Day 39 dB ENL
- Evening 33 dB ENL
- Night 28 dB ENL

It is noted that none of the above projects were developed or designed at a time when the Noise Protocol, associated noise limits and equal sharing principle of the EPA Publication 1997 were in effect.

The equal sharing principle presents a number of practical challenges, specifically:

- Where existing or proposed CIT premises use a disproportionate amount of the noise budget
- How the noise emissions of proposed nearby CIT premises can be controlled where they are consented or approved but not yet constructed
- How the equitable sharing concept is practically applied to existing premises that have been designed and operated based on legacy noise policy which has been superseded by the requirements of the EP Act, EP Regulations, Noise Protocol and supporting publications.

EPA Publication 1997 recognises these challenges and states:

> *The equal sharing principle may be too simplistic in complex situations where the amount of noise each individual premises contributes to the cumulative noise within sensitive areas varies to a large degree. This can be the case if, for example,*
>
> - *there is a large diversity in the size or nature of the industries affecting noise sensitive areas,*
> - *the distance from each individual premises to the noise sensitive area varies greatly, or*
> - *the practicability of noise control varies greatly between the different premises.*
>
> *Rather than applying the equal sharing principle, noise reductions achievable from each site need to be investigated to obtain a suitable outcome. It may then be relevant to adopt individual criteria that give regard to the circumstances of each premises.*

These projects, and their consideration in the context of cumulative noise assessment for the Project, are discussed in the following sections.

Figure 2: Other projects in the area

5.4.1 Tarrone Terminal Station and Hawkesdale and Ryan Corner Substation

The Tarrone Terminal Station (TTS) is an existing facility located close to the Project. The location of TTS in relation to the Project and receivers is shown in Figure 2.

The main noise generating equipment related to TTS is an existing 600 MVA power transformer located at the west end of the site, associated with Macarthur Wind Farm. A secondary, smaller 420 MVA power transformer has been proposed for the facility, associated with the nearby Hawkesdale Wind Farm and Ryan Corner Wind Farm.

An assessment of noise associated with TTS including the proposed additional power transformer has previously been conducted by MDA. The noise assessment[7] was submitted to the Minister for Planning as part of a planning permit application for the augmentation of the existing TTS to provide connection capacity for the Hawkesdale and Ryan Corner Wind Farms. The planning permit was granted on 30 June 2022 (PA 2101319).

The noise assessment includes predicted noise levels from TTS (and the proposed additional power transformer) at surrounding receivers, common to the Project. The predicted noise levels are reproduced in Table 9.

Table 9: Predicted noise levels for Tarrone Terminal Station

Receiver ID		**Predicted noise level, dB ENL** [2]		
Project	**TTS** [1]	**Day**	**Evening**	**Night**
TBESS Receiver 01	R3	26	26	26
TBESS Receiver 02	R2	24	24	24

1 This is the Receiver ID used in the TTS noise assessment

2 The TTS noise assessment applies a + 2 dB tonality adjustment for the project

The TTS predicted noise levels are below the equal sharing noise limits during the day, evening, and night by margins of up to 4 dB, even with adjustments for tonality.

Given the TTS is an existing facility and MDA's familiarity with the site (having conducted the referenced noise assessment), there is a high level of confidence that predicted noise levels outlined for the TTS (and additional power transformer) are relevant and representative for consideration.

5.4.2 Tarrone Power Station

Tarrone Power Station (TPS) is a proposed gas-fired power station facility by AGL Energy Ltd (AGL). The TPS is proposed to be constructed within 1 km of the Project. The location of TPS in relation to the Project and receivers is shown in Figure 2.

The EES Referral and Supporting Documents for TPS were prepared by URS Australia Pty Ltd (URS), on behalf of AGL and submitted to the Minister for Planning in September 2007.

The Minister for Planning determined:

> *that an Environment Effects Statement is not required for the proposed Tarrone Power Station*

On this basis publicly available noise assessment for TPS is limited to a noise impact assessment[8] submitted as part of the EES Referral.

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7 MDA *Lt 001 20201000 Hawkesdale and Ryan Corner Substation - Environmental Noise Assessment*, prepared by MDA, dated 1 July 2021

8 *Noise Impact Assessment Tarrone Power Station*, prepared by URS, dated October 2009.

Subsequent to the Minister's determination several applications were made by AGL including Amendment C47 to the Moyne Planning Scheme and Works Approval Applications WA67398, WA67399 and WA67400.

TPS received EPA Works Approval in June 2010, with construction proposed to commence in 2011[9]. Addenda to the EPA Works Approval were submitted by URS in October 2010 and January 2011.

The Minister approved the planning scheme amendment in April 2012.

Despite the planning scheme amendment and EPA Works Approval, no construction has commenced for the TPS project.

AGL has stated[10]:

> *AGL has no immediate plans to begin construction on this project. However, should AGL's generation portfolio requirements change, AGL will undertake consultation with the local community to ensure all stakeholders' views are heard and considered before a commitment is made to commence construction.*

Noise levels associated with the TPS, at receivers identified in the noise impact assessment, common to the Project are summarised in Table 10.

Table 10: Predicted noise levels for Tarrone Power Station

Receiver ID		**Predicted noise level, dB ENL [2]**		
Project	**TPS [1]**	**Day**	**Evening**	**Night**
TBESS Receiver 01	E	27	27	27
TBESS Receiver 02	D	30	30	30

1 This is the Receiver ID used in the TPS noise impact assessment

2 The TPS noise impact assessment does not apply a tonality adjustment for the project

The TPS predicted noise levels are below the equal sharing noise limits during the day and evening, but up to 2 dB above the equal sharing noise limit during the night-time.

Crucially, due to the protracted time since the noise assessment it is not known whether the noise impact assessment remains relevant, or representative of potential noise level contributions for TPS.

5.4.3 Willatook Substation and BESS

The proposed Willatook Substation and BESS (WS&B) forms part of the ancillary infrastructure associated with the approved Willatook Wind Farm, (WWF), developed by Wind Prospect. The location of WS&B in relation to the Project and receivers is shown in Figure 2.

WWF is proposed to comprise up to fifty nine (59) wind turbines and associated infrastructure.

On 27 December 2018, the Minister for Planning determined that an Environment Effects Statement (EES) must be prepared for the project.

Documents prepared in support of the EES included an environmental noise assessment[11] that included predicted noise levels from WS&B at surrounding receivers, common to the Project. The predicted noise levels are reproduced in Table 11.

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9 https://www.agl.com.au/content/dam/digital/agl/documents/about-agl/how-we-source-energy/tarrone-power-project/agl-tarrone-works-aproval-application-revised-final-report-2011.pdf

10 https://www.agl.com.au/about-agl/how-we-source-energy/tarrone-power-project

11 *Willatook Wind Farm Environmental Noise Assessment*, prepared by Sonus, dated April 2022

Table 11: Predicted noise levels for Willatook substation and BESS

Receiver ID		Predicted noise level, dB ENL [2]		
Project	**WS&B [1]**	**Day**	**Evening**	**Night**
TBESS Receiver 01	D18	30	30	28
TBESS Receiver 02	D11	33	33	31

1 This is the Receiver ID used in the WS&B environmental noise assessment

2 The WS&B environmental noise assessment does not apply a tonality adjustment for the project

The WS&B predicted noise levels are at or below the equal sharing noise limits during the day and evening, but up to 3 dB above the equal sharing noise limit during the night-time.

Following submission of the EES the Minister for Planning appointed an inquiry to consider the environmental effects of WWF, under the EE Act, and a panel to consider the planning permit applications under the *Planning and Environment Act 1987 (Vic)*. The inquiry and panel provided a report to the Minister on 16 January 2023 which found the potential for unacceptable residual impacts on threatened species. The inquiry and panel made 3 key recommendations and 21 other recommendations.

On 21 July 2023, the Minister for Planning released a Ministers Assessment determining that the WWF project can proceed conditional on the implementation of specific recommendations. These included:

- A requirement for wind turbine free buffers
- Restricted construction periods.

Compliance with the recommended buffers would require removal of approximately two thirds of the total number of proposed turbines.

Wind Prospect has stated[12]:

> *The project isn't viable if we were to implement the recommendations*

On this basis it is unlikely the predicted noise levels are relevant.

5.4.4 Cumulative noise excluding the Project

Based on the predicted noise levels detailed in Table 9, Table 10, and Table 11, cumulative noise levels have been calculated without contributions from the Project, to establish the cumulative noise context within which the Project may be required to be addressed. The calculated cumulative effective noise levels are shown in Table 12 and are compared to the total noise limits set out in Section 3.1.1.

12 https://www.abc.net.au/news/rural/2023-08-04/willatook-wind-farm-proposal-doubt-government-recommendations/102691028

Table 12: Predicted cumulative effective noise levels excluding the Project, dB ENL

Receiver ID	Predicted ENL [1]	Noise limit	Compliance? (margin)
Day			
TBESS Receiver 01	34	45	✓ (-11 dB)
TBESS Receiver 02	37	45	✓ (-8 dB)
Evening			
TBESS Receiver 01	34	38	✓ (-4 dB)
TBESS Receiver 02	37	38	✓ (-1 dB)
Night			
TBESS Receiver 01	33	34	✓ (-1 dB)
TBESS Receiver 02	36	34	× (+2 dB)

1 This is the sum of noise levels detailed in the relevant noise assessments for Tarrone Power Station, Willatook Substation and BESS, and Tarrone Terminal Station and includes an overall + 2 dB adjustment for tonality

As shown in Table 12, cumulative noise without the Project complies with the derived noise limits during the day and evening but is higher than the night-time noise limit for TBESS Receiver 02 by a margin of 2 dB.

It is clear this does not align with the intent of the Noise Protocol to prescribe noise limits that define whether noise emitted from CIT premises is unreasonable under the EP Regulations, or the primary consideration outlined in EPA Publication 1997 of applying an equal sharing principle.

Further, the currently indicated non-compliance and unequitable distribution of noise budgets results in the Project being subject to a disproportionate and unequitable responsibility for minimising noise contributions.

It is apparent that predicted noise levels from the existing (modified) facility Tarrone Terminal Station are below the equal sharing noise limits for all time periods. On this basis contributions from this facility are not incongruous with the equal sharing principle for cumulative compliance with noise limits. Conversely, the proposed Willatook Substation and BESS, and Tarrone Power Station have night-time predicted noise levels above the equal sharing night-time noise limits, meaning that these facilities do not align with the equal sharing principle from the perspective of cumulative noise compliance.

It is not clear how the Noise Protocol and EPA Publication 1997 expects noise emissions related to approved, yet unconstructed, projects to be reduced such that the night-time noise protocol noise limits can be achieved, or the equal sharing principle can be applied. Even if a non-equal sharing principle was adopted, the contributions from these facilities mean the noise limits are predicted to be exceeded at night.

Crucially, Tarrone Power Station received EPA Works Approval 14 years ago, but is yet to commence construction (with no apparent likelihood of construction commencing in the future). It is not clear whether this proposed facility will proceed.

Similarly, Willatook substation and BESS is subject to significant design constraints that mean the project as currently documented is unlikely to eventuate.

Therefore, it is not clear whether these facilities should be considered for cumulative assessment, or that the available information regarding their noise contributions is relevant, current, and representative, particularly given indicated cumulative non-compliance.

Notwithstanding the above, an assessment of cumulative noise including the Project is provided in the following section.

5.4.5 Cumulative noise including the Project

Based on the cumulative noise levels without the Project, detailed in Table 12, and the predicted noise levels for the Project detailed in Table 8, total cumulative effective noise levels have been calculated and are presented in Table 13.

Table 13: Predicted total cumulative effective noise levels including the Project, dB ENL

Receiver ID	Predicted ENL [1]	Noise limit	Compliance? (margin)
Day			
TBESS Receiver 01	36	45	✓ (-9 dB)
TBESS Receiver 02	38	45	✓ (-7 dB)
Evening			
TBESS Receiver 01	36	38	✓ (-2 dB)
TBESS Receiver 02	38	38	✓ (0 dB)
Night			
TBESS Receiver 01	36	34	× (+2 dB)
TBESS Receiver 02	37	34	× (+3 dB)

1 This is the sum of noise levels detailed in the relevant noise assessments for Tarrone Power Station, Willatook Substation and BESS, and Tarrone Terminal Station, as well as the predicted noise levels for the Project. An overall + 2 dB A_{tone} adjustment is included.

As shown in Table 13, cumulative noise levels at night, including the Project are above the noise limits. To provide context to this, additional cumulative permutations, excluding the Tarrone Power Station, and Willatook substation and BESS in turn are provided in Table 14 for the night period only.

Table 14: Predicted cumulative effective noise levels including the Project, with and without TPS and WS&B, dB ENL

Receiver ID	Predicted ENL [1]	Noise limit	Compliance? (margin)
Project + TTS + WS&B			
TBESS Receiver 01	34	34	✓ (0 dB)
TBESS Receiver 02	36	34	× (+2 dB)
Project + TTS + TPS			
TBESS Receiver 01	34	34	✓ (0 dB)
TBESS Receiver 02	35	34	× (+1 dB)
Project + TTS			
TBESS Receiver 01	33	34	✓ (-1 dB)
TBESS Receiver 02	33	34	✓ (-1 dB)

1 An overall + 2 dB A_{tone} adjustment is included.

Day and evening periods have also been considered and are below the corresponding Noise Protocol noise limits for all three permutations. These results are not tabulated for simplicity.

Table 14 demonstrates that the Project with existing industry, i.e. Tarrone Terminal Station, is predicted to comply with the Noise Protocol noise limit, including a + 2 dB adjustment for tonality.

Cumulative noise with either Tarrone Power Station or Willatook substation and BESS included (or both) is predicted above the night-time Noise Protocol noise limit. This demonstrates the disproportionate effect of the noise budget consumption for these two undeveloped and uncertain projects.

5.4.6 Potential project noise control

Given the results shown in Table 13 and Table 14, noise control measures have been investigated for the Project. This work has been conducted recognising that:

- Where an unequal sharing principle is considered (i.e. predicted noise levels associated with Tarrone Power Station and Willatook Substation and BESS is adopted as currently documented), no amount of noise control will permit cumulative compliance with the Noise Protocol noise limits, due to the disproportionate contributions from these two projects. It is expected that both these projects would need to reduce their noise emissions to result in predicted cumulative noise compliance regardless of noise from the Project.
- Where an equal sharing principle is adopted, noise from the Project would need to be reduced such that the equal sharing noise limits detailed in Section 5.4 are achieved. Crucially, this approach would also require Tarrone Power Station and Willatook substation and BESS to reduce their noise emissions such that their allocated equal sharing noise limits are achieved

Investigations have been conducted to establish whether there is likely to be sufficient engineering controls available to reduce noise levels associated with the Project during the detail design stage. Consideration was given to:

- Potential equipment reselection, preferring reduced noise levels
- Changes to Project layout and equipment orientation
- Provision of noise barriers
- A combination of the above.

The noise control measures would be designed to achieve a noise reduction in the order of 3 dB at TBESS Receiver 01 and 4 dB at TBESS Receiver 02, such that the equal sharing noise limit is achieved.

If a barrier is required, other factors such as visual impact, hydrology, or structural engineering, would need to be considered as part of the design, to determine whether such a solution is reasonable and practicable.

The detailed design of noise control would be specific to final equipment selections, project layout and other factors that are yet to be determined, however preliminary analysis indicates that:

- Inverter and battery unit reselection may reduce noise levels by between 2 dB to 6 dB at source
- Provision of a noise barrier may reduce noise levels at receivers by up to 3 dB

The totality of the above indicates that there is likely to be sufficient engineering noise control options during detailed design and procurement such that noise levels from the Project can be reduced to achieve the equal sharing noise limits.

5.5 Conclusion

The noise assessment conducted for the Project indicates that predicted noise levels are below the Noise Protocol noise limits when the Project is considered individually.

With respect to cumulative noise assessment a complex situation occurs in which the other facilities considered for assessment do not comply with the Noise Protocol noise limits at night, even without contributions from the Project.

Two of the projects in particular, Tarrone Power Station and Willatook substation and BESS, comprise a disproportionate and unequitable component of the available noise budget. This puts undue development constraints and limitations on the Project and any additional projects that may be proposed to be developed. The projects are subject to significant planning concerns and, based on current development progress may not be constructed in their currently proposed forms, if at all. Their current noise predictions effectively preclude the possibility for equitable development of infrastructure in the area surrounding the existing Tarrone Terminal Station.

If all projects were designed and developed to achieve the equal sharing based noise limit of 28 dB ENL, then the overall noise limit of 34 dB ENL is predicted to be achieved cumulatively.

GPGA does not have control of the performance or design of projects developed by other parties. It is however able to reduce noise levels from the Project during detailed design.

Preliminary noise control design analysis indicates that there is likely to be sufficient engineering noise control options during detailed design and procurement such that noise levels from the Project can be reduced to achieve the equal sharing noise limits.

This approach would permit development and operation of the Project, as well as the development and operation of Tarrone Power Station, Willatook substation and BESS and Tarrone Terminal Station, while complying with the Noise Protocol noise limits.

5.6 General Environmental Duty

In accordance with the GED under the EP Act, the risks of harm as a result of operational noise from the Project must be minimised as far as reasonably practicable. The GED is an enduring requirement which applies throughout the planning, design, and operation of the Project.

Noise related risks of harm to human health and the environment are expected to be limited to possible impacts on amenity (such as annoyance), rather than significant health or physical hearing damage, based on the significant distances between the Project and the nearest dwellings, and typical noise levels from site equipment.

Noise associated with the Project is expected to be steady-state in nature and would therefore not be expected to generate significant maximum noise level events that may lead to awakening events at the nearest noise-sensitive areas during the night period. Accordingly, the risk of harm due to sleep disturbance is considered to be low.

Ultimately the feasibility and practicability of noise control solutions will be investigated during detailed design stage once the Project is refined in more detail. At this stage, the risk of harm, and the methods of minimising the risk will be reviewed considering the GED in the context of the developed project.

The following methods of minimising risk of harm from operational noise, amongst others, would be considered:

- Selection of low noise equipment items, and consideration of manufacturer supplied attenuation kits
- Optimisation of the Project layout
- Physical noise control measures such as noise barriers.

6.0 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

In accordance with the EPA Guideline 1834, construction of the Project will require the adoption of reasonably practicable management measures and working practices. These measures are normally documented and agreed in a Construction Noise and Vibration Management Plan (CNVMP) for inclusion in a broader Environmental Management Plan (EMP), which is typically prepared for review and approval by the responsible authority prior to commencing any construction works.

The following sections provide general information regarding the types of activities that are expected to be associated with the construction of the Project, and reference data that should be considered as part of the preparation of a future CNVMP for the Project once a main contractor is appointed and specific equipment and work processes are known. Indicative noise levels due to various construction activities are provided to inform the types and scales of reasonably practicable noise controls.

6.1 Construction activities

Based on information provided to MDA by GPGA, the following construction phases are expected to be required:

- Access road construction;
- BESS installation;
- Cable trench digging;
- Gravel laydown;
- Site compound construction;
- Site rehabilitation;
- Substation and O&M facility construction; and
- Vegetation clearing.

Specific details of the construction program and the number, type, and duty of the construction plant to be used would be determined during the advanced stages of the project when a construction contractor has been selected.

The types of equipment associated at different stages of construction typically include excavation plant, pneumatic equipment and lifting equipment.

A conservative construction noise assessment has been undertaken to provide information during the planning stage regarding the potential worst-case noise levels associated with construction of the Project.

Eight (8) primary scenarios have been considered as detailed in Table 15.

The assessment assumes that all construction activity described in the various scenarios occurs within an area closest to the nearest receiver and occurs simultaneously, presenting a conservative approach that is unlikely to occur in practice.

All works associated with each construction stage other than the construction of access roads or cable trench digging, have been assumed to be able to occur at the location within the Project boundary nearest to any receiver. Works associated with access road construction or cable trench digging have been assumed to occur at the shortest position within the subject work area to a receiver.

A construction layout plan is provided for reference in Appendix G.

Table 15: Construction phases and equipment

Construction phase	Plant/Equipment	Approximate overall sound power level, dB L_{WA}
Access road construction	2 x Bulldozer, 4 x Dump truck, 2 x Front end loader, 2 x Generator, 1 x Roller (vibratory)	125
BESS installation	1 x Concrete truck, 2 x Crane (500 t), 4 x Delivery truck, 2 x Dump truck, 2 x Excavator, 1 x Forklift, 1 x Front end loader, 2 x Generator, 2 x Gritblaster (grit & nozzle air noise), 4 x Hand tools (electric), 1 x Jack hammers, 1 x Rock crusher, 1 x Truck (water cart)	135
Cable trench digging	1 x Crane (mobile), 2 x Dump truck, 1 x Excavator (100 to 200 kW), 1 x Generator, 1 x Hand tools (electric)	120
Gravel laydown	8 x Dump truck, 1 x Generator	125
Site compound construction	1 x Bulldozer, 1 x Concrete truck, 1 x Crane (200 t), 1 x Delivery truck, 1 x Excavator (100 to 200 kW), 1 x Forklift, 1 x Front end loader, 1 x Generator, 2 x Gritblaster (grit & nozzle air noise), 2 x Hand tools (electric), 1 x Rock crusher, 1 x Roller (vibratory), 1 x Truck (water cart)	130
Site rehabilitation	2 x Bulldozer, 2 x Generator, 2 x Vehicle (light commercial e.g. 4WD)	115
Substation & O&M facility construction	1 x Bulldozer, 1 x Concrete truck, 1 x Crane (500 t), 1 x Crane (mobile), 2 x Delivery truck, 2 x Dump truck, 1 x Excavator, 1 x Forklift, 1 x Front end loader, 1 x Generator, 2 x Gritblaster (grit & nozzle air noise), 2 x Hand tools (electric), 1 x Rock crusher, 1 x Truck (water cart)	135
Vegetation clearing	2 x Bulldozer, 2 x Generator, 1 x Hand tools (electric), 1 x Vehicle (light commercial e.g. 4WD)	115

6.2 Construction noise assessment

Noise levels associated with each of the main construction tasks have been predicted at the receiver nearest the subject work area to provide an indication of the upper range of noise levels.

Given that the precise equipment selections and methods of working would be determined during the future development of a CNVMP, and that the noise associated with construction plant and activity varies significantly, the predicted noise levels are provided in the following sections as an indicative range of levels which may occur in practice.

Table 16 details the predicted noise level ranges for each of the main construction tasks at the nearest receivers. The predicted level range accounts for variable equipment locations within the area considered in the assessment.

Table 16: Indicative range of construction noise predictions, dB L_{Aeq}

Construction phase	Nearest receiver (distance, m)	Predicted level range
Access road construction	TBESS Receiver 01 (259)	60 - 65
BESS installation	TBESS Receiver 02 (945)	60 - 65
Cable trench digging	TBESS Receiver 02 (1,053)	45 - 50
Gravel laydown	TBESS Receiver 02 (945)	50 - 55
Site compound construction	TBESS Receiver 02 (945)	55 - 60
Site rehabilitation	TBESS Receiver 02 (945)	40 - 45
Substation and O&M facility construction	TBESS Receiver 02 (945)	60 - 65
Vegetation clearing	TBESS Receiver 02 (945)	40 - 45

It is recommended that construction activities take place during normal working hours only. Construction outside of normal working hours would only be conducted for unavoidable works which meet the definitions and requirements of EPA Publication 1834.1, i.e. it would need to be demonstrated that the works cannot be reasonably moved to normal work hours. Normal working hours as set out by EPA Publication 1834.1 time period designations, have previously been defined in Table 2.

Justified unavoidable out of hours works would require additional consideration of potential noise and vibration generating activities, and controls to minimise noise and vibration. Further discussion is provided in Section 6.5.

6.3 Construction vibration assessment

The nearest receivers, TBESS Receiver 01 and TBESS Receiver 02, are more than 1 km from the Project.

This distance is significantly greater than minimum working distances for cosmetic damage or human comfort previously set out in Table 3.

Construction vibration is therefore considered a negligible risk for the Project and, as such, further detailed assessment of vibration is not warranted.

6.4 Decommissioning

Similar construction activities to those detailed in Section 6.1 are expected to be required during the decommissioning of the Project and as such, the same outcomes should be considered in preparation of the CNVMP.

6.5 Construction noise and vibration recommendations

At this early stage, only a preliminary assessment of construction noise and vibration impact risk is feasible. Once a more detailed schedule of equipment and plant items, construction method and work areas are known, a detailed CNVMP should be prepared.

Any future CNVMP should include site and process specific noise management work practices designed to mitigate the impact of construction noise activities.

EPA Guideline 1834.1 provides extensive details and guidance with respect to noise mitigation including:

- All construction works to be undertaken during normal working hours where possible
- Scheduling work to minimise noise impacts, for example; scheduling work when neighbours/residents are not present, scheduling noisy works together to reduce the overall duration of exposure, scheduling noisy activities for less-sensitive times, for example during the later morning or afternoon
- Notify community to keep them informed of upcoming construction works, including the anticipated duration of works, type of noise and contact details for information or in the event they want to make a noise complaint
- Undertake preparatory work offsite where there is low potential for impacting people (e.g., formwork, cutting or prefabrication of materials offsite prior to transporting to the construction site)
- Connect to the electricity grid as early as possible to avoid the use of diesel generators
- Restrict areas where mobile plant can operate so that it is away from people who could be affected by noise
- Locate site vehicle access and waiting areas away from people who could be affected by noise
- Plan vehicle movements to avoid manoeuvres and idling at location nearest to nearby people
- Use quieter equipment or methods
- Use low noise saw blades
- Use electrical equipment rather than equipment driven by a diesel generator
- Use low noise emitting generators
- Use effective alternatives to ‘beeper’ alarms (e.g., broadband alarms, proximity sensors)
- Avoid using reversing alarms by designing site layout to avoid reversing (e.g., drive-through for parking and deliveries)
- Maintain equipment and vehicles Limit noise caused by people on-site
- Implement substitute methods taking into consideration:
    - alternatives to rock-breaking work methods, such as hydraulic splitters for rock and concrete, hydraulic jaw crushers, chemical rock and concrete splitting, and controlled blasting such as penetrating cone fractures. The suitability of alternative methods should be considered on a case by case basis, including what potential risks they involve

- alternatives to diesel and petrol engines and pneumatic units, such as hydraulic or electrical generator located away from nearby people.

Controls to limit vibration as described in EPA Guideline 1834.1 include:

- Use alternative lower-impact equipment or methods (e.g., substitute impact piling with bored piling, grip jacking or the use of hammer cushion when driving steel piles that minimise the vibration)
- Use non-explosive demolition agents and/or chemical agents to facilitate concrete/rock breaking activities to reduce the noise generated
- Substitute demolition methods not involving impact where feasible (e.g., use hydraulic rock splitters rather than rock breakers)
- Schedule the use of vibration-causing equipment such as jackhammers, demolition, earthmoving and ground-impacting operations at the least sensitive time of day
- Routing, operating, or locating high vibration sources as far away from people who could be affected by noise
- Sequencing operations so that vibration-causing activities do not occur simultaneously
- Isolate equipment causing vibration on resilient mounts
- Isolate activities from adjoining structures
- Maintain equipment in accordance with manufacturer's specifications.

All of the above items should be considered as part of the future CNVMP, specific to the finalised Project design.

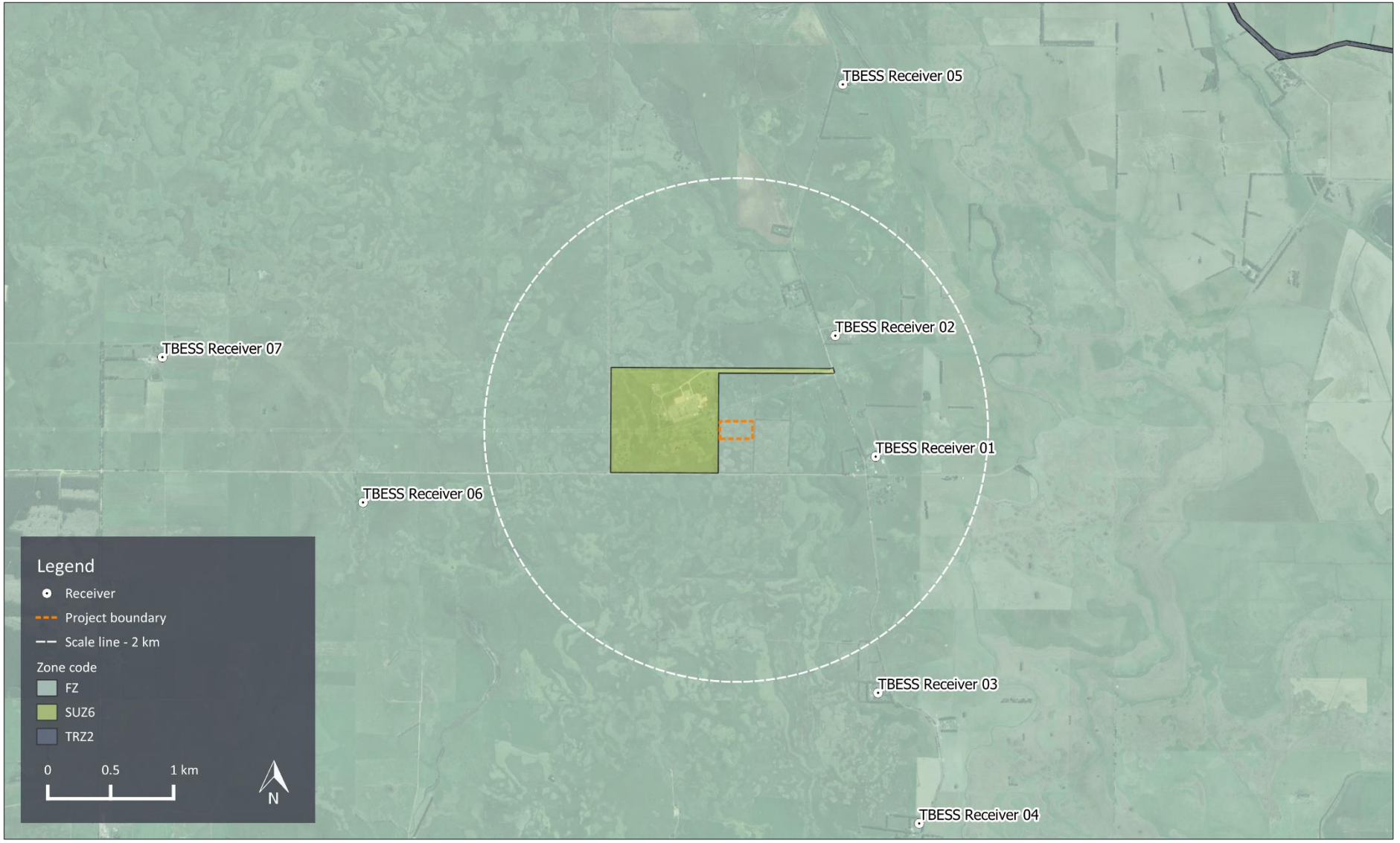
APPENDIX A GLOSSARY OF TERMINOLOGY

Term	Definition
A-weighting	A set of frequency-dependent sound level adjustments that are used to better represent how humans hear sounds. Humans are less sensitive to low and very high frequency sounds. Sound levels using an "A" frequency weighting are expressed as dB L_A.
Background sound	The sound that is continuously present in a room or outdoor location. Often expressed as the A-weighted sound level exceeded for 90 % of a given time period i.e. L_{A90}.
dB	Decibel. The unit of sound level.
Frequency	Sound occurs over a range of frequencies, extending from the very low (e.g. thunder) to the very high (e.g. mosquito buzz). Measured in units of Hertz (Hz). Humans typically hear sounds between 20 Hz and 20 kHz. High frequency acuity naturally reduces with age most adults can hear up to 15 kHz.
Hertz (Hz)	The unit of frequency, named after Gustav Hertz (1887-1975). One hertz is one pressure cycle of sound per second. One thousand hertz – 1000 cycles per second – is a kilohertz (kHz).
L_{Aeq}	The equivalent continuous A-weighted sound level. Commonly referred to as the average sound level and is measured in dB.
L_w	Sound Power Level. The calculated level of total sound power radiated by a sound source. Usually A-weighted i.e. L_{WA}.
Octave band	The interval between one frequency and its double. Sound is divided into octave bands for analysis. The typical octave band centre frequencies are 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, and 4 kHz.

The basic quantities used within this document to describe noise adopt the conventions outlined in ISO 1996-1:2016 *Acoustics - Description measurement and assessment of environmental noise – Basic quantities and assessment procedures*.

Accordingly, all frequency weighted sound pressure levels are expressed as decibels (dB) in this report. For example, sound pressure levels measured using an "A" frequency weighting are expressed as dB L_A. Alternative ways of expressing A-weighted decibels such as dBA or dB(A) are therefore not used within this report, unless included in a direct quote of external documentation.

APPENDIX B LAND ZONING MAP



APPENDIX C PROJECT LAYOUT

Figure 3: Tarrone BESS General Arrangement – provided by GPGA

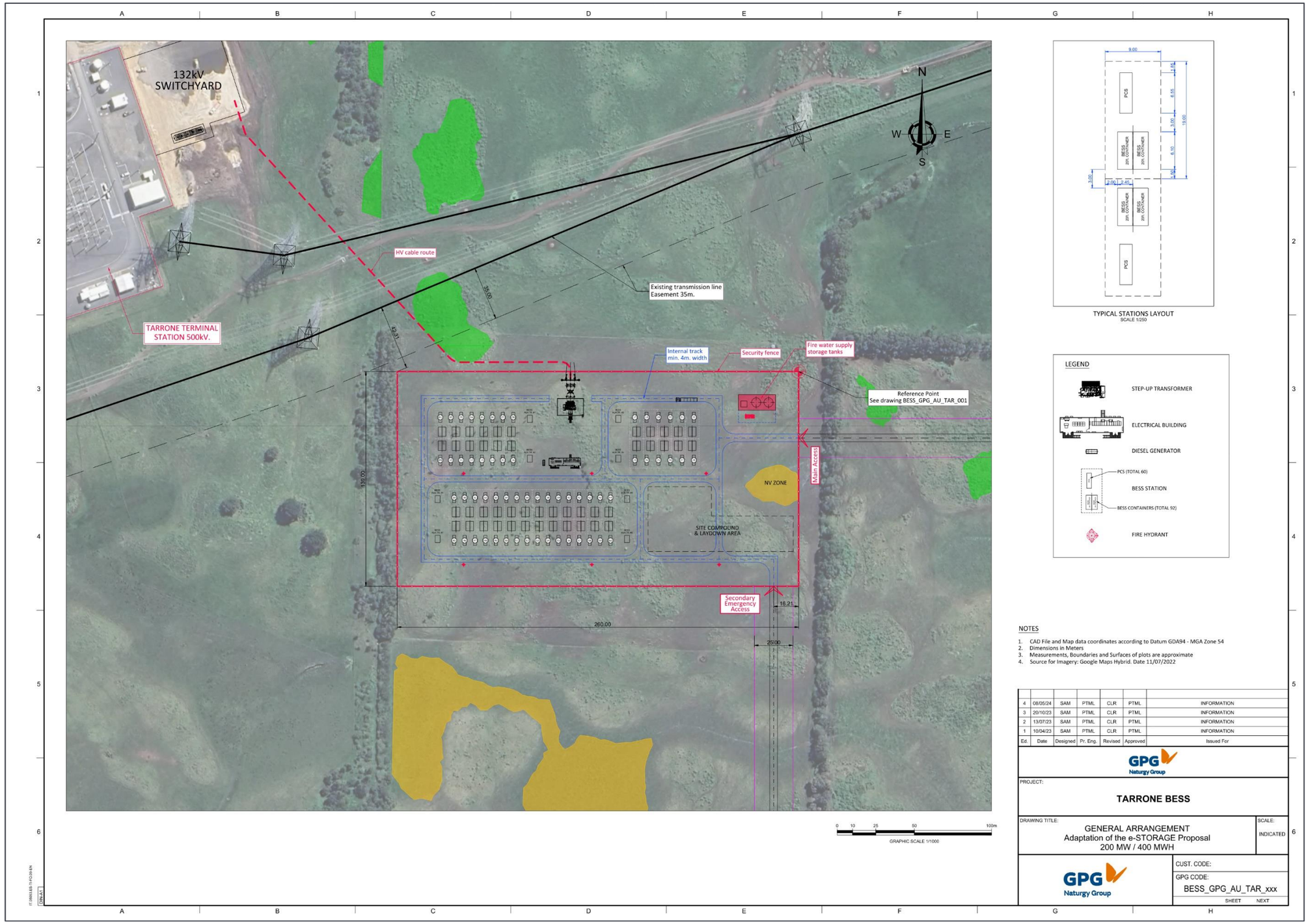


Figure 4: Project layout and site context

Figure 5: Project layout and site context (zoom out)

APPENDIX D RECEIVER LOCATIONS

Table 17 sets out the fourteen (14) receivers identified by Umwelt/GPGA in the vicinity of the Project. For the purposes of the noise assessment, only receivers located within 2 km of the Project have been considered. Compliance demonstrated at these receivers would mean compliance at receivers further away.

Data has been supplied to MDA by Umwelt/GPGA on 29 May 2024.

Table 17: Receiver coordinates – GDA2020 zone 54

Receiver ID	Easting	Northing	Approximate distance from the Project centroid (m)
TBESS Receiver 01	604,959	5,773,288	1,150
TBESS Receiver 02	604,639	5,774,249	1,100
TBESS Receiver 03	604,978	5,771,412	2,350
TBESS Receiver 04	605,305	5,770,375	3,450
TBESS Receiver 05	604,699	5,776,244	2,850
TBESS Receiver 06	600,889	5,772,924	3,000
TBESS Receiver 07	599,296	5,774,078	4,600
TBESS Receiver 08	604,998	5,769,532	4,150
TBESS Receiver 09	603,837	5,769,372	4,150
TBESS Receiver 10	603,652	5,769,525	4,000
TBESS Receiver 11	602,855	5,769,451	4,150
TBESS Receiver 12	602,080	5,769,517	4,350
TBESS Receiver 13	602,019	5,769,676	4,250
TBESS Receiver 14	601,379	5,769,751	4,500

APPENDIX E NOISE LEGISLATION AND GUIDELINES

E1 Environmental Protection Regulations 2021

The *Environment Protection Act 2017* (EP Act) does not specify noise limit values or technical aspects of environmental noise but sets out legal requirements to comply with the described below. Clause 166 of the EP Act essentially places the onus of achieving compliance with noise limits on the commercial premises.

The *Environmental Protection Regulations 2021* (EP Regulations) are made under Section 465 of the EP Act and impose obligations in relation to environmental protection, including noise. The EP Regulations state that a person who conducts a prediction, measurement, assessment, or analysis of noise within a noise sensitive area must do so in accordance with the Noise Protocol. In particular, noise from industrial, commercial and trade premises or entertainment venues or events is prescribed as unreasonable if it exceeds a noise limit or alternative criterion determined in accordance with the Noise Protocol.

Key matters addressed in the EP Regulations include:

- Definition of commercial, industrial and trade premises, which is essentially any premises that is not a residential premises, a road, or a railway. It is noted that noise from common building services equipment (such as shared condensing units and kitchen exhaust fans) is assessable;
- Definition of an indoor music entertainment venue;
- Definition of noise sensitive areas where the noise limits are assessed, which broadly include:
  - a residential building
  - temporary accommodation
  - hospital corrective institution
  - retirement or residential village
  - A room for learning in a childcare centre, kindergarten, or school
  - A tourist establishment, campground, or caravan park;
- Assessment time periods;
- Noise sources that must not be taken into account;
- Minimum noise limit values; and
- Management of cumulative noise from multiple premises.

Table 18 presents a summary of the relevant Divisions and EP Regulations from Part 5.3 – *Noise*.

Table 18: Summary of Part 5.3 - *Noise*

Section	Description
Division 1, Regulation 113	States that *a person who conducts a prediction, measurement, assessment, or analysis of noise within a noise sensitive area for the purposes of the Act or these Regulations, must conduct the prediction, measurement, assessment, or analysis in accordance with the Noise Protocol.*
Division 3	Applies to noise from commercial, industrial and trade premises
Regulation 116	Defines the day, evening and night period as follows: • Day: 0700 to 1800 hrs, Monday – Saturday • Evening: 1800 to 2200 hrs, Monday – Saturday 0700 to 2200 hrs, Sunday, and Public Holidays • Night: 2200 to 0700 hrs the next day, Monday – Sunday.
Regulation 117	In this Division, when the level of noise emitted from commercial, industrial and trade premises is assessed, the following sources of noise that could be expected at the proposed facility must not be taken into account: • Voices; • Construction or demolition activity on building sites; • Intruder, emergency or safety alarms or sirens; • Equipment used in relation to an emergency; and • Non-commercial vehicles (except for maintenance activities).
Regulation 118	Defines noise as being unreasonable if it exceeds the Noise Protocol limits or the alternative assessment criteria that apply at an alternative assessment location. Defines the lowest base noise limits as follows: Major urban area: Day: 45 dB ENL Evening: 40 dB ENL Night: 35 dB ENL Rural area: Day: 45 dB ENL Evening: 37 dB ENL Night: 32 dB ENL The noise limit for commercial, industrial and trade premises for the night period must not exceed 55 dB ENL.
Regulation 119	If multiple existing or proposed premises emit noise that contributes to the effective noise level at a noise sensitive receiver, all reasonable steps must be taken by the premises' management to ensure the combined noise level does not exceed the noise limit.
Regulation 120	This regulation essentially identifies that tonal aspects of noise must be considered when considering unreasonable noise for Section 3(1)(a)(v) of the EP Act. The Noise Protocol provides a method of assessing tonal characteristics of noise from commercial, industrial and trade premises, with additional guidance on low frequency noise available in EPA Publication 1996 *Noise guideline – assessing low frequency noise.*
Regulation 121	Noise emitted from commercial, industrial and trade premises is prescribed to be aggravated noise if it exceeds the noise limits by more than 15 dB, or the following if lower: • 75 dB ENL during the day; • 70 dB ENL during the evening; or • 65 dB ENL during the night.

E2 Noise Protocol

E2.1 Application

EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*, dated May 2021 (Noise Protocol) sets noise limits that apply to commercial, industrial and trade (CIT) premises and entertainment venues within Victoria. Compliance with the noise limits is mandatory under the EP Act.

The EP Act defines a 'commercial, industrial and trade premises' as:

Any premises except the following –

> *(a) residential premises (other than common plant under the control of an owners corporation);*
>
> *(b) a street or road, including every carriageway, footpath, reservation and traffic island on any street or road;*
>
> *(c) a railway track used by rolling stock in connection with the provision of a freight service or passenger service—*
>
> > *(i) while travelling on a railway track or tramway track; or*
> >
> > *(ii) while entering or exiting a siding, yard, depot, or workshop;*
>
> *(d) a railway track used by rolling stock in connection with the provision of a passenger service, while in a siding, yard, depot, or workshop and is—*
>
> > *(i) powering up to commence to be used in connection with the provision of a passenger service; or*
> >
> > *(ii) shutting down after being used in connection with the provision of a passenger service;*
>
> *(e) the premises situated at Lower Esplanade, St Kilda and known as "Luna Park" and being the whole of the land more particularly described in Certificate of Title Volume 1204 Folio 109;*

The EP Act defines an 'entertainment venue' as

> *Any premises or place where music is performed or played but does not include residential premises or a place of worship.*

Based on the above the Project is considered to be a CIT premises.

E2.2 Assessment method

The Noise Protocol prescribes the method and measurement procedure used to determine applicable noise limits and assessment of compliance.

The EP Act requires that proposed commercial premises be designed to comply with Noise Protocol noise limits and that premises have an ongoing obligation to meet the noise limits.

A 'noise sensitive area' is defined in the EP Regulations as:

> *(a) that part of the land within the boundary of a parcel of land that is—*
>
> > *(i) within 10 metres of the outside of the external walls of any of the following buildings—*
> >
> > > *(A) a dwelling (including a residential care facility but not including a caretaker's house);*

(B) a residential building;

(C) a noise sensitive residential use; or

(ii) within 10 metres of the outside of the external walls of any dormitory, ward, bedroom or living room of one or more of the following buildings—

(A) a caretaker's house;

(B) a hospital;

(C) a hotel;

(D) a residential hotel;

(E) a motel;

(F) a specialist disability accommodation;

(G) a corrective institution;

(H) a tourist establishment;

(I) a retirement village;

(J) a residential village; or

(iii) within 10 metres of the outside of the external walls of a classroom or any room in which learning occurs in the following buildings (during their operating hours)—

(A) a childcare centre;

(B) a kindergarten;

(C) a primary school;

(D) a secondary school; or

(b) subject to paragraph (c), in the case of a rural area only, that part of the land within the boundary of—

(i) a tourist establishment; or

(ii) a campground; or

(iii) a caravan park; or

(c) despite paragraph (b), in the case of a rural area only, where an outdoor entertainment event or outdoor entertainment venue is being operated, that part of the land within the boundary of the following are not noise sensitive areas for the purposes of that event or venue—

(i) a tourist establishment;

(ii) a campground;

(iii) a caravan park;

The assessment of non-music noise from the subject site under the Noise Protocol is based on the calculation of a noise limit at a receiver position, considering the background noise level and a zoning noise level derived from the land zoning types in the surrounding area.

Once a noise limit is established, the noise level $L_{Aeq,\ 30\ min}$ due to the CIT premises is measured or predicted. If necessary, the $L_{Aeq,\ 30\ min}$ noise level is adjusted for noise character and duration to give the effective noise level ENL, which also applies over a 30 minute assessment period. If the ENL exceeds the noise limit, then remedial action is required.

E2.3 Calculation of noise limits for the Project

The Noise Protocol provides two methods for deriving the relevant noise limits; the urban area method, and the rural area method. As the Project is not located within a major urban area, as defined by the Noise Protocol, the rural area method is applicable.

The derivation procedure for the rural area method involves:

- Determining zone levels for day, evening, and night periods; and
- Adjusting the zone levels accounting for the distance between the zone where the noise generator is located and the location of the noise receiver in the noise sensitive area, based on a range of specific factors;
- Consideration of definitions specified in the Noise Protocol including "*background relevant area*" and "*utility*".

The time periods are defined in the EP Regulations and shown in Table 19.

Table 19: Noise Protocol time periods

Period	Day of week	Start time	End time
Day	Monday-Saturday	0700 hrs	1800 hrs
Evening	Monday-Saturday	1800 hrs	2200 hrs
	Sunday, Public holidays	0700 hrs	2200 hrs
Night	Monday-Sunday	2200 hrs	0700 hrs

Based on the above time periods, the zone levels are determined on the basis of the Project and surrounding residential receivers both being located on land designated as Farming Zone (FZ) – refer to Appendix B for a land zoning map. The applicable zoning levels are shown in Figure 6.

Based on the specific factors outlined in the Noise Protocol, a distance adjustment of 0 dB applies, as the land zoning between the Project and the receivers is contiguous.

The Noise Protocol defines a "*background relevant area*" as being:

> *A noise sensitive area within a rural area where background levels may be higher than usual. This includes areas where freeway or highway traffic is a significant audible background noise source. It also includes coastal areas, where representative background levels are elevated by the sound of surf.*

While background noise levels have not been specifically measured for the Project, it is not expected that the above definition would apply, based on the surrounding environment.

Finally, where a Project is defined as being a "*utility*", is located within a Farming Zone, and the derived distance adjustment is 0 dB, specific, prescriptive noise limits apply, as set out in Section 2.6 of the Noise Protocol.

EPA Publication 1997 provides the following definition:

> *'Utility installation' as defined in the Victoria Planning Provisions and includes infrastructure used for telecommunications; to transmit or distribute gas or oil; to transmit, distribute or store power, including battery storage; to collect, treat, transmit, store, or distribute water; or to collect, treat, or dispose of storm or flood water, sewage, or sullage.*

Given the above definition, and consideration of the contiguous Farming Zone and applicable distance adjustment of 0 dB, the specific noise limits outlined in Section 2.6 of the Noise Protocol apply to the Project. These are set out in Section 3.1.1 of this report.

Figure 6: Zone levels for rural area method for commercial, industrial and trade premises

Receiving zone → / Generating Zone ↓	Green Wedge A GWAZ, Rural Conservation RCZ, Rural Living RLZ Group E CDZ, SUZ & UGZ (*)	Low Density Residential LDRZ Public Conservation and Resource PCRZ Public Park and Conservation PPCZ Public Use 2 & 5 PUZ2 & PUZ5 Urban Floodway UFZ	Farming Zone FZ Green Wedge GW General Residential Zone GRZ Neighbour Residential Zone NRZ Residential Growth Zone RGZ, Rural Activity Zone RAZ, Township Zone TZ Urban Growth Zone before an incorporated precinct structure plan UGZ Group B CDZ, SUZ & UGZ (*)	Commercial 1 Zone C1Z B1Z B2Z B5Z Commercial 3 Zone C3Z Mixed use Zone MUZ Activity Centre Zone ACZ Public Use Zone 1,3,4,6&7 PUZ1 PUZ3 PUZ4 PUZ6 & PUZ7 Road RDZ1 RDZ2 Group A CDZ, SUZ & UGZ (*)	Industrial 3 IN3Z Group C CDZ, SUZ & UGZ (*)	Commercial 2 Zone C2Z B3Z B4Z	Industrial 2 Zone IN2Z Industrial 1 Zone IN1Z Group D CDZ, SUZ, UGZ (*)
Low Density Residential LDRZ Public Conservation and Resource PCRZ Public Park and Conservation PPCZ Public Use 2,5 PUZ2 & PUZ5 Urban Floodway UFZ Group E CDZ, SUZ & UGZ (*)	Day 45 Evening 37 Night 32	Day 45 Evening 39 Night 34	Day 45 Evening 40 Night 35	Day 47 Evening 42 Night 37	Day 48 Evening 43 Night 38	Day 50 Evening 45 Night 40	Day 53 Evening 48 Day 43
Farming FZ (*) Green Wedge GWZ, Green Wedge A GWAZ Public Use 2 & 5 PUZ2, PUZ5 Rural Activity RAZ Rural Conservation RCZ Rural Living RLZ Urban Growth Zone before an incorporated precinct structure plan (UGZ) Group B CDZ, SUZ & UGZ (*)	Day 45 Evening 38 Night 33	Day 45 Evening 40 Night 35	Day 46 Evening 41 Night 36	Day 48 Evening 43 Night 38	Day 50 Evening 45 Night 40	Day 52 Evening 47 Night 42	Day 54 Evening 49 Night 44
Commercial 1 CZ1 B1Z B2Z BZ5 Mixed Use MUZ Activity Centre Zone ACZ Public Use 1,2,3,4,6 & 7 PUZ1 PUZ3 PUZ4 PUZ6 PUZ7 Group A CDZ, SUZ & UGZ (*)	Day 45 Evening 40 Night 35	Day 47 Evening 42 Night 37	Day 48 Evening 43 Night 38	Day 50 Evening 45 Night 40	Day 52 Evening 47 Night 42	Day 53 Evening 48 Night 43	Day 55 Evening 50 Night 45
Industrial 3 IN3Z Group C CDZ, SUZ & UGZ (*)	Day 46 Evening 41 Night 36	Day 49 Evening 44 Night 39	Day 50 Evening 45 Night 40	Day 52 Evening 47 Night 42	Day 53 Evening 48 Night 43	Day 55 Evening 50 Night 45	Day 56 Evening 51 Night 46
Commercial 2 C2Z, B3Z, B4Z Commercial 3 C3Z	Day 48 Evening 43 Day 38	Day 50 Evening 45 Night 40	Day 52 Evening 47 Night 42	Day 54 Evening 49 Night 44	Day 55 Evening 50 Night 45	Day 56 Evening 51 Night 46	Day 57 Evening 52 Night 47
Industrial 1, 2 IN1Z IN2Z Group D CDZ, SUZ & UGZ (*)	Day 50 Evening 45 Night 40	Day 52 Evening 47 Night 42	Day 53 Evening 48 Night 43	Day 55 Evening 50 Night 45	Day 56 Evening 51 Night 46	Day 57 Evening 52 Night 47	Day 58 Evening 53 Night 48

(*) For Comprehensive Development Zone (CDZ), Special Use Zone (SUZ) and Urban Growth Zone (UGZ) refer to Table B.2.

APPENDIX F NOISE PREDICTION METHOD

F1 Operational noise

A computer model was created in the environmental noise modelling program SoundPLANnoise v9.0 to predict noise levels from the proposed development to relevant noise-affected receivers in the vicinity of the subject site. The noise model has been used to calculate noise levels at the nearest noise-affected premises in accordance with ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* (ISO 9613-2).

This standard has recently been superseded by the standard ISO-9613-2:2024 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: Engineering method for the prediction of sound pressure levels outdoors*, however, at the date of preparing this report, the revised standard has not yet been implemented in commonly used noise modelling software options, including SoundPLANnoise v9.0.

The core elements of the two versions are similar and the relevant calculation formulae for this Project have not materially changed. The noise model enables the calculation of noise levels over a wide area, and accounts for key considerations including site arrangement, terrain, and atmospheric conditions.

The ISO 9613-2 standard specifies an engineering method for calculating noise at a known distance from a variety of sources under meteorological conditions that are favourable to sound propagation. The standard defines favourable conditions as downwind propagation where the source blows from the source to the receiver within an angle of +/-45 degrees from a line connecting the source to the receiver, at wind speeds between approximately 1 m/s and 5 m/s, measured at a height of 3 m to 11 m above the ground. Equivalently, the method accounts for average propagation under a well-developed moderate ground based thermal inversion.

Accordingly, predictions based on ISO 9613-2 account for the instances when local atmospheric conditions at the site favour the propagation of sound to surrounding receptor locations. Under alternative atmospheric conditions, such as when the wind is blowing from a receiver location to the development site, the noise levels would be lower than calculated. This is expected to satisfy the definition of 'noise-enhancing meteorological condition' under the NPfI, providing a conservative approach to noise modelling.

To calculate far-field noise levels according to the ISO 9613-2, the noise levels of each source are firstly characterised in the form of octave band frequency levels. A series of octave band attenuation factors are then calculated for a range of effects including:

- Geometric divergence
- Air absorption
- Reflecting obstacles
- Screening
- Ground reflections.

The octave band attenuation factors are then applied to the noise data to determine the corresponding octave band and total calculated noise level at relevant receiver locations.

Geometry data for the model has been sourced from public aerial photography and client provided data. The geometries in the model are simplified representations of the built environment that have been configured to a level of detail that is appropriate for noise calculation purposes.

The following inputs have been referenced in the noise model to predict noise levels from onsite activities.

- Receivers at 1.5 m (single storey) above ground level.
- Receiver locations positioned according to data provided by the Proponent.
- Emission data for each source at the site as detailed in Section 5.1.

F2 Construction noise

Predicted noise levels have been calculated in general accordance with the method detailed in Australian Standard 2436:2010 *Guide to noise and vibration control on construction, demolition and maintenance sites* AS 2436. This method enables the prediction of noise levels for sound propagation over hard or soft ground but does not provide the ability to calculate predicted noise levels for mixed ground cover with varied soil conditions. The standard also notes that caution must be applied when considering predicted noise levels at distances beyond 100 m. For these reasons, predicted noise levels have been determined as the arithmetic average of the hard and soft ground prediction methods.

This approach is broadly consistent with the equivalent prediction procedure in British Standard 5228-1:2009 *Code of practice for noise and vibration control on construction and open sites: Noise* (BS 5228, referenced in AS 2436), and provides a margin of caution with respect to ground conditions for the typical magnitude of separating distances between construction activities and neighbouring sensitive receivers.

APPENDIX G CONSTRUCTION LAYOUT