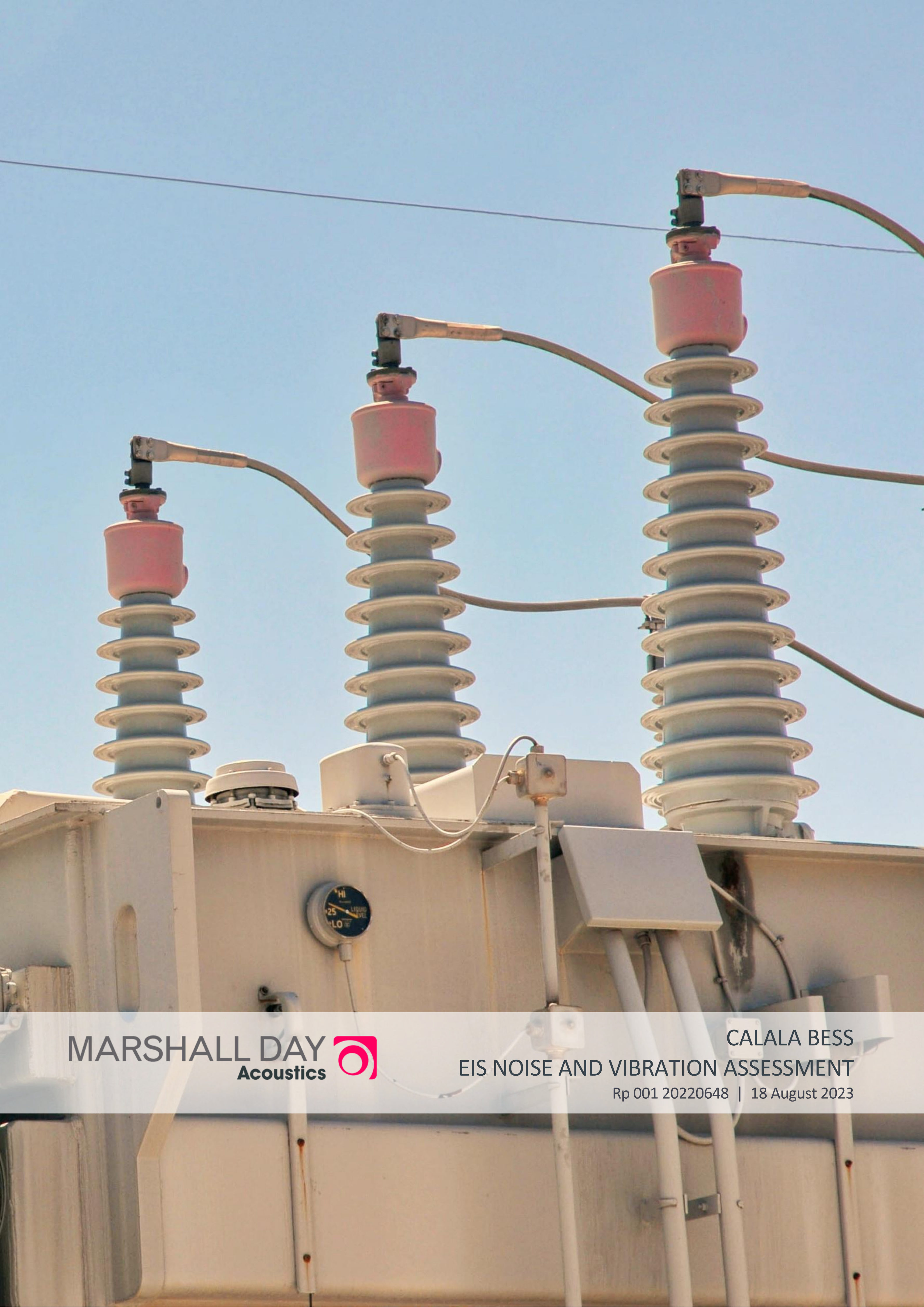


MARSHALL DAY Acoustics

CALALA BESS
EIS NOISE AND VIBRATION ASSESSMENT

Rp 001 20220648 | 18 August 2023

Marshall Day Acoustics Pty Ltd
ABN: 53 470 077 191
C 14, 372 Wattle Street
Ultimo NSW 2007
Australia
T: +612 9282 9422
www.marshallday.com

Project:	**Calala Battery Energy Storage System**
Prepared for:	**Equis Energy (Australia) Projects (Ngumi 4) Pty Ltd as trustee for Equis Energy (Australia) Ngumi 4 Asset Trust Unit 1 / 36 Esplanade, Brighton VIC 3186**
Attention:	**Elizabeth Zorondo**
Report No.:	**Rp 001 20220648**

Document Control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
Complete	-	Issued to client	18 Aug. 2023	A. Stoker	O. Wesley-Smith

EXECUTIVE SUMMARY

Marshall Day Acoustics has been engaged to prepare an environmental noise and vibration assessment of the proposed Calala battery energy storage system, located near the township of Calala, in northern NSW.

Inputs for this assessment have been provided by the proponent, Equis Energy (Australia) Projects (Ngumi 4) Pty Ltd, as trustee for Equis Energy (Australia) Ngumi 4 Asset Trust, as far as they are available at this stage of the development process. Where relevant noise data or input information could not be provided, representative data has been developed based on previous project experience, relevant standards, and typical noise assessment assumptions. The developed data has been reviewed by the proponent and approved as being representative of the types and specification of equipment items likely to be used for the project.

The following potential noise impacts have been considered:

- Operational noise from the project;
- Noise and vibration during the construction of the project;
- Noise from construction traffic on public roads; and
- Cumulative operational noise considering the nearby Transgrid Tamworth Substation.

Operational noise from the project is expected to meet relevant noise criteria at all receivers contingent on the inclusion of noise barriers to limited extents of the project perimeter and nearfield noise barriers to high voltage transformers within the proposed substation. The noise limits derived for assessment include inherent allowances for cumulative noise from other nearby industrial noise sources, including the Transgrid Tamworth Substation. On this basis no additional impacts are expected from the cumulative operation of the proposed project and the existing Transgrid Tamworth Substation.

The upper range of construction noise levels, predicted under a conservative method, are indicated to exceed the noise affected management level at the noise sensitive receiver closest to the subject works stage. However, for the lower range of construction noise levels, representing average or typical noise levels, the noise management level will be achieved for all but four (4) work stages. Noise levels at receivers further away will be lower than that indicated by the construction noise assessment.

Exceedances above the noise affected management levels are not unique to this project and are typical of most construction assessments due to the significant source noise levels of construction equipment. Based on previous project experience the predicted noise levels are typical of the range expected for a medium size infrastructure project in a semi-rural setting, considering the distances to receivers.

Based on the results of the construction noise assessment, all feasible and reasonable work practices and mitigation measures should be implemented as part of a detailed Construction Noise and Vibration Management Plan, to be drafted once a main contractor is appointed.

Minimum distances between receivers and proposed work zones are in the order of 200 m. As a result vibration events associated with construction activities are not anticipated to result in adverse impacts at any of the residential receivers considered for assessment.

Based on information provided by the project traffic consultant, predicted increases in traffic flows for construction activity are unlikely to give rise to perceptible noise impacts at noise sensitive receivers.

Based on the sum of the assessments documented in this report, the proposed project is capable of being designed, constructed, and operated in accordance with policy and guidance documents referred to in the applicable Planning Secretary's Environmental Assessment Requirements (Application Number SSD-52786213), dated 30 January 2023.

MARSHALL DAY Acoustics

TABLE OF CONTENTS

1.0 INTRODUCTION

Equis Energy (Australia) Projects (Ngumi 4) Pty Ltd as trustee for the Equis Energy (Australia) Ngumi 4 Asset Trust (the Proponent) are proposing to develop a battery energy storage system (BESS) project on land nearby to the township of Calala in northern NSW. The project is identified as the Calala Battery Energy Storage System (the Project).

The Project is proposed to comprise a BESS with an estimated capacity of 300 MW / 1200 MWh and associated infrastructure, including connection to existing transmission infrastructure.

This report, commissioned by Mecone, on behalf of the Proponent, presents the results of an assessment of operational and construction noise for the proposed Project undertaken in accordance with the applicable Planning Secretary's Environmental Assessment Requirements (Application Number SSD-52786213), dated 30 January 2023 (SEARs).

The assessment of operational noise associated with the Project has been undertaken in accordance with the NSW EPA publication *Noise Policy for Industry*, as required by the SEARs.

Noise associated with construction of the Project has been assessed in accordance with the NSW DECC[1] publication *Interim Construction Noise Guideline*, as required by the SEARs.

Operational and construction traffic has been assessed in accordance with the NSW DECCW[2] publication *NSW Road Noise Policy*.

Further details are provided in Section 3.0.

The noise assessment presented in this report is based on:

- Noise limits determined in accordance with applicable regulatory documentation;
- Predicted noise levels for the operation of the proposed Project, based on the proposed site layout and equipment noise emission data;
- Predicted noise levels for the construction of the proposed Project, based on noise data detailed in relevant standards; and
- Predicted noise levels due to additional road traffic for construction and operation of the Project, based on traffic data provided by others.

A background noise survey to evaluate existing noise levels in the vicinity of the Project site has been conducted. Measured background noise levels are below the minimum background noise levels indicated in the NPfI. On this basis the mandated minimum background noise levels and associated noise limits, as set out in the NPfI, have been adopted for assessment.

A glossary of relevant acoustic terminology used within this report has been included in Appendix A.

[1] The former Department of Environment and Climate Change, now the DPIE

[2] The former Department of Environment, Climate Change and Water, now the DPIE

2.0 PROJECT OVERVIEW

2.1 Description

The Project is proposed to be located approximately 2.5 km south-east of the township of Calala, within Tamworth Regional Council, located in the New England region of NSW.

The current Project design is expected to have an installed capacity of up to 300 MW, providing up to 1200 MWh of battery storage capacity or up to 4 hours of storage duration.

The proposed Project comprises.

- Large-scale BESS including battery enclosures, inverters, DC and AC combiner boxes, transformers, and auxiliary components.
- 33 / 330 kV switchyard
- Underground transmission line connection between the BESS and the nearby TransGrid Tamworth 330 kV substation, located approximately 800 m to the southwest of the Project boundary.
- Ancillary elements including site access from Calala Lane, internal access roads and parking, control room and staff amenities, warehouse, stormwater and fire management infrastructure, utilities, fencing, security systems, and landscaping.

Information with respect to noise generating equipment associated with the Project has been supplied by the Proponent and is described as:

- One hundred and twenty (120) inverters;
- Up to six (6) auxiliary transformers;
- Two hundred and forty (240) DC combiners;
- Nine hundred and sixty (960) battery units; and
- Up to two (2) high voltage transformers.

A plan of the project layout, as provided by the Proponent, is shown in Figure 1.

2.2 Noise sensitive receivers

A receptor plan has been developed and provided by the Proponent and is presented graphically in Figure 2, with geographic co-ordinates tabulated in Appendix B.

Generally, receptors are distributed across the following land use zones per NSW Planning Portal Spatial Viewer[3] and Tamworth Regional Local Environmental Plan 2010[4]. A zoning map is provided in Appendix C.

- Zone RU4 Primary Production Small Lots
- Zone R5 Large Lot Residential
- Zone R1 General Residential

For the purposes of the EIS noise assessment, the nearest receivers surrounding the project site in each direction have been considered. Compliance at the nearest receivers would also mean compliance at receivers further away.

---

[3] https://www.planningportal.nsw.gov.au

[4] https://www.planningportal.nsw.gov.au/publications/environmental-planning-instruments/tamworth-regional-local-environmental-plan-2010

The receivers considered for assessment are detailed in Table 1 alongside the geographic coordinates of the assessment position developed in accordance with the NPfI[5] and associated land use zones.

It should be noted that as part of the Project, R78 within the project site will be retained as part of the project infrastructure but will no longer be utilised as a dwelling. On this basis it has not been included in the assessment.

Table 1: Noise sensitive receiver positions included in the assessment, GDA2020 / MGA Z56

Receiver ID	Easting, m	Northing, m	LEP Zoning	Distance to Project boundary, m
R1	306,380	6,553,415	RU4	661
R2	305,926	6,553,261	RU4	431
R3	305,688	6,553,273	RU4	554
R4 (Project Landholder)	305,556	6,552,895	RU4	460
R5	305,435	6,552,815	RU4	535
R6	305,396	6,552,612	RU4	485
R7	305,324	6,552,545	RU4	535
R8	305,283	6,552,455	RU4	565
R9	305,619	6,552,096	RU4	408
R10	305,664	6,551,980	RU4	490
R11	304,821	6,551,754	RU4	1,231
R12	305,082	6,551,611	RU4	1,124
R16	305,395	6,552,722	RU4	533
R44	305,526	6,553,229	R1	642
R45	305,511	6,553,194	R1	635

Receiver R4 has been identified as being the Project Landholder i.e. the owner of this property is also the owner of the land on which the Project is proposed to be developed.

[5] The NPfI indicates that for residences an assessment is to be conducted at the "*reasonably most-affected point on or within the residential property boundary or, if that is more than 30 metres from the residence, at the reasonably most-affected point within 30 metres of the residence*"

Figure 1: Site layout as provided by the Proponent

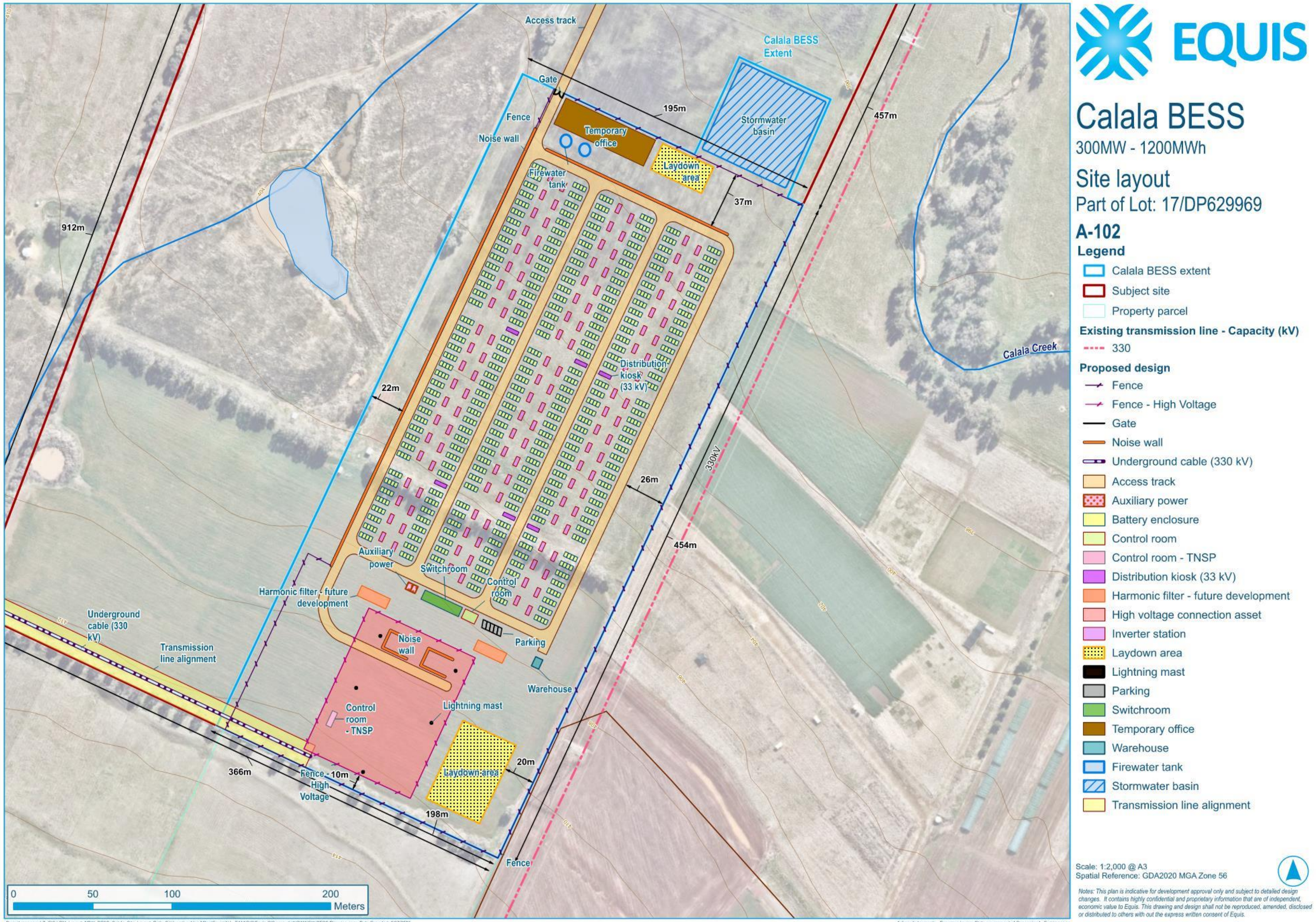
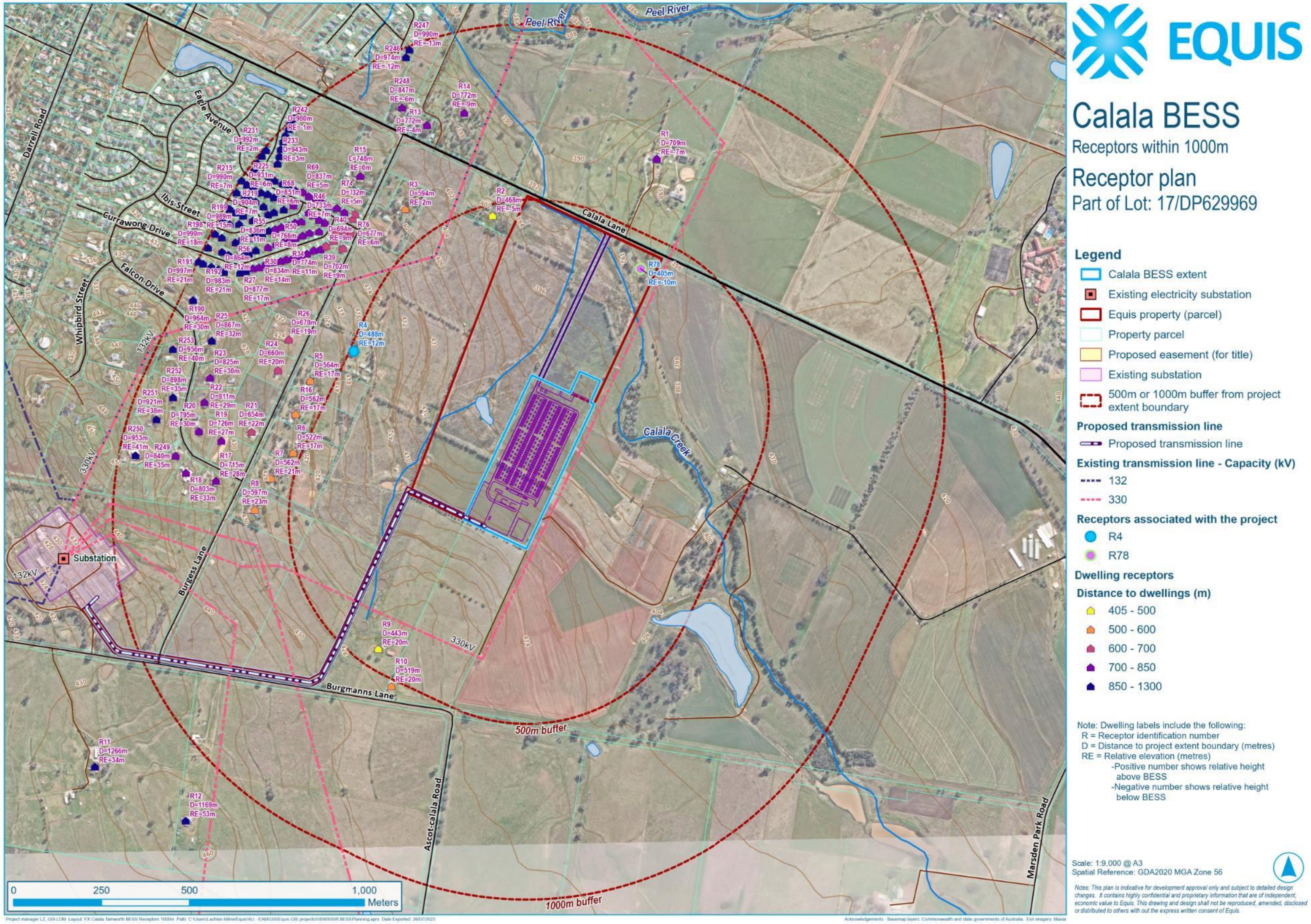


Figure 2: Receptor plan as provided by the Proponent



3.0 NEW SOUTH WALES POLICY & GUIDELINES

Based on the requirements specified in the project SEARs, as well as standard practices in the absence of SEARs direction, the following NSW publications are relevant to the assessment of operational and construction noise from the Project:

- NSW EPA publication *Noise Policy for Industry*, dated 2017 (NPfI);
- NSW DECC[6] publication *Interim Construction Noise Guideline*, dated 2009 (ICNG);
- NSW DECCW[7] publication *NSW Road Noise Policy*, dated 2011 (RNP); and
- NSW DECC publication *Assessing Vibration: A Technical Guideline*, dated 2006 (AVTG).

Details of the guidance and noise criteria provided by these publications are provided in the following sections.

3.1 Noise Policy for Industry

The NPfI is the applicable guideline for assessing operational noise associated with the Project.

The NPfI provides a method for determining project noise trigger levels that are used for assessing the potential impact of noise from industry at existing receivers. Specifically, the project noise trigger levels provide a benchmark or objective for assessing a proposal or site. The NPfI states that the project noise trigger levels are not intended for use as mandatory requirements, but represent the levels that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response; e.g. further investigation of mitigation measures.

The project noise trigger levels are derived from an analysis of the background noise environment and zoning information, accounting for amenity-based criteria and, in the case of residential receivers, intrusiveness criteria. The project noise trigger levels are defined as the minimum of the intrusiveness noise levels and the amenity noise levels.

The following subsections describe the amenity and intrusiveness noise levels used to determine the project noise trigger levels. Further details on the derivation of appropriate project noise trigger levels are provided in Section 6.1 and Appendix D.

3.1.1 Amenity noise levels

The amenity noise assessment is designed to prevent industrial noise continually increasing above an acceptable level. The NPfI provides recommended amenity noise levels based on receiver categories and typical planning zones.

The recommended amenity noise levels outlined in the NPfI have been selected on the basis of studies that relate industrial noise to annoyance in communities and have been subjectively scaled to reflect the perceived differential expectations and ambient noise environments of rural, suburban, and urban communities for residential receivers. They are based on protecting the majority of the community (90 %) from being highly annoyed by industrial noise.

The amenity levels defined in the NPfI relate to total industry noise levels. The project amenity noise levels for an individual industry are set at a level 5 dB below the recommended amenity levels to provide a margin for cumulative industry noise.

---

[6] The former Department of Environment and Climate Change, now the DPIE

[7] The former Department of Environment, Climate Change and Water, now the DPIE

3.1.2 Intrusiveness noise levels

The intrusiveness noise assessment is applicable to residential receivers and is based on knowledge of the background noise level at the receiver. The background noise levels are referred to as the rating background noise level (RBL) in the NPfI.

The intrusiveness noise level is the RBL at the nearest noise sensitive location plus 5 dB. Therefore, the noise emissions from the premises are considered to be intrusive if the source noise level ($L_{Aeq, 15\,min}$) is greater than the background noise level (L_{A90}) plus 5 dB.

3.1 Interim Construction Noise Guideline

The ICNG, developed by a number of NSW state agencies, aims to provide a clear understanding of ways to identify and minimise noise from construction works through applying all ‘feasible’ and ‘reasonable’ work practices to control noise impacts. The guideline identifies sensitive land uses and recommends construction hours, provides quantitative and qualitative assessment methods, and subsequently advises on appropriate work practices.

The ICNG recommended standard hours detailed in Table 2.

Table 2: ICNG recommended standard hours of work

Work type	Recommended standard hours of work
Normal construction	Monday to Friday 0700 to 1800 hrs Saturdays 0800 to 1300 hrs No work on Sundays or public holidays

The ICNG defines management noise levels for both residential and non-residential receiver types.

The ICNG provides two primary management levels for the assessment of construction noise at residential receivers during recommended standard hours of construction:

- The noise affected management level, $L_{Aeq\,15\,min}$, is the NPfI’s RBL + 10 dB; and
- The highly noise affected management level is prescriptively set at 75 dB $L_{Aeq, 15\,min}$.

Where noise from construction works is above the noise affected management level, all feasible and reasonable work practices should be applied. Where the noise from construction works is above highly noise affected management level for residential receivers, restrictions to the hours of construction may be required. Neither the noise affected management level or the highly noise affected level are intended as strict noise criteria. The ICNG indicates that they are intended as trigger levels for additional assessment and the implementation of appropriate noise controls.

The ICNG also defines the following five categories of works that might be undertaken outside the recommended standard hours are:

- the delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads;
- emergency work to avoid the loss of life or damage to property, or to prevent environmental harm;
- maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours;
- public infrastructure works that shorten the length of the project and are supported by the affected community; and
- works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

The ICNG defines additional assessment and reporting requirements that apply if out of hours work is proposed, including justification of the need to work during these periods.

The ICNG also provides additional criteria for ground borne noise from construction vibration, applicable during the evening and night periods only. As construction is not expected to occur during these periods, ground borne noise is not considered in this assessment.

3.2 Assessing Vibration: A Technical Guideline

The AVTG presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. Preferred and maximum vibration values outlined in the AVTG are taken from British Standard 6472:1992 *Evaluation of human exposure to vibration in buildings (1-80 Hz)* (BS 6472).

The AVTG identifies three vibration categories:

- *Continuous vibration* – Examples: Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery);
- *Impulsive vibration* – Examples: Infrequent activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading; and
- *Intermittent vibration* – Examples: Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer this would be assessed against impulsive vibration criteria.

Similar to other policy and guideline documentation, the AVTG allows for assessment at various receiver types.

3.2.1 Intermittent vibration

The vibration characteristics of most construction activities (e.g. excavation and pilling) are considered to be intermittent. Intermittent vibration can be defined as interrupted periods of continuous vibration (e.g. heavy truck pass-bys or rock breaking) or continuous periods of impulsive vibration (e.g. impact pile driving). Higher vibration levels are allowed for intermittent vibration compared with continuous vibration on the basis that the higher levels occur over a shorter time period.

Human disturbance vibration levels are assessed on the basis of the Vibration Dose Value (VDV), based on the level and the duration of the vibration events. Vibration criteria applicable to residential receivers for intermittent vibration sources are summarised in Table 3.

Table 3: Preferred and maximum vibration levels for human disturbance limits, VDV [2]

Assessment period [1]	Preferred value	Maximum value
Daytime	0.20	0.40
Night-time	0.13	0.26

1 Daytime is 0700 hr to 2200 hr and night-time is 2200 hr to 0700 hr

2 These values are only indicative, and there may be a need to assess to other sensitive areas against the relevant criteria.

3.2.2 Continuous and impulsive vibration

Vibration criteria applicable to the residential receivers in the vicinity of the Project for continuous and impulsive vibration sources are summarised in Table 4.

Table 4: Preferred and maximum vibration levels for human disturbance limits, m/s^2

Vibration type	Assessment period[1]	Preferred values [2]		Maximum values [2]	
		Z axis	X and Y axes	Z axis	X and Y axes
Continuous vibration	Daytime [1]	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0,014	0.010
Impulsive vibration	Daytime [1]	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14

1 Daytime is 0700 hr to 2200 hr and night-time is 2200 hr to 0700 hr

2 The preferred and maximum values are weighted RMS acceleration values. These values are only indicative, and there may be a need to assess to other sensitive areas against the relevant criteria.

3.3 Road Noise Policy

The RNP provides noise level criteria for increased traffic flow as a result of a land-use development with the potential to create additional traffic, as detailed in Table 5.

Table 5: Road traffic noise assessment criteria for residential land uses

Type of development	Day (0700-2200 hrs)	Night (2200-0700 hrs)
Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	60 dB $L_{Aeq,\ 15\ hr}$ (external)	55 dB $L_{Aeq,\ 9\ hr}$ (external)
Existing residences affected by additional traffic on existing local roads generated by land use developments	55 dB $L_{Aeq,\ 1\ hr}$ (external)	50 dB $L_{Aeq,\ 1\ hr}$ (external)

Additionally, the RNP requires that the relative increase in noise levels at residential receivers not exceed 12 dB for land use developments with the potential to generate additional traffic on existing freeways, arterial or sub-arterial roads. The relative increase criterion does not apply for local roads.

The RNP notes that in assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

Where night-time construction traffic is likely to occur, an assessment of sleep disturbance is appropriate. The RNP provides guidance:

- Maximum internal noise levels below 50–55 dB L_{Amax} are unlikely to awaken people from sleep
- One or two noise events per night, with maximum internal noise levels of 65–70 dB L_{Amax}, are not likely to affect health and wellbeing significantly.

Based on the accepted assumption that an open window provides 10 dB attenuation, noise levels below 60-65 dB L_{Amax} outside an open bedroom window would be unlikely to cause awakening reactions.

Furthermore, one or two events with a noise level of 75-80 dB L_{Amax} outside an open bedroom window would be unlikely to affect health and well-being significantly.

4.0 NOISE PREDICTION METHOD

4.1 Operational noise

Operational noise levels associated with the Project, i.e. the typical operation of inverters, transformers, battery units and DC combiners, are predicted using:

- noise emission data for the inverters, transformers, battery units, and DC combiners;
- a 3D digital model of the Project and the surrounding environment using proprietary noise modelling software SoundPLAN (version 8.2); and
- international standards used for the calculation of environmental sound propagation.

The method selected to predict noise levels is International Standard ISO 9613-2: 1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* (ISO 9613).

The implementation of ISO 9613 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 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. This is expected to satisfy the *'noise-enhancing meteorological conditions'* definition in the NPfI and provide a conservative approach to noise modelling.

1 m vertical resolution terrain data for the Project site and surrounds has been sourced from publicly available terrain data[8] and is considered appropriate for noise modelling purposes.

Generally, 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 6.2.

Where the built form of proposed equipment items provides shielding, such as the grouping of multiple battery units, the geometries of the equipment have been included in the model. The geometries in the model are simplified representations that have been configured to a level of detail that is appropriate for noise calculation purposes.

Assumptions required to undertake the noise modelling, include:

- The ground factor, 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 = 0.2 i.e. hard ground, within the Project boundary to represent an expected gravel mulch footing.
  - G = 0.6 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 E.

[8] Sourced from NSW Government – Spatial Services via Elvis – Elevation and Depth – Foundation Spatial Data - https://elevation.fsdf.org.au/

4.2 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 is referred to in the ICNG and 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.

5.0 EXISTING NOISE ENVIRONMENT

Based on review of the Project site and surrounding noise sensitive receivers, five (5) receivers were nominated by MDA for the purposes of background noise assessment:

- R1
- R2
- R4
- R6
- R9

These receivers were selected to provide a spread of the nearest receiver locations around the Project. At the request of the Proponent an additional receiver, R16, was also included in the background noise survey.

Approval to deploy noise monitoring equipment was not provided by receiver R1. As part of the site visit, access to receiver R4 was blocked by locked gates and deployment of equipment was not possible. In addition, due to inconsistencies between receiver IDs and recorded addresses, consent for deployment was provided by the resident at R10, and not R9. On this basis equipment was deployed at the noise monitoring locations detailed in Table 6.

Table 6: Background noise monitoring locations

Receiver ID	Deployment date	Retrieval date	Equipment type	Equipment Serial Number
R2	3/07/2023	25/07/2023	01dB DUO	10419
R6	4/07/2023	25/07/2023	01dB DUO	12691
R10	4/07/2023	25/07/2023	01dB DUO	10496
R16	4/07/2023	25/07/2023	01dB DUO	10770

Measurement equipment was calibrated before and after the survey with no significant drift observed.

Average L_{A90} (described as the rating background level, RBL, in the NPfI) and L_{Aeq} noise levels measured during the noise survey are shown in Table 7 and have been derived in accordance with the data exclusion rules described in the NPfI.

Table 7: Measured average rating background level and ambient noise levels

Receiver/Period [1]	RBL L_{A90} dB	L_{Aeq} dB
R2		
Day	34	47
Evening	29	44
Night	24	40
R6		
Day	29	45
Evening	28	39
Night	22	36
R10		
Day	25	45
Evening	26	40
Night	23	37
R16		
Day	29	47
Evening	28	37
Night	23	37

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

The NPfI recognises that rural background noise levels may be very low. In such cases the policy stipulates minimum rating background levels. The purpose of providing minimum rating background levels is to ensure that receiver noise amenity is protected, and also avoid the situation where applying a very low background noise level would not improve the level of protection for a receiver but may impose very strict requirements on a new development. Research conducted by the EPA indicates that there is no evidence to suggest that noise impacts on amenity occur at levels lower than 35 dB L_{PA}.

The minimum rating background levels are detailed in Table 2.1 of the NPfI and reproduced in Table 8.

Table 8: Minimum assumed rating background levels per Table 2.1 of the NPfI

Receiver/Period	RBL L_{A90} dB
All receivers	
Day	35
Evening	30
Night	30

Review of the measured rating background levels in Table 7 indicates that day, evening, and night measured rating background levels are below the minimum assumed rating background level at all receivers for all times of day.

On this basis, and in accordance with the NPfI, the minimum rating background levels detailed in Table 8 have been adopted to represent the background noise environment for all receivers surrounding the Project.

6.0 OPERATIONAL NOISE ASSESSMENT

6.1 Project noise trigger levels

Per Section 5.0 minimum assumed background noise levels have been adopted from the NPfI.

Based on this approach the project noise trigger levels shown in Table 9 have been derived and apply at all residential receivers surrounding the Project.

Derivation of the project noise trigger levels is detailed in Appendix D.

Table 9: Project noise trigger level

Receiver	Time of day	Project noise trigger level, $L_{Aeq, 15min}$, dB
Residential	Day	40
	Evening	35
	Night	35

6.2 Operational noise sources

The primary influence over the accuracy of a noise model is the accuracy of input noise data.

The preferred standard of noise data is third octave band sound power levels for each equipment item operating under the worst-case condition likely to occur during the operation of the Project, provided by the manufacturer and measured in accordance with a recognised standard.

The selection of an appropriate measurement standard will depend on various factors including the conditions under which the measurements occur, the measurement equipment available, and the character of the noise being measured, amongst others. Example standards include:

- ISO 3741 to ISO 3747 - determination using sound pressure level measurements
- ISO 9614-1 to ISO 9614-3 - determination using sound intensity measurements

The above standard of information was requested from the Proponent but was not available in all instances. Where this data was not available MDA has established approximations or assumptions based on comparable data, existing acoustic literature or conducted derivations from alternative noise metrics such as sound pressure level. Responsibility for providing representative, accurate noise emissions data for proposed equipment items is that of the Proponent. Where inaccurate data is used, predicted noise levels may not accurately represent resultant noise levels in practice.

Sound power levels for project equipment items, as used in the noise model, are detailed in Table 10. Data is provided as un-weighted (linear) octave band spectra and A-weighted overall sound power level.

Table 10: Sound power levels for Project equipment items, dB L_W

Item	Octave band centre frequency, Hz							
	63	125	250	500	1000	2000	4000	dBA
Inverter	91	86	83	79	78	77	84	88
Battery Unit	70	75	71	68	66	61	55	71
DC Combiner	70	75	71	68	66	61	55	71
Aux. Transformer	68	70	65	65	59	54	49	65
HV Transformer	95	97	92	92	86	81	76	92

Additional information with respect to the source of the data is provided in Table 11.

Table 11: Noise data descriptions

Item	Description
Inverter	Third octave band sound power levels measured in accordance with EN ISO 9614-2 have been provided by a manufacturer. Extensive specific operating conditions for the test were described in the supplied data sheet but included all fans running at 100 %. Measurements were inclusive of manufacturer provided noise control packages. Due to commercial sensitivities the specific inverter manufacturer and model is not detailed in this report but has been confirmed by the Proponent to be representative of the specification required for the Project. The data sheet provided by the manufacturer does not provide information with respect to measurement uncertainty however, at the request of the Proponent, a 2 dB uncertainty factor is included in the sound power levels used for assessment.
Battery Unit	The Proponent advised that noise related to the battery unit is limited to two (2) chiller fans per battery unit. The Proponent supplied a sound power level per chiller fan of 71 dB L_{WA}. Comparative spectral data has been taken from a typical residential condenser unit (Kirby WRC493BECB). The spectral data was then normalised to provide a resultant 71 dB L_{WA} which was used for assessment.
DC Combiner	The Proponent indicated that noise levels associated with one (1) battery unit chiller should be used for the DC combiner.
Aux. Transformer	The Proponent advised that the auxiliary transformers would have a capacity of 1 MVA and supplied an overall sound power level of 65 dB L_{WA}. Spectral data for the transformer was estimated by applying Bies & Hansen[9] corrections from Table 11.27, (Location 1a for outdoor transformer noise) to client provided overall sound power level.
HV Transformer	The Proponent advised that the HV transformers would have a capacity of 200 MVA and supplied an overall sound power level of 92 dB L_{WA}. Spectral data for the transformer was estimated following the same method applied for the Aux. Transformer.

6.3 Predicted noise levels

Operational noise level predictions at the relevant noise sensitive receivers have been conducted based on the method detailed in Section 4.1, and the Project design described in Section 2.0 and Section 6.2.

The results of these predictions are provided in Table 12.

As the Project is proposed to be operated over a 24-hr period, the predicted noise levels have been assessed against the more stringent evening and night period project noise trigger levels. An assessment of compliance with the relevant trigger level has been included for each receiver in Table 12.

The results are representative of the 'base' project design being without additional noise controls, other than the manufacturer provided noise control package described in Table 11.

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

Table 12: Predicted noise levels for 'base' project design i.e. without additional noise controls, dB $L_{Aeq,15min}$

Receiver	Predicted noise level [1]	Compliance
R1	35	✓
R2	**37**	×
R3	34	✓
R4	**40**	×
R5	**38**	×
R6	**37**	×
R7	35	✓
R8	34	✓
R9	34	✓
R10	33	✓
R11	23	✓
R12	28	✓
R16	**37**	×
R44	33	✓
R45	33	✓

1 Any predicted noise levels above the applicable project noise trigger level are shown in bold for clarity.

The results shown in Table 12 demonstrate that the predicted noise level for the 'base' project design, without additional noise controls, is up to 5 dB above the evening and night project noise trigger level of 35 dB $L_{Aeq,15\ min}$ at some receivers.

To achieve compliance with the relevant criteria, it is required that additional noise control measures be incorporated into the Project design.

6.3.1 Perimeter noise barriers

Minor design development has been undertaken to introduce physical noise controls that can assist in demonstrating compliance with the evening and night project noise trigger level.

The developed design includes perimeter noise barriers to the north and west boundaries of the site and near-field barriers to the HV transformers.

An image depicting the location and height of each of these barriers is shown in Figure 3.

Figure 3: Extent of noise barriers

In order to provide appropriate acoustic performance, perimeter noise barriers must be designed to meet a certain standard. The Bridge Technical Note *Code of Practice Noise attenuation walls* (BTN007 v1.1, June 2018), published by the former VicRoads, provides useful guidance with respect to performance expectations for noise barriers.

BTN007 states:

> *...the noise attenuation walls shall have sufficient intrinsic airborne sound insulation performance to ensure that, for all receivers, the sound transmitted directly through the barrier is not less than 10 dB below the sound diffracted at the top of the barrier.*
>
> *The following is deemed to satisfy this requirement:*
>
> o *a non-porous construction with no gaps and a surface density of at least 20 kg/m^2 at its thinnest point*
>
> *or:*
>
> o *a construction that has a sound insulation rating value of the weighted sound reduction index with spectrum adaptation term Rw + Ctr of at least 25dB when determined in accordance with AS/NZS ISO 717-1 using results from a NATA-accredited laboratory.*

Construction materials with a minimum surface density of 20 kg/m^2 include:

- 3 mm thick steel (e.g. Bluescope HW350 – Corten)
- 40 mm thick timber
- 10 mm thick glass
- 18 mm thick Perspex or polycarbonate
- 75 mm thick brick or concrete

Alternative materials could be considered, provided that they are capable of meeting the requirement of *"sound transmitted directly through the barrier is not less than 10 dB below the sound diffracted at the top of the barrier"*.

Care shall be taken such that the barrier is well sealed and free from any holes or gaps. There must not be a gap at the base of the barrier, it is recommended that the base of the barrier is buried to a depth of 10 – 20 cm. Design life of the barrier will also need to be considered; a minimum design life of 25 years generally applies. The design life requirement, as well as the suitability with regard to wind loading and foundation design, will need to be confirmed by the contractor.

Proprietary solutions may be available however adherence to the BTN007 requirements should be evidenced. Suppliers may include:

- Wallmark
- Modular Walls
- NAP
- Noise Control Engineering
- RJE

6.3.2 Nearfield HV transformer noise barriers

Nearfield HV transformer noise barriers should be constructed from 200 mm Hebel or equivalent. Powershield may provide a suitable alternative, offering tuneable absorption at lower frequencies designed to reduce low frequency hum associated with HV transformers.

6.4 Predicted noise levels including additional noise control measures

The predicted noise levels at each receiver following the inclusion of the above-described noise barriers are shown in Table 13.

Predicted noise level contours are shown in Appendix F.

Table 13: Predicted noise levels with additional noise control measures, dB $L_{Aeq,15min}$

Receiver	Predicted noise level	Compliance
R1	33	✓
R2	35	✓
R3	33	✓
R4	35	✓
R5	34	✓
R6	34	✓
R7	33	✓
R8	32	✓
R9	33	✓
R10	32	✓
R11	22	✓
R12	27	✓
R16	34	✓
R44	32	✓
R45	32	✓

6.5 Operational noise discussion and recommendations

It can be seen from the results in Table 13 that with the inclusion of suitable noise control measures, the Project is capable of achieving compliance with the evening and night project noise trigger level.

This compliance is contingent on the inclusion of the inverter noise control package provided by the manufacturer as well as the described noise barriers.

Where alternative equipment selections are made during procurement the findings of this report, and the required noise control measures, may change. It is recommended that additional noise modelling is conducted for any finalised Project design and equipment selections to establish continued compliance with NPfI criteria and determine noise control measures specific to that design.

The noise assessment assumes continuous operation of all noise generating equipment throughout a 24-hr period, including the entirety of any 15-minute assessment period. The battery and inverter cooling systems are assumed to run at 100 % fan speed since the OEM has not proposed a stochastic approach based on ambient temperature. Where, battery equipment operates at reduced duty, noise levels are expected to be lower than that predicted in Table 13.

6.6 Cumulative noise

The Transgrid Tamworth 330 kV Substation is located approximately 800 m southwest of the Project boundary. Current noise levels from the operation of this facility have not been measured or quantified.

The NPfI project amenity noise level is designed *'to protect against cumulative noise impacts from industry'* with modifications made to the recommended amenity noise level to account for noise contributions for existing industry, as described in Section 3.1.1 and Appendix D.

Further, the NPfI states:

> *Where the project amenity noise level applies and it can be met, no additional consideration of cumulative industrial noise is required.*

On this basis no further consideration is given to noise from the Transgrid Tamworth 330 kV Substation and assessment of cumulative industrial noise under the NPfI is considered satisfied.

7.0 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

The construction of the Project will generate noise and vibration as a result of activities occurring both on and off the site of the proposed development. As per the SEARs, construction noise is to be assessed in accordance with the ICNG and construction vibration in accordance with the AVTG (see Section 3.0).

Off-site noise generating activities primarily relate to heavy goods vehicle movements to and from the site and is addressed in the traffic noise assessment in Section 8.2.

On-site works include a range of activities such as access road construction, cable trenching, site compound and substation construction and other tasks.

The majority of construction works are expected to be limited to standard construction hours. Per the ICNG, exceptions to this may occur for potential unavoidable works or low-noise managed-works. Unavoidable works outside of normal hours may comprise oversize / over mass (OSOM) deliveries scheduled to minimise traffic disruption associated with intersection closures and associated unloading and installation of oversize equipment. Should these works be required, an out of hours construction noise and vibration assessment should be conducted during the detailed design stage. OSOM deliveries are considered at a high level in Section 8.2.

As per the ICNG, noise associated with the construction of a BESS may require the adoption of reasonable and feasible general management measures and considerate 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.

7.1 Construction activities

Based on information provided by the Proponent, construction of the Project is likely to involve the following key stages:

- Access road construction
- Cable trench digging
- Site compound construction
- Substation construction
- Delivery of components and equipment
- Benching of the site
- Clearing of surface vegetation
- Installing security fencing
- Laying down of mulch and gravel in battery and substation plant areas
- Site rehabilitation, landscaping and vegetation works

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 and concreting plant.

Appendix G details typical major equipment items associated with the above relevant construction stages, alongside noise levels developed on the basis of reference data from AS 2436 and previous project experience. Construction activities related to deliveries, particularly the construction stages identified as '*Delivery of components and equipment'* and *'Installing of security fences'*, in which the primary noise source is vehicle movements on public roads, are specifically considered as part of the traffic noise assessment in Section 8.2.

As shown in Appendix G typical construction plant sound power levels range from approximately 99-117 dB L_{WA} per equipment item.

Based on the groupings of major plant items during key construction tasks, the total aggregated noise emissions for the stages typically range from 110 to 125 dB L_{WA}. These predictions assume that each item of plant associated with a task operates simultaneously for the entire duration of an assessment period thus providing a conservative approach that is unlikely to occur in practice.

7.2 Construction noise assessment

Noise levels associated with each of the main construction tasks have been predicted at the nearest receivers 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 Construction Noise and Vibration Management Plan (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 14 details the predicted noise level ranges for each of the main construction tasks at the noise sensitive receiver nearest the subject construction task, based on aggregated sound power levels for each task. Noise levels at receivers further away will be lower than that indicated by the construction noise assessment.

The upper bound of the range represents typical worst case noise levels that may be experienced during the subject construction task.

Construction works for this worst-case scenario are assumed to be occurring at the nearest point in the subject construction area to the receiver, all equipment and plant items are assumed to operating for 100 % of the subject 15-minute period, and all equipment and plant items are assumed to be operating in the same general area. In practice this is unlikely to happen as plant and equipment items are likely to be distributed throughout the subject work area, and not all plant and equipment items identified for each construction task are likely to be operating concurrently.

The lower bound of the range represents the typical average noise level, in which a reduced number of plant and equipment items are operating concurrently and only for portions of the 15-minute period. Construction activities are also assumed to be at more distant or distributed locations throughout the work area.

Table 14: Indicative range of construction noise predictions, dB L_{Aeq}

Construction task	Nearest receiver	Predicted level range	Noise affected management level	Exceedance (Average)	Exceedance (Worst case)	Highly noise affected management level	Exceedance
Access road construction	R1	53-65	45	≤ 8	≤ 20	75	-
Cable trench digging	R9	42-52	45	--	≤ 7	75	-
Site compound construction	R9	42-51	45	--	≤ 6	75	-
Substation construction	R9	50-60	45	≤ 5	≤ 15	75	-
Benching of site	R9	50-61	45	≤ 5	≤ 16	75	-
Clearing of surface vegetation	R9	43-52	45	--	≤ 7	75	-
Laying down of gravel mulch in the battery and electrical plant areas	R9	51-63	45	≤ 6	≤ 18	75	-
Site rehabilitation, landscaping and vegetation works	R9	43-52	45	--	≤ 7	75	-

The following can be seen from Table 14:

- The upper range of the construction noise levels are predicted to be above the noise affected management level at the nearest affected receiver for all proposed construction tasks.
- The lower range of the some of the construction noise levels are predicted to be above the noise affected management level at the nearest affected receiver for the four (4) nosiest construction tasks only.
- Construction noise levels are predicted to be below the highly noise affected management levels at all receivers for all assessed construction activities.

Exceedances above the noise affected management levels are not unique to this Project and are typical of most construction assessments due to the significant source noise levels of construction equipment. Based on previous project experience the predicted noise levels are typical of the range expected for a medium size infrastructure project in a semi-rural setting.

7.3 Discussion

The ICNG indicates:

> *The noise affected level represents the point above which there may be some community reaction to noise.*
>
> - *Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.*
> - *The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.*

Therefore, community consultation should be considered during a future detailed CNVMP.

7.4 Construction vibration assessment

The prediction of vibration propagation through the ground is complex and subject to considerable uncertainty. Actual propagation in practice depends on several factors including damping, reflection, and impedance in-ground conditions. A detailed vibration propagation assessment is considered to be a site-specific assessment and often requires a combination of baseline vibration assessment, empirical measurement of equipment and analytical methods. Assessment of this nature is outside of the scope of a planning stage vibration risk assessment.

In lieu of this, publicly available propagation data, generally related to safe working distances for various plant or equipment types has been reviewed and included where relevant.

The AVTG provides guidance with respect to the assessment of human comfort due to vibration from construction works. This guideline distinguishes between intermittent, impulsive, and continuous vibration sources, which can be generated by construction activities. For the purposes of this planning risk assessment only residential receivers are considered.

7.4.1 Intermittent vibration

The AVTG indicates that intermittent vibration should be assessed in terms of the Vibration Dose Value (VDV) with acceptable vibration dose values detailed in Section 3.2.1.

These values are highly specific to site conditions, equipment selections and operational durations. As such, calculation of VDV levels is not typical or practical at the planning stage. Due to the complexity of the calculations required as well as the general lack of information, calculations of VDV would only be considered for projects involving activities near to receiver locations. This would not apply to the Project as minimum distances between nearby receivers and proposed construction work areas are in the order of 200 m.

The AVTG recommends that best management practices in all cases should be to reduce values as far as practicable, and a comprehensive community consultation program should be developed. Management practice for the Project will be notification of construction activities and construction program and complaints procedure, as defined in the Project Stakeholder Engagement Plan.

7.4.2 Continuous vibration

Vibration due to some construction operations can be considered continuous depending on the duration and nature of the works. Since the guide values for continuous vibration are independent of exposure duration, indicative safe working distances can be developed. Section 7.1 of the NSW RMS *Construction Noise & Vibration Guideline* (CNVG) sets out minimum working distances from sensitive receivers for typical items of vibration intensive plant. The minimum distances, reproduced in Table 15, are quoted for effects relating to human comfort.

Table 15: Recommended minimum working distances for human response limits for vibration intensive plant at nearest receivers

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

Note: Reproduced from Table 2 of Section 7.1 of the CNVG

It should be noted that the plant items detailed in Table 15 are not proposed for the Project. Whilst minimum working distances for Project relevant equipment items described in Appendix G are not provided in the CNVG, the plant items in Table 15 are known to be much more significant sources of vibration than the plant and equipment proposed for the Project.

On this basis and considering the minimum distances between nearby receivers and proposed construction work areas are in the order of 200 m, no proposed works for the Project are expected to give rise to continuous vibration impacts or exceedance of the criteria set out in Section 3.2.2.

7.5 Construction noise and vibration recommendations

Until a detailed construction plan is developed 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.

The ICNG provides extensive details and guidance with respect to noise mitigation including:

- Universal work practices;
- Consultation and notification;
- Plant and equipment;
- On-site controls;
- Work scheduling; and
- Transmission path and at-receiver considerations.

All of the above items should be considered as part of the future CNVMP.

Generally, it is likely to be feasible for a majority of works to be restricted to normal working hours, i.e. the ICNG recommended standard construction hours detailed in Section 3.1. This will assist in limiting noisy activities to times of the day when intrusive impacts or adverse reactions may be less likely.

In some cases, construction works may be required to occur outside of these hours. Such activities are typically related to public infrastructure i.e. timing oversized deliveries to avoid hazardous traffic conditions.

Where out of hours works are proposed, the ICNG advises:

- *A strong justification would typically be required for works outside the recommended standard hours.*
- *The proponent should apply all feasible and reasonable work practices to meet the noise affected level.*
- *Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.*

As with most construction projects works in any one location is typically of short duration with any adverse noise impact or disturbance being temporary. With reasonable and feasible work practices implemented it is expected that noise associated with the construction and decommissioning of the Project can be acceptably managed.

8.0 TRAFFIC NOISE ASSESSMENT

Noise criteria for the assessment of traffic associated with the construction and operation of the Project are set out in Section 3.3.

The traffic generation associated with the Project once it has reached the operational stage is limited, with construction stage traffic likely to comprise the majority of traffic associated with the development. On this basis, operational traffic on public roads is not considered further in this report as it is likely to be very low and have negligible noise impacts.

The estimated construction traffic flows on public roads have been provided by Stantec in correspondence dated 1 August 2023 and reproduced in Table 16. Additional information has been sourced from the Transport Impact Assessment prepared by Stantec and dated 3 August 2023 (the Stantec report).

Information provided by Stantec advises that construction traffic associated with the Project is likely to be variable, with relatively low traffic volumes each day for majority of the construction program, with a distinct peak month in which much of the construction traffic volumes will occur. Assessment of traffic noise is based on this peak month to provide a conservative assessment.

Table 16: Existing traffic and existing plus construction traffic flows on public roads – vehicles (% heavy vehicles)

Road category	Existing traffic		Future: Existing + construction traffic	
	Day [1]	Night [1, 10]	Day [1]	Night [1, 10]
Local roads [2]				
Calala Lane[5, 7]	320 (11 %)	130 (14 %)	392 (24 %)	181 (10 %)
Freeways / arterial / sub-arterial roads [3, 4]				
Goonoo Goonoo Road[6, 8, 9]	10,344 (12 %)	1,020 (12 %)	11,090 (17 %)	1,071 (11 %)

MDA Notes:

1 Day is 0700 - 2200 hrs; Night is 2200 - 0700 hrs

2 Day & Night: Peak 1 hr AADT (Annual Average Daily Traffic) / Heavy vehicle (%)

3 Day: Total 15 hr AADT / Heavy vehicle (%)

4 Night: Total 9 hr AADT / Heavy vehicle (%)

Stantec Notes:

5 Calala Lane AADT - based on 7-day tube count as annual data is not available

6 Goonoo Goonoo Road AADT - sourced from Table 6-1, Goonoo Goonoo Road duplication - Tamworth (New England Highway), Review of Environmental Factors, Transport for NSW, November 2021

7 Confirming Calala Lane has considered the peak one-hour periods in day and night periods (both existing and during construction)

8 Confirming Goonoo Goonoo Road has considered total volume for entire day and night period (both existing and during construction)

9 Assumes 100% of light vehicles use Goonoo Goonoo Road – this is conservative as some light vehicles would travel east from site

10 Any night traffic is entirely contained to the 6:00am to 7:00am period, and relates to staff arriving to site (in light vehicles i.e. cars/ vans) prior to 7:00am commencement of works

Public roads identified by Stantec in relation to the Project are limited to Calala Lane, a local road which is the main route for access to the site, and Goonoo Goonoo Road, an arterial road approximately 4.5 km from the Project.

Nearby Burgess Lane, Burgmanns Lane and Ascot-Calala Road are not identified in the Stantec Report, and it is assumed traffic related to the Project will not occur on these roads or, if it does, is not sufficiently significant to be considered for assessment.

Based on information provided in the Stantec Report, use of Goonoo Goonoo Road and Calala Lane will be for both general construction traffic as well as OSOM vehicles.

In considering feasible and reasonable mitigation measures, the RNP states that an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person. On this basis, to assess noise impacts from construction traffic, an initial screening test is undertaken to evaluate whether road traffic noise levels would increase beyond this threshold.

Where the predicted traffic noise increase is 2 dB or less, no further assessment is conducted, as impacts will be barely perceptible. Where road traffic noise levels are predicted to increase by more than 2 dB, consideration is given to the actual noise levels associated with construction traffic and whether or not these levels comply with the road traffic noise criteria detailed in Table 5 of Section 3.3.

A 2 dB increase in relative traffic noise level is approximately equal to a 60 % increase in traffic flow.

8.1 Screening assessment

For Goonoo Goonoo Road, the increase in road traffic is relatively minor compared to the existing traffic flows, with an increase of less than 17 % in all cases. On this basis the relative increase in traffic noise level associated with construction activities is below the 2 dB threshold during the day and night periods. Further detailed noise level predictions and assessments at receivers along Goonoo Goonoo Road are therefore not carried out herein.

For Calala Lane, the increase in road traffic is larger than Goonoo Goonoo Road, but still less than 24 % increase in all cases. This is much lower than the 60 % that would be required to align with a 2 dB relative increase in traffic noise level. Further detailed noise level predictions and assessments at receivers along Calala Lane are therefore not carried out herein.

On the above basis, no further assessment of general traffic noise is required and the predicted increases in traffic flows for construction activity are unlikely to give rise to perceptible impacts to noise sensitive receivers.

8.2 Sleep disturbance due to construction traffic

The majority of construction traffic movements are expected to occur during the day period only. However, during some construction stages, OSOM will be required for the delivery of larger items. Movements on local roads during the night period are more likely to be associated with the OSOM deliveries during a particular phase of the construction works.

Information provided by Stantec indicates that only four (4) OSOM vehicle journeys are expected throughout the entirety of the construction period. This may result in a maximum of two (2) OSOM vehicle movements in a single peak night-time hour.

The environmental context of the L_{Amax} noise levels from OSOM activities associated with the site t is important in assessing their potential impact on sleep. For example, a new noise event of 65 dB L_{Amax} occurring in a rural environment with no existing L_{Amax} events above 40 dB is likely to have a more significant impact than the same event occurring at a receiver next to a road where L_{Amax} levels already exceed 65 dB regularly due to existing vehicle passbys.

For Goonoo Goonoo Road, the number of night period heavy vehicle movements generated by the proposed construction works is expected to be small when compared with the existing number of heavy vehicles on the road. On this basis, the number of maximum noise events that could disturb sleep is unlikely to increase noticeably.

For Calala Lane, data provided in Table 16 indicates that heavy vehicle movements are an existing feature of the road, with up to 18 occurring within a peak night-time hour. On this basis L_{Amax} noise events associated with the two (2) proposed OSOM vehicle movements is unlikely to introduce a noise source not currently typical for Calala Lane traffic activities.

Notwithstanding the above, it is recommended where feasible to schedule arrival of OSOM vehicles at the Project to the daytime period.

For occasions where OSOM deliveries must be carried out during night periods, it may be reasonable to inform residents close to the Project, where dwelling density is lower and background noise levels likely to be quieter.

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 LA. Alternative ways of expressing A-weighted decibels are dBA or dB(A).
Background sound	The sound that is continuously present in a room our 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.

APPENDIX B RECEIVER LOCATIONS

The following table sets out the seventy-eight (78) receivers identified by the Proponent in the vicinity of the project site, together with their respective distance to the Project boundary. These receivers have been considered in the environmental noise assessment.

Data supplied by the Proponent on 18 October 2022.

Table 17: Receiver locations – GDA2020 / MGA Z56

Receiver ID	Easting, m	Northing, m	Terrain elevation, m	Distance to Project boundary
R1	306,396	6,553,462	396	709
R2	305,929	6,553,299	398	468
R3	305,681	6,553,318	406	594
R4	305,533	6,552,913	417	488
R5	305,408	6,552,829	421	566
R6	305,359	6,552,624	421	524
R7	305,296	6,552,552	424	564
R8	305,250	6,552,462	427	598
R9	305,604	6,552,066	425	442
R10	305,641	6,551,960	425	517
R11	304,796	6,551,731	437	1,266
R12	305,054	6,551,577	457	1,169
R13	305,742	6,553,557	400	772
R14	305,848	6,553,592	395	772
R15	305,553	6,553,412	404	748
R16	305,366	6,552,735	422	563
R17	305,140	6,552,544	433	716
R18	305,054	6,552,567	438	804
R19	305,155	6,552,659	431	728
R20	305,092	6,552,685	435	797
R21	305,241	6,552,684	427	656
R22	305,107	6,552,769	434	813
R23	305,123	6,552,838	435	827
R24	305,316	6,552,859	424	662
R25	305,128	6,552,944	436	868
R26	305,347	6,552,947	423	671
R27	305,208	6,553,137	421	877
R28	305,225	6,553,142	420	865

Receiver ID	Easting, m	Northing, m	Terrain elevation, m	Distance to Project boundary
R29	305,245	6,553,149	419	850
R30	305,263	6,553,152	418	835
R31	305,281	6,553,161	417	822
R32	305,300	6,553,167	416	807
R33	305,324	6,553,170	416	787
R34	305,340	6,553,175	415	774
R35	305,360	6,553,179	415	759
R36	305,382	6,553,181	416	739
R37	305,399	6,553,191	415	729
R38	305,418	6,553,201	414	717
R39	305,437	6,553,203	414	702
R40	305,453	6,553,213	414	694
R41	305,474	6,553,227	413	683
R42	305,480	6,553,251	412	692
R43	305,504	6,553,256	412	676
R44	305,524	6,553,249	412	655
R45	305,501	6,553,206	413	649
R46	305,449	6,553,279	411	733
R47	305,433	6,553,287	411	752
R48	305,433	6,553,254	412	733
R49	305,405	6,553,250	412	754
R50	305,386	6,553,243	413	766
R51	305,366	6,553,235	413	779
R52	305,349	6,553,231	413	792
R53	305,331	6,553,224	414	804
R54	305,311	6,553,218	415	819
R55	305,288	6,553,210	415	836
R56	305,253	6,553,201	417	864
R57	305,233	6,553,190	418	878
R58	305,271	6,553,246	415	868
R59	305,290	6,553,256	413	856
R60	305,308	6,553,261	413	842
R61	305,326	6,553,267	413	830

Receiver ID	Easting, m	Northing, m	Terrain elevation, m	Distance to Project boundary
R62	305,347	6,553,271	412	814
R63	305,365	6,553,280	411	804
R64	305,383	6,553,283	411	790
R65	305,403	6,553,308	410	788
R66	305,415	6,553,301	410	774
R67	305,360	6,553,328	409	835
R68	305,333	6,553,317	411	851
R69	305,386	6,553,367	408	837
R70	305,404	6,553,355	408	816
R71	305,424	6,553,350	408	796
R72	305,441	6,553,338	409	776
R73	305,460	6,553,326	410	754
R74	305,484	6,553,321	410	732
R75	305,505	6,553,309	410	709
R76	305,530	6,553,290	411	677
R77	305,537	6,553,304	410	681
R78	306,350	6,553,148	394	405

APPENDIX C LAND ZONING MAP AND BACKGROUND NOISE MONITORING LOCATIONS

APPENDIX D NOISE POLICY FOR INDUSTRY ASSESSMENT

In NSW, the Environmental Protection Authority's NPfI is the guideline for assessing noise emissions from industrial facilities and other developments with noise sources that may be considered industrial in nature. The NPfI sets out a procedure where an industrial facility can be assessed against a series of noise levels. Project specific noise levels are derived from an analysis of the ambient noise environment and zoning information.

An NPfI assessment requires the derivation of two project noise trigger levels - one from an intrusiveness assessment and another from an amenity assessment. Assessment locations for residential receivers have been taken as the nearest point within 30m of the dwelling, in accordance with the NPfI.

D1 Intrusive noise levels

The intrusiveness noise assessment is applicable to residential receivers and is based on knowledge of the background noise level at the receiver location. The background noise level is referred to as the rating background noise level (RBL) in the NPfI.

The intrusiveness level is taken to be the RBL plus 5dB. Therefore the level of noise from a source is considered to be intrusive if the A-weighted source noise level at the receiver location ($L_{Aeq,\ 15min}$) is greater than the background noise level (L_{A90}) plus 5 dB.

Per Section 5.0 minimum assumed background noise levels have been adopted from the NPfI.

These are presented in Table 18 alongside corresponding minim project intrusiveness noise levels.

Table 18: Minimum assumed RBLs and project intrusiveness noise levels

Time of day[1]	Minimum assumed rating background noise level, L_{A90} dB	Minimum project intrusiveness noise level, $L_{Aeq\ 15\ min}$, dB
Day	35	40
Evening	30	35
Night	30	35

[1] Time of day is defined as follows:
Day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays
Evening – the period from 6 pm to 10 pm
Night – the remaining periods.

D2 Amenity noise levels

Project amenity noise levels are designed to prevent industrial noise continually increasing above an acceptable level over time with the expansion of infrastructure and development.

The initial stage in determining the project amenity noise level is to correct the recommended amenity noise level, determined based on the residential receiver category, for time period changes and existing industrial noise sources.

Based on the land use zoning of the noise sensitive receivers (see Section 2.2) and consideration guidance provided in Table 2.3 of the NPfI, a rural residential receiver category has been determined to apply to all noise sensitive receivers.

Modification of the corresponding recommended amenity noise level is then undertaken to account for the standardisation of the assessment time periods to 15-minute periods (-3 dB per Section 2.2 of the NPfI).

Further modification is applied to account for the existing contribution of industrial noise from Transgrid Tamworth Substation on the noise sensitive receivers (+5 dB per Section 2.4 of the NPfI).

This approach provides an inherent consideration of cumulative noise from Transgrid Tamworth Substation and the Project.

Resultant project amenity noise levels and the relevant modifications are shown in Table 19.

Table 19: Recommended amenity noise levels and project amenity noise levels

Receiver	Time of day	Recommended amenity noise level, $L_{Aeq, Period}$, dB	Project amenity noise level $L_{Aeq, 15min}$, dB
Residential	Day	50	48
	Evening	45	43
	Night	40	38

D3 Project noise trigger levels

The final process in determining the operational noise assessment objectives for the Project is to derive the project noise trigger levels. The project noise trigger Levels are levels that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response; for example, further investigation of mitigation measures.

The project noise trigger levels are derived by selecting the more stringent of either the project intrusiveness noise level or project amenity noise levels. The project noise trigger levels applicable to the Project are shown in Table 20 and apply to all residential receivers surrounding the Project.

Table 20: Project noise trigger level

Receiver	Time of day	Project noise trigger level, $L_{Aeq, 15min}$, dB
Residential	Day	40
	Evening	35
	Night	35

APPENDIX E NOISE MODELLING METHOD

A computer model was created in the environmental noise modelling program SoundPLAN v8.2 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). 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.

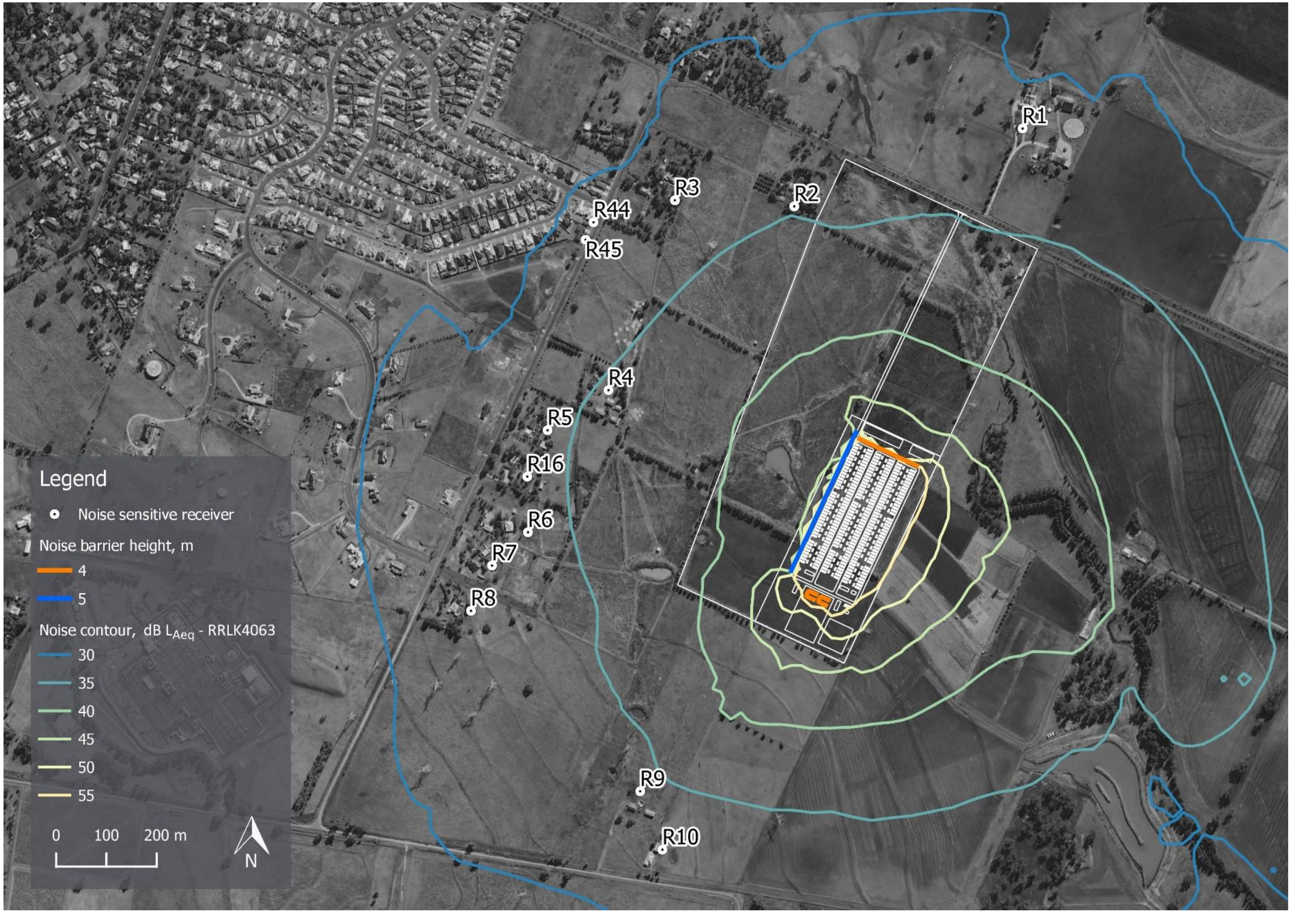
The octave band attenuation factors are then applied to the noise data to determine the corresponding octave band and total calculated noise level at relevant receiver locations.

Geometry data for the model has been sourced from public aerial photography, client provided data, and building heights defined based on standard assumed heights per floor level. 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) and 4.5 m (two storey) above ground level.
- Receiver locations positioned according to client provided data.
- In the absence of client provided elevation data, the noise model uses publicly available data.
- Emission data for each source at the site as detailed in Section 6.2.

APPENDIX F SITE NOISE CONTOURS WITH NOISE CONTROLS



APPENDIX G CONSTRUCTION EQUIPMENT, WORK STAGES AND ACOUSTIC DATA

It is anticipated that a variety of construction equipment would be used for this Project.

Sound power levels for the types of equipment used to construct the Project have been determined based on information provided by the Proponent and data sources including Australian Standard AS 2436:2010 *Guide to noise and vibration control on construction, demolition and maintenance sites* (AS 2436), British Standard 5228-1:2009 *Code of practice for noise and vibration control on construction and open sites –Part 1: Noise* (BS 5228) and noise level data from previous projects of a similar nature.

Table 21 summarises the noise emissions used to represent key items of plant associated with construction.

Table 21: Construction noise sources sound power data

Noise source	Sound power level, dB L_{WA}
Delivery Trucks	107
Concrete trucks	108
Dump truck	117
Concrete pump	108
Generator	99
Grader	110
Bulldozer	108
Front end loader	113
Trenching machine	105

Overall aggregated total sound power levels for key construction tasks have been determined on the basis of a typical schedule of equipment associated with each task. The actual equipment choices and equipment numbers for each task are not presently defined in detail, and therefore the schedule of equipment listed here does not represent a final or definitive list of plant. The equipment schedule is therefore presented solely as an indication of construction noise levels.

The overall total aggregated sound power levels for each of the key construction tasks are detailed in Table 22, and assume that each item of plant associated with a task operates simultaneously for the entire duration of an assessment period.

Table 22: Overall sound power levels of key construction tasks

Construction task	Plant/Equipment	Approximate overall sound power level, dB L_{WA}
Access road construction	Four (4) x dump truck, two (2) x bulldozer, two (2) x front end loader, two (2) x grader	125
Cable trench digging	Two (2) x trenching machine	110
Site compound construction	Eight (8) x delivery trucks [1], two (2) x concrete truck, two (2) x concrete pump, two (2) x generator	115
Substation construction	Four (4) x dump truck, two (2) x bulldozer, two (2) x front end loader, two (2) x grader	125
Benching of site	Four (4) x dump truck, two (2) x bulldozer, two (2) x front end loader, two (2) x grader	125
Clearing of surface vegetation	Two (2) x bulldozer, two (2) x grader	115
Installing security fencing	Four (4) x delivery trucks [1]	---
Laying down of gravel mulch in the battery and electrical plant areas	Eight (8) x dump truck, one (1) x grader	125
Site rehabilitation, landscaping and vegetation works	Two (2) x bulldozer, two (2) x grader	115

1 Delivery trucks have not been directly assessed as part of the construction noise assessment but are included in the traffic noise assessment per comments in Section 7.1