RENZO TONIN & ASSOCIATES
inspired to achieve

Acoustics
Vibration
Structural Dynamics

GLANMIRE SOLAR FARM

Construction & Operational Noise & Vibration Assessment

25 October 2022

NGH

TM423-01F02 Construction & Operational Noise & Vibration Assessment (r3).docx

35 1982-2017 ACOUSTIC ENGINEERING EXCELLENCE

Sydney Melbourne Brisbane Gold Coast Kuwait Singapore
Renzo Tonin & Associates ABN 29 117 462 861
Level 1/418A Elizabeth St SURRY HILLS NSW 2010 | PO Box 877 STRAWBERRY HILLS NSW 2012
P (02) 8218 0500 F (02) 8218 0501 sydney@renzotonin.com.au www.renzotonin.com.au

aaac Association of Australian Acoustical Consultants

Document Details

Detail	Reference
Doc reference:	TM423-01F02 Construction & Operational Noise & Vibration Assessment (r3).docx
Prepared for:	NGH
Address:	T3, Level 7, 348 Edward St Brisbane QLD 4000
Attention:	Ms Tammy Vesely

Document Control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
27.06.2022	Draft report	0	1	W. Chan	M. Chung	M. Chung
12.09.2022	Updated design	-	2	W. Chan	M. Chung	M. Chung
25.10.2022	Final	-	3	W. Chan	M. Chung	M. Chung

Contents

1 Introduction 5
2 Project Description 6
2.1 Background Information 6
2.2 Regulatory Requirements 7
2.3 Receiver Locations 7
2.4 Hours of Operation 8
2.4.1 Construction 8
2.4.2 Operation 8
3 Existing Noise Environment 11
4 Construction Noise Assessment 12
4.1 Construction Noise Management Levels 12
4.2 Construction Noise Sources 13
4.3 Construction Noise Assessment 14
4.4 Construction Noise Management Measures 18
5 Operational Noise Assessment 20
5.1 Operational Noise Criteria 20
5.1.1 Intrusive Noise Impacts 20
5.1.2 Protecting Noise Amenity 20
5.1.3 Summary of Project Noise Trigger Levels 21
5.2 Operational Noise Sources 22
5.3 'Modifying Factor' Adjustments 23
5.4 Operational Noise Assessment 23
5.5 Sleep Disturbance Assessment 25
6 Vibration Assessment 27
6.1 Vibration Criteria 27
6.2 Potential Vibration Impacts 29
7 Road Traffic Noise Assessment 30
7.1 Road Traffic Noise Criteria 30
7.2 Predicted Road Traffic Noise 31
8 Conclusion 32
APPENDIX A Glossary of Terminology 33
APPENDIX B Draft Construction Noise Management Plan 35
B.1 Project Description 35
B.2 Receiver Locations 35
B.3 Construction Hours 35
B.4 Construction Noise Management Levels 35

B.5 Construction Noise Sources 35
B.6 Construction Noise Assessment 35
B.7 Construction Noise Mitigation and Management Measures 35
B.7.1 General Engineering Noise Controls 35
B.7.2 General Noise Management Measures 37

List of Tables

Table 2.1 – Noise Requirements Under SEARs 7
Table 2.2 – Receiver Locations 7
Table 3.1 – Applicable RBLs, dB(A) 11
Table 4.1 – Noise Management Levels (NML) at Residential Receivers, dB(A) 13
Table 4.2 – Construction Noise Management Levels (NML) at Residential Receivers, dB(A) 13
Table 4.3 – Typical Construction Equipment & Sound Power Levels 14
Table 4.4 – Predicted $L_{Aeq,15\ min}$ Construction Noise Levels at Receiver Locations, dB(A) 16
Table 5.1 – NPfI Intrusive Noise Levels at Residential Receivers, dB(A) 20
Table 5.2 – NPfI Project Amenity Noise Levels, dB(A) 21
Table 5.3 – Project Noise Trigger Levels, dB(A) 22
Table 5.4 – Typical Operational Plant and Equipment & Sound Power Levels 23
Table 5.5 – Predicted $L_{Aeq,15\ min}$ Operational Noise Levels at Residential Receiver Locations, dB(A) 24
Table 6.1 – Types of Vibration 27
Table 6.2 – Preferred and Maximum Levels for Human Comfort 28
Table 6.3 – Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$) 28
Table 6.4 – Potential Vibration Impacts for Identified Receivers 29
Table 7.1 – Summary of the Estimated Construction Traffic Volumes During Peak Construction 30
Table 7.2 – RNP Road Traffic Noise Criteria, dB(A) 30
Table 7.3 – Predicted Road Traffic Noise Contribution Levels Along Public Roads, dB(A) $L_{Aeq,15\ hr}$ 31
Table B.8.1 – Relative Effectiveness of Various Forms of Noise Control, dB(A) 36
Table B.8.2 – Noise Control Measures for Likely Construction Plant 36

List of Figures

Figure 1 – Site, Surrounds and Receiver Locations 9
Figure 2 – Indicative infrastructure layout 10
Figure 3 – Orthogonal Axes for Human Exposure to Vibration 28

1 Introduction

Renzo Tonin & Associates was engaged to conduct an environmental noise and vibration assessment of the proposed Glanmire Solar Farm (Project), located at 4823 Great West Highway, Glanmire approximately 11 km east of the city of Bathurst and approximately 4.5 km east of the suburb of Raglan, as part of the Environmental Impact Statement (EIS) for the Project. Noise and vibration impacts from the construction and operation phases of the Project will be addressed in this report in accordance with relevant Council and EPA requirements and guidelines.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

2 Project Description

2.1 Background Information

The Glanmire Solar Farm project includes the construction and operation of a solar photovoltaic (PV) plant and associated infrastructure, with a capacity of approximately 60 MW_{AC}. The development site is located at 4823 Great Western Highway, Glanmire, approximately 11 km east of the city of Bathurst and approximately 4.5 km east of the suburb of Raglan, within the Bathurst Regional Council Local Government Area (LGA).

Key development and infrastructure components would include:

- Ground mounted solar photovoltaic (PV) panels single axis tracking, single portrait solar arrays with 60 MW AC (77 DC).
- Inverters and voltage step-up transformers positioned throughout the solar arrays.
- Underground and aboveground cabling to connect the arrays to the inverters/transformer stations.
- A hybrid (AC-coupled) Battery Energy Storage System (BESS) with a power rating up to approximately 60 MW with one hour storage (60 MWh).
- A switchyard and on-site substation.
- National Energy Market (NEM) compliant metering.
- Internal access tracks to enable site maintenance.
- Security fencing around the perimeter with CCTV.
- An operations and maintenance building.
- Development of an appropriate site access off Brewongle Lane.
- An operations and maintenance building
- Site access off Brewongle Lane.

During the construction phase, temporary ancillary facilities would be established on the site and may include:

- Laydown areas
- Construction site offices and amenities
- Car and bus parking areas for construction staff.

2.2 Regulatory Requirements

The Secretary's Environmental Assessment Requirements (SEAR) and Environment Protection Authority (EPA) Submission for the project nominate the following specific noise issues to be addressed in this assessment.

Table 2.1 – Noise Requirements Under SEARs

Secretary's Environmental Assessment Requirements (SEAR)	Section of Report Addressing SEAR Content
Noise – including an assessment of the construction noise impacts of the development in accordance with the Interim Construction Noise Guideline (ICNG), operational noise impacts in accordance with the NSW Noise Policy for Industry (2017), cumulative noise impacts (considering other developments in the area), and a draft noise management plan if the assessment shows construction noise is likely to exceed applicable criteria.	Sections 4, 5, 6 and 7

Noise and vibration impacts are assessed in accordance with a number of policies, guidelines and standards, including:

- NSW 'Interim Construction Noise Guideline' (ICNG – DECC, 2009)
- NSW 'Noise Policy for Industry' (NPfI – EPA, 2017)
- 'Assessing Vibration: A Technical Guideline' (DECC, 2006)
- NSW 'Road Noise Policy' (RNP – DECCW, 2011).

2.3 Receiver Locations

The nearest affected receivers were identified through aerial maps and are presented in Table 2.2.

Table 2.2 – Receiver Locations

ID	Address	Description
R1	4824 Great Western Highway, Glanmire	Residential property located approximately 667 m north of the development area
R2	23 Glanmire Lane, Glanmire	Residential property located approximately 230 m north-east of the development area
R3	16 Glanmire Lane, Glanmire	Residential property located approximately 218 m north-east of the development area
R4	264 Brewongle Lane, Brewongle	Residential property located approximately 215 m south of the development area
R5	244 Brewongle Lane, Brewongle Dwelling 1	Residential property located approximately 325 m south of the development area
R6	244 Brewongle Lane, Brewongle Dwelling 2	Residential property located approximately 639 m south of the development area
R7	4887 Great Western Highway, Glanmire	Residential property located approximately 466 m west of the development area
R8	4940 Great Western Highway, Glanmire	Residential property located approximately 858 m north-west of the development area

ID	Address	Description
R14	44 Mersing Road, Glanmire	Residential property located approximately 912 m north-east of the development area
R44a	Possible future residence	Residential property located approximately 765 m east of the development area
R44b	Possible future residence	Residential property located approximately 290 m east of the development area
R44c	Possible future residence	Residential property located approximately 300 m west of the development area

Figure 1 provides details of the site, surrounds and receiver locations. Figure 2 provides the indicative infrastructure layout showing where key infrastructure components would be likely be located and most closely represents the area of actual impact required to operate the solar farm.

2.4 Hours of Operation

2.4.1 Construction

The construction phase of the Project would take about 12 – 18 months. The peak construction period would be a shorter period of about 6 months.

Construction will occur during the following standard hours of construction:

- Monday to Friday: 7:00am to 6:00pm
- Saturday: 8:00am to 1:00pm
- No work on Sundays or public holidays

2.4.2 Operation

The solar farm will operate autonomously during times when there is sunlight. This will predominantly be during day and evening periods (7:00am – 6:00pm and 6:00pm – 10:00pm, respectively) throughout the year and potentially part of the night time period (prior to 7:00am) during the summer months.

Furthermore, there will be up to five (5) staff on site during the following standard hours:

- Monday to Friday: 7:00am to 6:00pm
- Saturday: 8:00am to 1:00pm

Figure 1 – Site, Surrounds and Receiver Locations

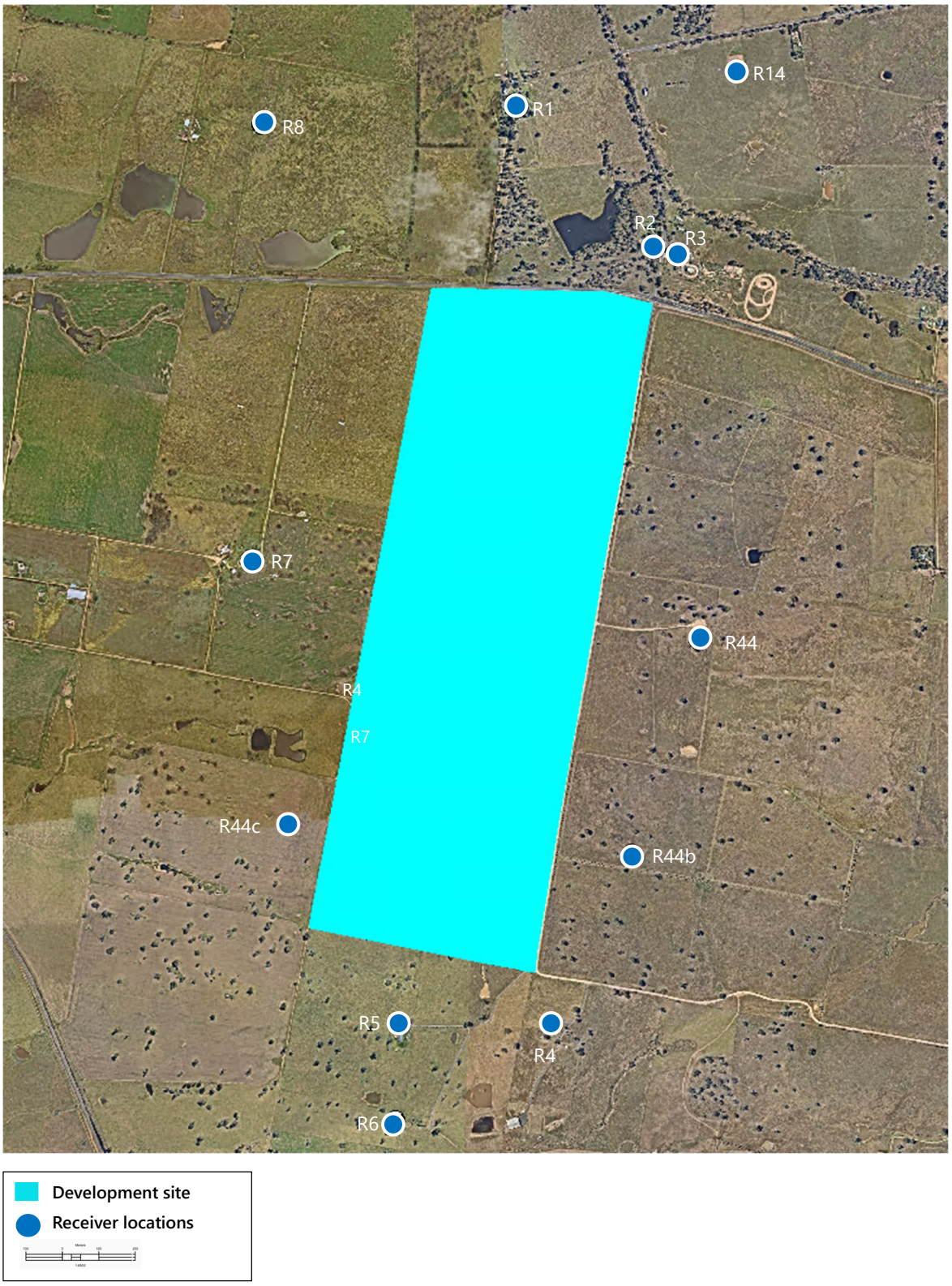
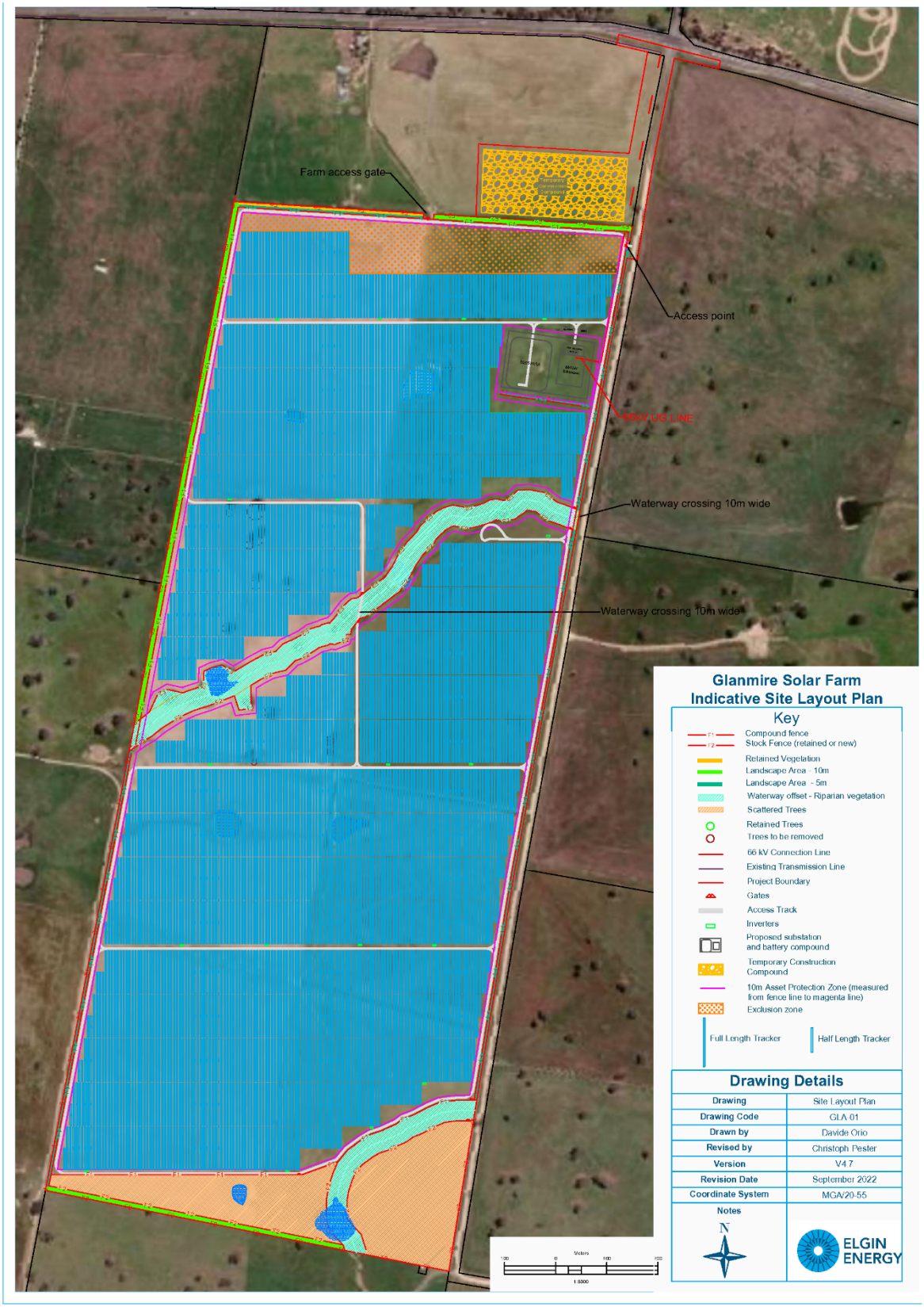


Figure 2 – Indicative infrastructure layout



3 Existing Noise Environment

Background noise varies over the course of any 24 hour period, typically from a minimum at 3am in the morning to a maximum during morning and afternoon traffic peak hours. Therefore, the NPfI requires that the level of background and ambient noise be assessed separately for the daytime, evening and night-time periods. The NPfI defines these periods as follows:

- **Day** is defined as 7:00am to 6:00pm, Monday to Saturday and 8:00am to 6:00pm Sundays & Public Holidays.
- **Evening** is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays.
- **Night** is defined as 10:00pm to 7:00am, Monday to Saturday and 10:00pm to 8:00am Sundays & Public Holidays.

The identified receivers surrounding the Project site are all classified as rural under NPfI guidelines. Based on Table 2.1 on page 10 of the NPfI, for a conservative assessment the minimum assumed Rating Background Levels (RBLs) are adopted for all receiver locations. Therefore, the applicable RBLs used for this assessment are presented in Table 3.1 below.

Table 3.1 – Applicable RBLs, dB(A)

Time of Day	Minimum RBL, dB(A)[1]	Applicable RBL, dB(A)
Day	35	**35**
Evening	30	**30**
Night	30	**30**

Notes: 1. In accordance with Table 2.1 of the NSW NPfI

4 Construction Noise Assessment

4.1 Construction Noise Management Levels

The NSW 'Interim Construction Noise Guideline' (ICNG, 2009) provides guidelines for assessing noise generated during the construction phase of developments.

The key components of the guideline that are incorporated into this assessment include:

- *Use of L_{Aeq} as the descriptor for measuring and assessing construction noise*

  NSW noise policies, including the NPfI, RNP and RING have moved to the primary use of L_{Aeq} over any other descriptor. As an energy average, L_{Aeq} provides ease of use when measuring or calculating noise levels since a full statistical analysis is not required as when using, for example, the L_{A10} descriptor.

- *Application of reasonable and feasible noise mitigation measures*

  As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice and is practical to build given the project constraints.

  Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects.

The ICNG provides two methods for assessment of construction noise, being either a quantitative or a qualitative assessment. A quantitative assessment is recommended for major construction projects of significant duration, and involves the measurement and prediction of noise levels, and assessment against set criteria. A qualitative assessment is recommended for small projects with duration of less than three weeks and focuses on minimising noise disturbance through the implementation of reasonable and feasible work practices, and community notification.

Given the length of the construction works proposed, a quantitative assessment is carried out herein, consistent with the ICNG requirements.

Table 4.1 reproduced from the ICNG, sets out the noise management levels and how they are to be applied for residential receivers.

Table 4.1 – Noise Management Levels (NML) at Residential Receivers, dB(A)

Time of Day	Management Level $L_{Aeq,15\ min}$	How to Apply
Recommended standard hours: Monday to Friday 7:00am to 6:00pm Saturday 8:00 am to 1:00pm No work on Sundays or public holidays	Noise affected RBL + 10 dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq,15\ min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: • times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

Table 4.2 presents the construction noise management levels established for the nearest noise sensitive residential receivers based upon the noise monitoring results presented in Table 2.2, the proposed construction hours and the above ICNG requirements. Given that construction works are to occur during the daytime period as presented in Section 2.4.1, only the daytime period will be assessed.

Table 4.2 – Construction Noise Management Levels (NML) at Residential Receivers, dB(A)

Location Description	Day L_{A90} Background Noise Level (RBL)	Day NML $L_{Aeq,15\ min}$
All residential receivers	35[1]	**45**

Notes: 1. Construction works occur during the daytime period only; hence, only the day period is assessed

4.2 Construction Noise Sources

The following tables lists typical plant and equipment likely to be used by the contractor to carry out the necessary construction works for the project.

Table 4.3 – Typical Construction Equipment & Sound Power Levels

Plant Item	Plant Description	Number of Items	L_{Aeq} Sound Power Levels, dB(A) re. 1pW (single item)
General Construction Works			
1	Mobile crane	1	110
2	Delivery truck/trailer	1	108
3	Power generator	1	100
4	Telehandler	1	98
5	Light vehicle	1	88
Civil Construction Works			
6	Dozer	3	109
7	Vibratory roller	As required	109
8	Backhoe/excavator	2	107
9	Grader	2	107
10	Laser bucket	1	107
11	Concrete truck	1	106
12	Dump truck	1	105
13	Water truck	3	104
Mechanical / Electrical Construction Works			
14	Piling rig	6	114
15	Drilling rig	2	112
16	Mobile crane	1	110
17	Flatbed truck	3	105
18	Hand tools	As required	100
19	Forklift	3	90
20	Ute	As required	88

The sound power levels for the majority of activities presented in the above table are provided by the client, based on maximum levels given in Table A1 of Australian Standard 2436 - 2010 'Guide to Noise Control on Construction, Demolition and Maintenance Sites', the ICNG, information from past projects and/or information held in our library files.

4.3 Construction Noise Assessment

Noise emissions were predicted by modelling the noise sources, receiver locations, topographical features of the intervening area, and possible noise control treatments using the CadnaA (version 2021 MR 1) noise modelling computer program. The program calculates the contribution of each noise source at each specified receptor point and allows for the prediction of the total noise from a site.

The noise prediction models takes into account:

- Location of noise sources and receiver locations;

- Height of sources and receivers;
- Separation distances between sources and receivers;
- Ground type between sources and receivers (soft); and
- Attenuation from barriers (natural and purpose built).

Noise levels at any receptors resulting from construction would depend on the above and the type and duration of construction being undertaken. Furthermore, noise levels at receivers would vary substantially over the total construction program due to the transient nature and large range of plant and equipment that could be used.

Table 4.4 presents construction noise levels likely to be experienced at the nearby affected receivers based on the construction activities and plant and equipment associated with the Project. The noise level ranges represent the noise source being located at the furthest to the closest proximity to each receiver location.

Table 4.4 – Predicted $L_{Aeq,15\ min}$ Construction Noise Levels at Receiver Locations, dB(A)

Plant Item	Plant Description	Predicted $L_{eq,15\ min}$ Construction Noise Levels											
		R1	R2	R3	R4	R5	R6	R7	R8	R14	R44a	R44b	R44c
Noise Management Level[1]		*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*
General Construction Works													
1	Mobile crane	<20-27	<20-45	<20-**46**	<20-45	<20-40	<20-32	<20-35	<20-30	<20-25	<20-33	<20-42	<20-**48**
2	Delivery truck/trailer	<20-25	<20-43	<20-44	<20-43	<20-38	<20-30	<20-33	<20-28	<20-23	<20-31	<20-40	<20-**46**
3	Power generator	<20	<20-35	<20-36	<20-35	<20-30	<20-22	<20-25	<20-20	<20	<20-23	<20-32	<20-38
4	Telehandler	<20	<20-33	<20-34	<20-33	<20-28	<20-20	<20-23	<20	<20	<20-21	<20-30	<20-36
5	Light vehicle	<20	<20-23	<20-24	<20-23	<20	<20	<20	<20	<20	<20	<20-20	<20-26
Up to 3 (noisiest) plant operating concurrently		<20-29	<20-**47**	<20-**48**	<20-**48**	<20-43	<20-35	<20-37	<20-32	<20-27	<20-36	<20-44	<20-**51**
Civil Construction Works													
6	Dozer	<20-26	<20-44	<20-45	<20-44	<20-39	<20-31	<20-34	<20-29	<20-24	<20-32	<20-41	<20-**47**
7	Vibratory roller	<20-26	<20-44	<20-45	<20-44	<20-39	<20-31	<20-34	<20-29	<20-24	<20-32	<20-41	<20-**47**
8	Backhoe/excavator	<20-24	<20-42	<20-43	<20-42	<20-37	<20-29	<20-32	<20-27	<20-22	<20-30	<20-39	<20-45
9	Grader	<20-24	<20-42	<20-43	<20-42	<20-37	<20-29	<20-32	<20-27	<20-22	<20-30	<20-39	<20-45
10	Laser bucket	<20-24	<20-42	<20-43	<20-42	<20-37	<20-29	<20-32	<20-27	<20-22	<20-30	<20-39	<20-45
11	Concrete truck	<20-23	<20-41	<20-42	<20-41	<20-36	<20-28	<20-31	<20-26	<20-21	<20-29	<20-38	<20-44
12	Dump truck	<20-22	<20-40	<20-41	<20-40	<20-35	<20-27	<20-30	<20-25	<20-20	<20-28	<20-37	<20-43
13	Water truck	<20-21	<20-39	<20-40	<20-39	<20-34	<20-26	<20-29	<20-24	<20	<20-27	<20-36	<20-42
Up to 3 (noisiest) plant operating concurrently		<20-30	<20-**48**	<20-**49**	<20-**49**	<20-44	<20-36	<20-38	<20-33	<20-28	<20-37	<20-45	<20-**52**
Mechanical / Electrical Construction Works													
14	Piling rig	<20-31	<20-**49**	<20-**50**	<20-**49**	<20-44	<20-36	<20-39	<20-34	<20-29	<20-37	<20-**46**	<20-**52**
15	Drilling rig	<20-29	<20-**47**	<20-**48**	<20-**47**	<20-42	<20-34	<20-37	<20-32	<20-27	<20-35	<20-44	<20-**50**
16	Mobile crane	<20-27	<20-45	<20-**46**	<20-45	<20-40	<20-32	<20-35	<20-30	<20-25	<20-33	<20-42	<20-**48**
17	Flatbed truck	<20-22	<20-40	<20-41	<20-40	<20-35	<20-27	<20-30	<20-25	<20-20	<20-28	<20-37	<20-43
18	Hand tools	<20	<20-35	<20-36	<20-35	<20-30	<20-22	<20-25	<20-20	<20	<20-23	<20-32	<20-38
19	Forklift	<20	<20-25	<20-26	<20-25	<20-20	<20	<20	<20	<20	<20	<20-22	<20-28
20	Ute	<20	<20-23	<20-24	<20-23	<20	<20	<20	<20	<20	<20	<20-20	<20-26
Up to 3 (noisiest) plant operating concurrently		<20-34	<20-**52**	<20-**53**	<20-**52**	<20-**47**	<20-39	<20-42	<20-37	<20-32	<20-40	<20-**49**	<20-**55**

Plant Item	Plant Description	Predicted $L_{eq,15\ min}$ Construction Noise Levels											
		R1	R2	R3	R4	R5	R6	R7	R8	R14	R44a	R44b	R44c

Notes: 1. **Bold** font represents exceedance of the NML

Based on the predicted construction noise levels presented in the table above, the construction management levels will be exceeded when works are conducted at the closest proximity and when the three noisiest plant items are operating concurrently, for Receivers R2, R3, R4, R5, R44b and R44c by up to 10 dB(A). It is noted that R44b and R44c are possible future residences and may not be built and occupied during the construction phase of the Project. Predicted construction noise levels at all other receivers will comply with the construction management levels.

Furthermore, construction noise levels at all receivers are predicted to be below the highly noise affected level of 75 dB(A).

It should be noted that the exceedances predicted are based on the loudest plant and equipment or the three loudest plant and equipment operating concurrently and at a location closest to the corresponding receiver location. This scenario would not typically occur on site.

For Receivers R2, R3, R4, R5, R44b and R44c, it is expected that exceedance of the noise management level would likely occur when the construction works are conducted within approximately 700 m of the dwelling / building. Construction works conducted within approximately 700 m of the dwelling / building would typically be completed over two to three days. Construction works conducted beyond 700 m of the dwelling / building of Receivers R2, R3, R4, R5, R44b and R44c would comply with the noise management level. In light of the short duration of predicted noise exceedances, it is recommended that a feasible and reasonable approach towards noise management measures be applied, in consultation with the potentially affected residents.

Further details on construction noise management measures are provided in Section 4.4 below.

4.4 Construction Noise Management Measures

The following recommendations provide in-principle feasible and reasonable noise management measures to reduce noise impacts to sensitive receivers. Where actual construction activities differ from those assessed in this report, more detailed design of noise control measures may be required once specific items of plant and construction methods have been chosen and assessed on site.

The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

For construction works conducted within approximately 700 m of the dwelling / building of Receivers R2, R3, R4, R5, R44b and R44c, potential noise impacts to these locations will be managed by implementing time restrictions and/or providing periods of repose for residents, where feasible and reasonable. That is, daily periods of respite from noisy activities may also be scheduled for building occupants during business hours. For example, between 10am and 3pm (with one-hour break for lunch between 12pm and 1pm), noisy activities could occur with no noise level restrictions over a limited time period. Allowing the construction activities to proceed, despite the noise exceedance may be the preferred method in order to complete the works expeditiously, with noise exceedances occurring over only 2-3 days. Residents would be consulted to determine appropriate respite periods and will be

notified of the potential noise impact during this time period so that they can organise their day around the noisy period.

In addition, the following noise management measures should be considered.

- Plant and equipment should be properly maintained.
- Avoid any unnecessary noise when carrying out manual operations and when operating plant.
- Any equipment not in use for extended periods during construction work should be switched off.
- Good relations with people living and working in the vicinity of a construction site should be established at the beginning of a project and be maintained throughout the project, as this is of paramount importance. Keeping people informed of progress and taking complaints seriously and dealing with them expeditiously is critical. The person selected to liaise with the community should be adequately trained and experienced in such matters.

A draft construction noise management plan is presented in Appendix B which includes additional noise mitigation and management measures to be considered.

5 Operational Noise Assessment

5.1 Operational Noise Criteria

Noise impact from the general operation of the Project is assessed against the NSW 'Noise Policy for Industry' (NPfI). The assessment procedure in terms of the NPfI has two components:

- Controlling intrusive noise impacts in the short-term for residences; and
- Maintaining noise level amenity for residences and other land uses.

In accordance with the NPfI, noise impact should be assessed against the project noise trigger level which is the lower value of the project intrusiveness noise levels and project amenity noise levels.

5.1.1 Intrusive Noise Impacts

According to the NPfI, the intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the $L_{Aeq,15\ min}$ descriptor) does not exceed the background noise level measured in the absence of the source by more than 5 dB(A). The project intrusiveness noise level, which is only applicable to residential receivers, is determined as follows:

$L_{Aeq,15\ min}$ Intrusiveness noise level = Rating Background Level (RBL) plus 5 dB(A)

Based on the minimum RBLs presented in Table 3.1, the intrusiveness noise levels for the residential receivers are determined in Table 5.1.

Table 5.1 – NPfI Intrusive Noise Levels at Residential Receivers, dB(A)

Period	RBL, dB(A)	Intrusiveness Noise Level, $L_{Aeq,15\ min}$, dB(A)
Daytime	35	35+5 = **40**
Evening	30	30+5 = **35**
Night-time	30	30+5 = **35**

5.1.2 Protecting Noise Amenity

The project amenity noise levels for different time periods of a day are determined in accordance with Section 2.4 of the NSW NPfI. The NPfI recommends amenity noise levels ($L_{Aeq,\ period}$) for various receivers including residential, commercial, industrial receivers and sensitive receivers such as schools, hotels, hospitals, churches and parks. These "recommended amenity noise levels" represent the objective for **total** industrial noise experienced at a receiver location. However, when assessing a **single** industrial development and its impact on an area, "project amenity noise levels" apply.

To ensure that the total industrial noise level (existing plus new) remain within the recommended amenity noise levels for an area, the project amenity noise level that applies for each new industrial noise source is determined as follows:

$L_{Aeq,period}$ Project amenity noise level = $L_{Aeq,period}$ Recommended amenity noise level – 5 dB(A)

Furthermore, given that the intrusiveness noise level is based on a 15 minute assessment period and the project amenity noise level is based on day, evening and night assessment periods, the NPfI provides the following guidance on adjusting the $L_{Aeq,period}$ level to a representative $L_{Aeq,15minute}$ level in order to standardise the time periods.

$$L_{Aeq,15\ min} = L_{Aeq,period} + 3\ dB(A)$$

The policy, in accordance with the NPfI, applies an adjustment of (+3 dB) to the recommended noise levels ($L_{Aeq,period}$) in order to standardise the time periods for the intrusiveness and amenity noise levels. The project amenity noise levels ($L_{Aeq,15\ min}$) applied for this project are reproduced in Table 5.2.

It is noted that the residential receivers in the vicinity of the site have been categorised as being in a 'rural' area in accordance with Table 2.3 of the NPfI.

Table 5.2 – NPfI Project Amenity Noise Levels, dB(A)

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended Noise Level	
			$L_{Aeq,\ Period}$	$L_{Aeq,15\ min}$
Residence	Rural	Day	50 – 5 = 45	45 + 3 = **48**
		Evening	45 – 5 = 40	40 + 3 = **43**
		Night	40 – 5 = 35	35 + 3 = **38**

Notes:
1. Monday-Saturday, Day 7.00am to 6.00pm; Evening 6.00pm to 10.00pm; Night 10.00pm to 7.00am
2. On Sundays and Public Holidays, Day 8.00am to 6.00pm; Evening 6.00pm to 10.00pm; Night 10.00pm to 8.00am
3. The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

5.1.3 Summary of Project Noise Trigger Levels

In accordance with the NPfI the project noise trigger level, which is the lower (ie. more stringent) value of the project intrusiveness noise level and project amenity noise level, has been determined and reproduced in Table 5.3 below.

Table 5.3 – Project Noise Trigger Levels, dB(A)

Receiver ID	Address	$L_{Aeq, 15min}$ Project Noise Trigger Levels		
		Day	Evening	Night
R1	4824 Great Western Highway, Glanmire	40	35	35
R2	23 Glanmire Lane, Glanmire	40	35	35
R3	16 Glanmire Lane, Glanmire	40	35	35
R4	264 Brewongle Lane, Brewongle	40	35	35
R5	244 Brewongle Lane, Brewongle Dwelling 1	40	35	35
R6	244 Brewongle Lane, Brewongle Dwelling 2	40	35	35
R7	4887 Great Western Highway, Glanmire	40	35	35
R8	4940 Great Western Highway, Glanmire	40	35	35
R14	44 Mersing Road, Glanmire	40	35	35
R44a	Possible future residence	40	35	35
R44b	Possible future residence	40	35	35
R44c	Possible future residence	40	35	35

Notes:
1. Monday-Saturday, Day 7.00am to 6.00pm; Evening 6.00pm to 10.00pm; Night 10.00pm to 7.00am
2. On Sundays and Public Holidays, Day 8.00am to 6.00pm; Evening 6.00pm to 10.00pm; Night 10.00pm to 8.00am
3. The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period

5.2 Operational Noise Sources

Predominant noise generating plant and equipment during the operational phase include:

- Tracker Motors
- Inverter Station
- HV Transformers

The Project setup includes the NEXTracker NX Horizon tracking system. This tracking system is composed of independent tracker rows which are attached at the centre of each tracker row totalling to 2,125 pieces, which will be evenly distributed across the solar farm area.

In addition to the trackers, the site will require the operation of up to 18 inverter stations with MV transformers (SMA SC4200), which will be evenly distributed across the solar farm area.

A Dyn11 type, 66/33 kV HV transformer with a capacity of approximately 70 MVA will be used for the connection of the solar farm to the Essential Energy grid.

An electrochemical BESS with a nominal capacity of 65MW and 1-hour duration, partly grouped in containerised modules near the substation on a pad of approximately 0.8 ha (AC coupled), and/or wholly partly distributed throughout the array in containers adjacent to the solar inverters (DC coupled).

This will include an additional 17 inverters and transformers in containers, collocated at the BESS site for power storage

During operations, it is assumed that five (5) staff members will attend site daily during the day time period to inspect the equipment. It is also assumed that each staff member will travel around the subject site in a light vehicle.

Based on the above, the following table lists associated plant and equipment likely to be used for the operation of the Project and their corresponding sound power levels.

Table 5.4 – Typical Operational Plant and Equipment & Sound Power Levels

Plant Item	Plant Description	L_{Aeq} Sound Power Levels, dB(A) re. 1pW
1	NEXTracker motor (2,125 in total)	50 (each)[1]
2	SMA SC4200 inverter stations (18 in total)	93 (each)[1]
3	HV transformer (1 in total)	72 (each)[1]
4	Light vehicle (5 in total)	88 (each)[2]
5	BESS inverters and transformers (17 in total)	93 (each)[2]

Notes: 1. Based on sound power level data provided by the manufacturer or the client
2. Based on sound power level data from past projects and/or RT&A's acoustic database

The sound power levels for the plant and equipment presented in the above table are provided by the manufacturer, the client, information from past projects and/or information held in our library files.

5.3 'Modifying Factor' Adjustments

Further to the above and in accordance with the NPfI, where the character of the noise in question is assessed as particularly annoying (i.e. if it has an inherently tonal, low frequency, impulsive or intermittent characteristic), then an adjustment of 5 dB(A) for each annoyance aspect, up to a total of 10 dB(A), is to be added to the predicted value to penalise the noise for its potential increase in annoyance. Table C1 in Fact Sheet C of the NSW NPfI provides definitive procedures for determining whether a penalty or adjustment should be applied from increased annoyance.

For the assessment of the solar farm, the noise from the inverters and transformers are considered to be tonal in nature. Therefore, a 5 dB(A) penalty has been applied to the predicted noise contributions from the inverters and transformers.

5.4 Operational Noise Assessment

Noise emissions were predicted by modelling the noise sources, receiver locations, topographical features of the intervening area, and possible noise control treatments using the CadnaA (version 2021 MR 2) noise modelling computer program. The program calculates the contribution of each noise source at each specified receptor point and allows for the prediction of the total noise from a site.

The noise prediction models takes into account:

- Location of noise sources and receiver locations;
- Height of sources and receivers;
- Separation distances between sources and receivers;
- Ground type between sources and receivers (soft); and
- Attenuation from barriers (natural and purpose built).

Furthermore, in accordance with Fact Sheet D, Table D.1 of the NPfI noise predictions were prepared for the following standard and noise-enhancing meteorological conditions:

1. Standard meteorological conditions – 0.5 m/s wind velocity at 10 m from ground level between each noise source and each noise receiver. Wind direction was based on wind travelling from the source to the receiver
2. Slight to gentle breeze – 3 m/s wind velocity at 10 m from ground level between each noise source and each noise receiver (as per NPfI default wind conditions). Wind direction was based on wind travelling from the source to the receiver
3. Moderate temperature inversion – applicable for noise predictions during night time periods only. F-class temperature inversion with 2 m/s wind velocity at 10m from ground level between each noise source and each noise receiver.

Table 5.5 below present the predicted noise levels for the worst-case scenario based on concurrent operation of all the plant and equipment shown in Table 5.4.

Table 5.5 – Predicted $L_{Aeq,15\ min}$ Operational Noise Levels at Residential Receiver Locations, dB(A)

Receiver Location	Project Noise Trigger Levels			Predicted Operational Noise Levels			Comply? (Yes/No)
	Day	Evening	Night	Calm & Isothermal Conditions	Slight to Gentle Breeze	Moderate Temperature Inversion[1]	
R1	*40*	*35*	*35*	27	28	28	Yes
R2	*40*	*35*	*35*	25	26	26	Yes
R3	*40*	*35*	*35*	25	27	27	Yes
R4	*40*	*35*	*35*	31	32	32	Yes
R5	*40*	*35*	*35*	28	30	30	Yes
R6	*40*	*35*	*35*	23	24	24	Yes
R7	*40*	*35*	*35*	32	34	34	Yes
R8	*40*	*35*	*35*	22	23	23	Yes
R14	*40*	*35*	*35*	23	24	24	Yes
R44a	*40*	*35*	*35*	34	36	36	Yes
R44b	*40*	*35*	*35*	29	31	31	Yes
R44c	*40*	*35*	*35*	35	**36**	**36**	**No**

Receiver Location	Project Noise Trigger Levels			Predicted Operational Noise Levels			Comply? (Yes/No)
	Day	Evening	Night	Calm & Isothermal Conditions	Slight to Gentle Breeze	Moderate Temperature Inversion[1]	

Notes: 1. Applicable for the night time period only
2. Bold font denotes exceedance of Project Noise Trigger Level

Based on the predicted operational noise levels presented in the table above, predicted noise levels at the nearest receivers generally comply with the nominated criteria under all scenarios and meteorological conditions for all receivers except for Receiver R44c, where a 1 dB(A) exceedance is predicted during the evening and night periods when there is a slight to gentle breeze and/or moderate temperature inversion.

Reference is made to Tables 4.1 and 4.2 of the NPfI, which states that exceedances of up to 2 dB(A) are considered negligible and would not be discernible by the average person.

Therefore, noise impacts at Receiver R44c due to the operation of the Project is considered to be in compliance and would not warrant receiver based treatment of controls. Furthermore, Receiver R44c is a location identified as a possible future residence and there is no dwelling currently constructed at this location.

Therefore, no further reasonable and feasible noise mitigation measures are required to reduce operational noise impacts.

5.5 Sleep Disturbance Assessment

To assess the likelihood of sleep disturbance, the potential of maximum noise level events from premises during the night-time period has been considered in this assessment. In accordance with the NPfI, a detailed maximum noise level event assessment should be undertaken where the subject development night-time noise levels at a residential location exceed:

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

Where there are noise events found to exceed the initial screening level, further analysis is undertaken to identify:

- The likely number of events that might occur during the night assessment period,
- The extent to which the maximum noise level exceeds the rating background noise level.

During the night time period, only mechanical plant will be operating, including the tracking motors, inverters and the substations. Noise emissions from these plant items are considered to be continuous with no potential for high peak noise level events. Therefore, the L_{Amax} noise levels experienced at the identified receivers will be similar to the predicted $L_{Aeq,15\ min}$ noise levels shown in Table 5.5. Hence, it is

expected that both the $L_{Aeq,15\ min}$ and L_{AFmax} will be well below the nominated sleep disturbance criteria of 40 dB(A) and 52 dB(A), respectively.

6 Vibration Assessment

Vibration generating activities would occur only during the construction phase of the project. There are no vibration generating activities expected during the operational phase. As the nearest identified receivers are in excess of 190 m from the subject site, structural damage due to vibration is not expected. Assessment for construction vibration impact on human comfort is assessed in accordance with EPA requirements.

6.1 Vibration Criteria

Assessment of potential disturbance from vibration on human occupants of buildings is made in accordance with the EPA's *'Assessing Vibration; a technical guideline'* (DECC, 2006). The guideline provides criteria which are based on British Standard BS 6472-1992 *'Evaluation of human exposure to vibration in buildings (1-80Hz)'*. Sources of vibration are defined as either 'Continuous', 'Impulsive' or 'Intermittent'. Table 6.1 provides definitions and examples of each type of vibration.

Table 6.1 – Types of Vibration

Type of Vibration	Definition	Examples
Continuous vibration	Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time)	Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).
Impulsive vibration	A rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.
Intermittent vibration	Can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer, this would be assessed against impulsive vibration criteria.

Source: Assessing Vibration; a technical guideline, Department of Environment & Climate Change, 2006

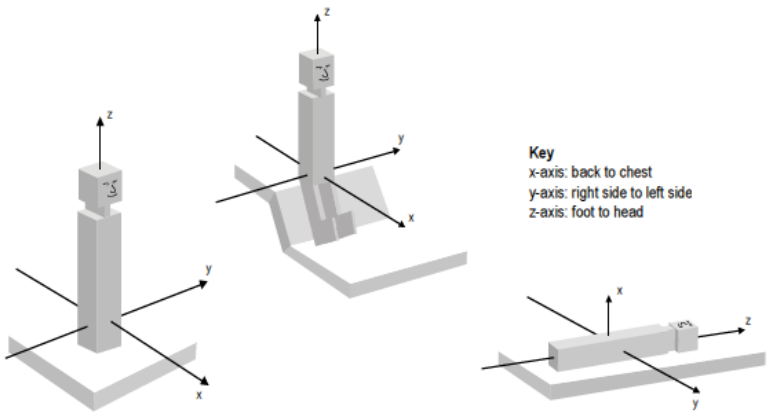
The vibration criteria are defined as a single weighted root mean square (rms) acceleration source level in each orthogonal axis. Section 2.3 of the guideline states:

> *"Evidence from research suggests that there are summation effects for vibrations at different frequencies. Therefore, for evaluation of vibration in relation to annoyance and comfort, overall weighted rms acceleration values of the vibration in each orthogonal axis are preferred (BS 6472)."*

When applying the criteria, it is important to note that the three directional axes are referenced to the human body, i.e. x-axis (back to chest), y-axis (right side to left side) or z-axis (foot to head). Vibration may enter the body along different orthogonal axes and affect it in different ways. Therefore,

application of the criteria requires consideration of the position of the people being assessed, as illustrated in Figure 3. For example, vibration measured in the horizontal plane is compared with x- and y-axis criteria if the concern is for people in an upright position, or with the y- and z- axis criteria if the concern is for people in the lateral position.

Figure 3 – Orthogonal Axes for Human Exposure to Vibration



The preferred and maximum values for continuous and impulsive vibration are defined in Table 2.2 of the guideline and are reproduced in Table 6.2 for the applicable receivers.

Table 6.2 – Preferred and Maximum Levels for Human Comfort

Location	Assessment Period[1]	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration (weighted RMS acceleration, m/s^2, 1-80Hz)					
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Impulsive vibration (weighted RMS acceleration, m/s^2, 1-80Hz)					
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14

Notes: 1. Daytime is 7:00am to 10:00pm and Night-time is 10:00pm to 7:00am

The acceptable vibration dose values (VDV) for intermittent vibration are defined in Table 2.4 of the guideline and are reproduced in Table 6.3 for the applicable receiver type.

Table 6.3 – Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

Location	Daytime[1]		Night-time[1]	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Residences	0.20	0.40	0.13	0.26

Notes: 1. Daytime is 7:00am to 10:00pm and Night-time is 10:00pm to 7:00am

6.2 Potential Vibration Impacts

Based on the proposed plant items presented in Table 4.3, vibration generated by construction plant was estimated and potential vibration impacts are summarised in Table 6.4 below. The assessment is relevant to the identified receiver locations.

Table 6.4 – Potential Vibration Impacts for Identified Receivers

Receiver ID	Approx. Distance to Nearest Buildings from Works	Type of Nearest Sensitive Buildings	Assessment on Potential Vibration Impacts	Vibration Monitoring
R1	667 m	Residential	Very low risk of adverse comments	Not required
R2	230 m	Residential	Very low risk of adverse comments	Not required
R3	218 m	Residential	Very low risk of adverse comments	Not required
R4	215 m	Residential	Very low risk of adverse comments	Not required
R5	325 m	Residential	Very low risk of adverse comments	Not required
R6	639 m	Residential	Very low risk of adverse comments	Not required
R7	466 m	Residential	Very low risk of adverse comments	Not required
R8	858 m	Residential	Very low risk of adverse comments	Not required
R14	912 m	Residential	Very low risk of adverse comments	Not required
R44a	765 m	Residential	Very low risk of adverse comments	Not required
R44b	290 m	Residential	Very low risk of adverse comments	Not required
R44c	300 m	Residential	Very low risk of adverse comments	Not required

The potential for adverse comments to vibration impacts during the construction works was determined to be very low due to the large distances between the receiver locations and the construction activities. Therefore, additional vibration mitigation measures and vibration monitoring are not required at the identified receiver locations during construction works associated with the project.

7 Road Traffic Noise Assessment

Noise impact from the potential increase in traffic on the surrounding road network due to construction and operational activities is assessed against the NSW 'Road Noise Policy' (RNP). The RNP sets out criteria to be applied to particular types of road and land uses. These noise criteria are to be applied when assessing noise impact and determining mitigation measures for sensitive receivers that are potentially affected by road traffic noise associated with the construction and operation of the subject site, with the aim of preserving the amenity appropriate to the land use.

Based on information provided by the client, the peak vehicle movements during the construction stage of the project are presented in the following table. Furthermore, vehicle movements will only occur during the day time period when construction works occur. Access to the development site is directly off the Great Western Highway.

Table 7.1 – Summary of the Estimated Construction Traffic Volumes During Peak Construction

Vehicle Type	Daily Peak Vehicle Movements (two-way)
Light Vehicle (car / 4WD)	107
MRV/HRV	18
AV	13
B-Double	47
Total	**185**

During the operational stage, vehicle access to the site will be maintenance vans or delivery trucks which would occur on an irregular basis. Traffic noise impacts during the operational stage of the project would be minimal and insignificant and will not be assessed further.

7.1 Road Traffic Noise Criteria

Based on functionality, the Great Western Highway is categorised as an arterial road. For existing residences affected by additional traffic on existing arterial roads generated by land use developments, the following RNP road traffic noise criteria apply.

Table 7.2 – RNP Road Traffic Noise Criteria, dB(A)

Road Category	Type of Project/Land Use	Assessment Criteria, dB(A)	
		Day 7:00am – 10:00pm	Night 10:00pm – 7:00am
Freeway/arterial/sub-arterial roads	3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq,15\ hr}$ 60 (external)	$L_{Aeq,9\ hr}$ 55 (external)

Further to the above, the RNP states the following for land use developments generating additional traffic:

*"For existing residences and other sensitive land uses affected by **additional traffic on existing roads generated by land use development**, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'."*

7.2 Predicted Road Traffic Noise

Results of the road traffic noise predictions are presented in the table below. It is noted that the predicted noise levels represent the traffic noise contribution from the vehicle movements associated with the construction works and does not take into account existing traffic noise levels due to existing general traffic flows as existing traffic volumes along Great Western Highway are unknown.

Table 7.3 – Predicted Road Traffic Noise Contribution Levels Along Public Roads, dB(A) $L_{Aeq,15\ hr}$

Receiver	Criteria	Traffic Movements	Speed (km/h)[1]	Distance to Road[2]	Predicted Noise Level	Exceed?
Residences on Great Western Highway	$L_{Aeq,15\ hr}$ 60	As per Table 7.1	100	20 m	56	No

Notes: 1. Based on posted speed limit
2. Based on closest typical distance from facade of dwelling to the road

From the above table, it can be seen that road traffic noise level contributions from the vehicle movements associated with the construction works are at least 4 dB(A) below the applicable noise criterion based on dwellings being 20 m from the roads. Given that residences are located within a rural environment, distances between the road and the dwellings would likely be significantly greater than 20 m.

Furthermore, as the predicted levels are 4 dB(A) less than the traffic noise criterion, it is not expected that the traffic noise contribution from the construction vehicles would result in an exceedance of the traffic noise criterion and/or increase the existing traffic noise levels by more than 2 dB(A).

Therefore, traffic noise levels as a result of the construction works for the solar farm would not adversely contribute to the existing traffic noise levels at the most affected residences along the surrounding roads.

8 Conclusion

Renzo Tonin and Associates has completed an environmental noise and vibration assessment of the proposed Glanmire Solar Farm.

Noise emissions from the construction phase of the project were predicted to exceed the nominated criteria at six (6) of the nearest nominated receiver locations when the loudest plant and equipment or up to three plant and equipment are operating concurrently and at the closest proximity to the receivers. In-principle recommendations are provided in Section 4.4 to limit the potential impact of noise generated by construction activities to acceptable levels.

Noise emissions from the operational phase of the project were predicted to comply with the nominated criteria at all existing nearest affected receivers. A negligible exceedance of 1 dB(A) was predicted at a possible future residential location.

Given the large separation distance between the nearest affected receivers and the subject site, vibration impacts resulting in structural damage to buildings at the nearest affected receivers are determined to be negligible and there is a very low risk of adverse comments from occupants of dwellings due to construction vibration.

Road traffic noise impacts due to additional traffic generated during the construction phase of the development on residential properties along the access routes were found to comply with the relevant RNP criteria.

APPENDIX A Glossary of Terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 110dB Operating a chainsaw or jackhammer 120dB Deafening
dB(A)	A-weighted decibels. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.

L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B Draft Construction Noise Management Plan

B.1 Project Description

Refer to Section 2.1.

B.2 Receiver Locations

Refer to Section 2.3.

B.3 Construction Hours

Refer to Section 2.4.1.

B.4 Construction Noise Management Levels

Refer to Section 4.1.

B.5 Construction Noise Sources

Refer to Section 4.2.

B.6 Construction Noise Assessment

Refer to Section 4.3.

B.7 Construction Noise Mitigation and Management Measures

The following recommendations provide in-principle feasible and reasonable noise management measures to reduce noise impacts to sensitive receivers. Where actual construction activities differ from those assessed in this report, more detailed design of noise control measures may be required once specific items of plant and construction methods have been chosen and assessed on site.

The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

B.7.1 General Engineering Noise Controls

Implementation of noise control measures, such as those suggested in Australian Standard 2436-2010 "Guide to Noise Control on Construction, Demolition and Maintenance Sites", are expected to reduce predicted construction noise levels. Reference to Australian Standard 2436-2010, Appendix C, Table C1 suggests possible remedies and alternatives to reduce noise emission levels from typical construction equipment. Table C2 in Appendix C presents typical examples of noise reductions achievable after

treatment of various noise sources. Table C3 in Appendix C presents the relative effectiveness of various forms of noise control treatment.

Table B.1 below presents noise control methods, practical examples and expected noise reductions according to AS2436 and according to Renzo Tonin & Associates' opinion based on experience with past projects.

Table B.8.1 – Relative Effectiveness of Various Forms of Noise Control, dB(A)

Noise control method	Practical examples	Typical noise reduction possible in practice		Maximum noise reduction possible in practice	
		AS 2436	Renzo Tonin & Associates	AS 2436	Renzo Tonin & Associates
Distance	Doubling of distance between source and receiver	6	6	6	6
Screening	Acoustic barriers such as earth mounds, temporary or permanent noise barriers	5 to 10	5 to 10	15	15
Acoustic Enclosures	Engine casing lagged with acoustic insulation and plywood	15 to 25	10 to 20	50	30
Engine Silencing	Residential class mufflers	5 to 10	5 to 10	20	20
Substitution by alternative process	Use electric motors in preference to diesel or petrol	-	15 to 25	-	40

The Renzo Tonin & Associates' listed noise reductions are conservatively low and should be referred to in preference to those of AS2436.

Table B.2 below identifies possible noise control measures, which are applicable for the construction plant likely to be used on site.

Table B.8.2 – Noise Control Measures for Likely Construction Plant

Plant description	Screening	Acoustic enclosures	Silencing	Alternative process
Dozer	✔	x	✔	x
Grader	✔	x	✔	x
Excavator	✔	x	✔	x
Roller	✔	x	✔	x
Bobcat	✔	x	✔	x
Front End Loader	✔	x	✔	x
Road truck (delivers	✔	x	✔	x
Concrete truck	✔	x	✔	x
Drilling Rig	✔	✔	✔	x
Crane	✔	x	✔	x

B.7.2 General Noise Management Measures

The following general noise management measures should be followed:

- Use less noisy plant and equipment, where feasible and reasonable.
- Plant and equipment should be properly maintained.
- Provide special attention to the use and maintenance of 'noise control' or 'silencing' kits fitted to machines to ensure they perform as intended.
- Avoid any unnecessary noise when carrying out manual operations and when operating plant.
- Any equipment not in use for extended periods during construction work should be switched off.
- Trucks should not be left idling when possible.
- In addition to the noise mitigation measures outlined above, a management procedure would need to be put in place to deal with noise complaints that may arise from construction activities. Each complaint would need to be investigated and appropriate noise amelioration measures put in place to mitigate future occurrences, where the noise in question is in excess of allowable limits. See Appendix B for an example of a complaint handling procedure and form.

Where noise level exceedances cannot be avoided, then consideration may be given to providing periods of repose for residents, where feasible and reasonable.

Some items of plant may exceed noise limits even after noise treatment is applied. To reduce the overall noise impact, the use of noisy plant may be restricted to within certain time periods, where feasible and reasonable and to be negotiated with the residents. For example, between 10am and 3pm (with one-hour break for lunch between 12pm and 1pm), noisy activities could occur with no noise level restrictions over a limited time period. Residents would be notified of the potential noise impact during this time period so that they can organise their day around the noisy period. Allowing the construction activities to proceed, despite the noise exceedance may be the preferred method in order to complete the works expeditiously.

Noise Management Plan

Glanmire Solar Farm

October 2022

Project Number: 21-785

Document verification

Project Title:	Glanmire Solar Farm
Project Number:	21-785
Project File Name:	21-785_Glanmire SF Draft NMP_Final v1

Revision	Date	Prepared by	Reviewed by	Approved by
Final v1	26/10/2022	Jane Love	W. Weir	W. Weir

NGH Pty Ltd is committed to environmentally sustainable practices, including fostering a digital culture and minimising printing. Where printing is unavoidable, NGH prints on 100% recycled paper.

W. www.nghconsulting.com.au

E. ngh@nghconsulting.com.au

BEGA - ACT & SOUTH EAST NSW
Suite 11, 89-91 Auckland Street
(PO Box 470) Bega NSW 2550
T. (02) 6492 8333

NEWCASTLE - HUNTER & NORTH COAST
Level 1, 31-33 Beaumont Street
Hamilton NSW 2303
T. (02) 4929 2301

BRISBANE
T3, Level 7, 348 Edward Street
Brisbane QLD 4000
T. (07) 3129 7633

SYDNEY REGION
Unit 17, 21 Mary Street
Surry Hills NSW 2010
T. (02) 8202 8333

CANBERRA - NSW SE & ACT
Unit 8, 27 Yallourn Street
(PO Box 62) Fyshwick ACT 2609
T. (02) 6280 5053

WAGGA WAGGA - RIVERINA & WESTERN NSW
35 Kincaid Street (PO Box 5464)
Wagga Wagga NSW 2650
T. (02) 6971 9696

GOLD COAST
2B 34 Tallebudgera Creek Road
Burleigh Heads QLD 4220
(PO Box 424 West Burleigh QLD 4219)
T. (07) 3129 7633

WODONGA
Unit 2, 83 Hume Street
(PO Box 506) Wodonga VIC 3690
T. (02) 6067 2533

NSW • ACT • QLD • VIC
W. www.nghconsulting.com.au
ABN 31 124 444 622 ACN 124 444 622

Table of contents

1. Introduction 1

1.1. Background 1

1.2. Context 1

2. Environmental assurance 2

2.1. Relevant Legislation and guidelines 2

2.1.1. Legislation 2

2.1.2. Policies and Guidelines 2

3. Existing environment 3

3.1. Sensitive receivers 3

3.2. Background noise levels 6

4. Noise criteria 7

4.1. Construction noise criteria 7

4.2. Road traffic noise criteria 7

5. Environmental impacts and assessment 9

5.1. Construction noise sources 9

5.2. Construction noise assessment 10

5.3. Road traffic noise assessment 13

6. Mitigation measures 14

6.1. Construction hours 14

6.2. Consultation 14

6.3. Engineering noise controls 14

6.4. Respite periods 14

6.5. Noise management and mitigation measures 15

7. Compliance management 21

7.1. Training 21

7.2. Monitoring and inspections 21

7.3. Complaints Resolution 21

8. Review and improvement 23

8.1. Continuous improvement 23

8.2. NMP Update and amendment 23

9. Conclusion 24

10. References 25

Figures

Figure 3-1 Project site and closest sensitive receivers (Renzo Tonin, 2022). 5

Tables

Table 3-1 Nearest receivers to the Project 3
Table 3-2 Applicable RBLs for each time of day 6
Table 4-1 Noise Management Levels at residential receivers. 7
Table 4-2 Construction Noise Management Levels at residential recievers. 7
Table 4-3 RNP Road Traffic Noise Criteria, dB(A) 8
Table 5-1 Typical construction equipment and sound power levels 9
Table 5-2 Predicted LAeq 15 min construction noise levels at receiver locations, dB(A) 11
Table 5-3 Predicted road traffic noise contribution levels along public roads, dB(A). 13
Table 6-1 Noise mitigation measures 16
Table 10-1 Relative Effectiveness of Various Forms of Noise Control, dB(A) ..... A-I
Table 10-2 Noise Control Measures for Likely Construction Plant ..... A-II

Appendices

Appendix A effectiveness of noise controls ..... A-I

Acronyms and abbreviations

AS	Australian Standard
dB(A)	Decibels
DECC	Department of Climate Change
DECCW	Department of Climate Change and Water
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
ICNG	Interim Construction Noise Guidelines
INP	NSW Industrial Noise Policy
km	kilometres
L_{Aeq}	Equivalent continuous noise level
LGA	Local Government Area
m	Metres
MW	Megawatt
NML	Noise Management Level
NMP	Noise Management Plan
NSW	New South Wales
POEO	*Protection of the Environment Operations Act 1997, NSW*
RBL	Rating Background Level (background noise level)
RNP	NSW Road Noise Policy

1. Introduction

1.1. Background

Glanmire Solar Farm (the Project) proposed by Elgin Energy Pty Ltd would include the construction, operation and eventual decommissioning of 60MW AC (77DC) solar farm. The Project is located at Lot 141 DP1144786, in Glanmire, New South Wales (NSW), approximately 10 kilometres (km) east of Bathurst. The uppermost area of land that would be impacted by the Project (including all construction, operational and decommissioning impacts as well as all temporary and permanent impact areas) would be not greater than 158.6 hectares (ha).

The Project would incorporate the following permanent infrastructure components:

- Ground mounted solar photovoltaic (PV) panels single axis tracking, single portrait solar arrays with 60MW AC (77DC).
- 18 inverters and voltage step-up transformers positioned throughout the solar arrays.
- Underground and aboveground cabling to connect the arrays to the inverters/transformer stations.
- A hybrid (AC-coupled) Battery Energy Storage System (BESS) with a power rating up to approximately 60MW with one hour storage (60MWh); this will include additional 17 inverters and transformers collocated at the BESS.
- A switchyard and on-site substation.
- National Energy Market compliant metering.
- Internal access tracks to enable site maintenance.
- Security fencing around the perimeter with Closed Circuit Television (CCTV).
- An operations and maintenance building.
- Development of an appropriate site access off Brewongle Lane.
- Specific areas of vegetation screen plantings.

During the construction phase, temporary facilities would include a laydown area with a secure compound, construction site offices and amenities and car and bus parking areas for construction staff.

1.2. Context

A Construction and Operational Noise and Vibration Assessment for the proposed Glanmire Solar Farm was undertaken by Renzo Tonin and Associates (2022) as part of the Environmental Impact Statement (EIS)(NGH Consulting, 2022). Noise emissions from the construction phase of the Project were predicted to exceed the construction noise management levels at the nearest affected receivers. The Secretary's Environmental Assessment Requirements (SEARs) issued for the Project outline that a draft Noise Management Plan (NMP) is required to be prepared as part of the EIS if the noise assessment finds that construction noise is likely to exceed applicable criteria.

This draft NMP (the plan) has been prepared to satisfy the Project SEARS. The plan demonstrates and describes how noise will be managed during construction of the solar farm by Elgin Energy Pty Ltd and contractors. This plan would be updated prior to implementation as part of the Environmental Management Strategy (EMS).

2. Environmental assurance

2.1. Relevant Legislation and guidelines

2.1.1. Legislation

Legislation relevant to this NMP includes:

- *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act)
- Environmental Planning and Assessment Regulation 2021
- *Protection of the Environment Operations Act 1997* (POEO Act)
- Protection of the Environment Operations (Noise Control) Regulation 2008

2.1.2. Policies and Guidelines

The main guidelines relevant to this Plan include:

- NSW Department of Environment Climate Change (DECC) 2009, *Interim Construction Noise Guideline* (ICNG)
- NSW Environment Protection Authority (EPA) 2017, NSW *Noise Policy for Industry*
- NSW Department of Environment Climate Change and Water (DECCW) 2011, *Road Noise Policy* (RNP)

3. Existing environment

3.1. Sensitive receivers

The Project is located in Glanmire, approximately 10 km east of Bathurst and approximately 4.5 km east of the suburb of Raglan, within the Bathurst Regional Council Local Government Area (LGA). The locality is sparsely populated with the existing noise sources generally consisting of:

- Highway noise from vehicles travelling on the Great Western Highway located on the boundary of the site.
- Local road noise from Brewongle Lane.
- Agricultural activities such as livestock, motorbikes, tractors and farm vehicles.

Surrounding land uses are mixed, although predominantly agricultural. On the northern side of the highway there is a transport business and animal boarding kennels, with smaller land parcels dominating. On the southern side of the highway land use is agriculture, including grazing, improved pasture and farming (fodder, cereals and oilseed).

The site has a gently undulating terrain, forming a series of small valleys and dams. The site is currently occupied by open grazing pastures and sown paddocks with some scattered trees in central parts of the site, and a dense corridor of trees to the northeast of the site, adjacent to an existing dwelling.

The nearest affected receivers were identified as part of the noise assessment through aerial map are outlined in Table 3-1 and shown in Figure 3-1.

Table 3-1 Nearest receivers to the Project

ID	Address	Description
R1	4824 Great Western Highway, Glanmire.	Residential property located approximately 667 m north of the development area.
R2	23 Glanmire Lane, Glanmire.	Residential property located approximately 230 m north-east of the development area.
R3	16 Glanmire Lane, Glanmire.	Residential property located approximately 218 m north-east of the development area.
R4	264 Brewongle Lane, Brewongle.	Residential property located approximately 215 m south of the development area.
R5	244 Brewongle Lane, Brewongle Dwelling 1.	Residential property located approximately 325 m south of the development area.
R6	244 Brewongle Lane, Brewongle Dwelling 2.	Residential property located approximately 639 m south of the development area.
R7	4887 Great Western Highway, Glanmire.	Residential property located approximately 466 m west of the development area.

ID	Address	Description
R8	4940 Great Western Highway, Glanmire.	Residential property located approximately 858 m north-west of the development area.
R14	44 Mersing Road, Glanmire.	Residential property located approximately 912 m north-east of the development area.
R44	Possible future residence.	Residential property located approximately 765 m east of the development area.
R44b	Possible future residence.	Residential property located approximately 290 m east of the development area.
R44c	Possible future residence.	Residential property located approximately 300 m west of the development area.

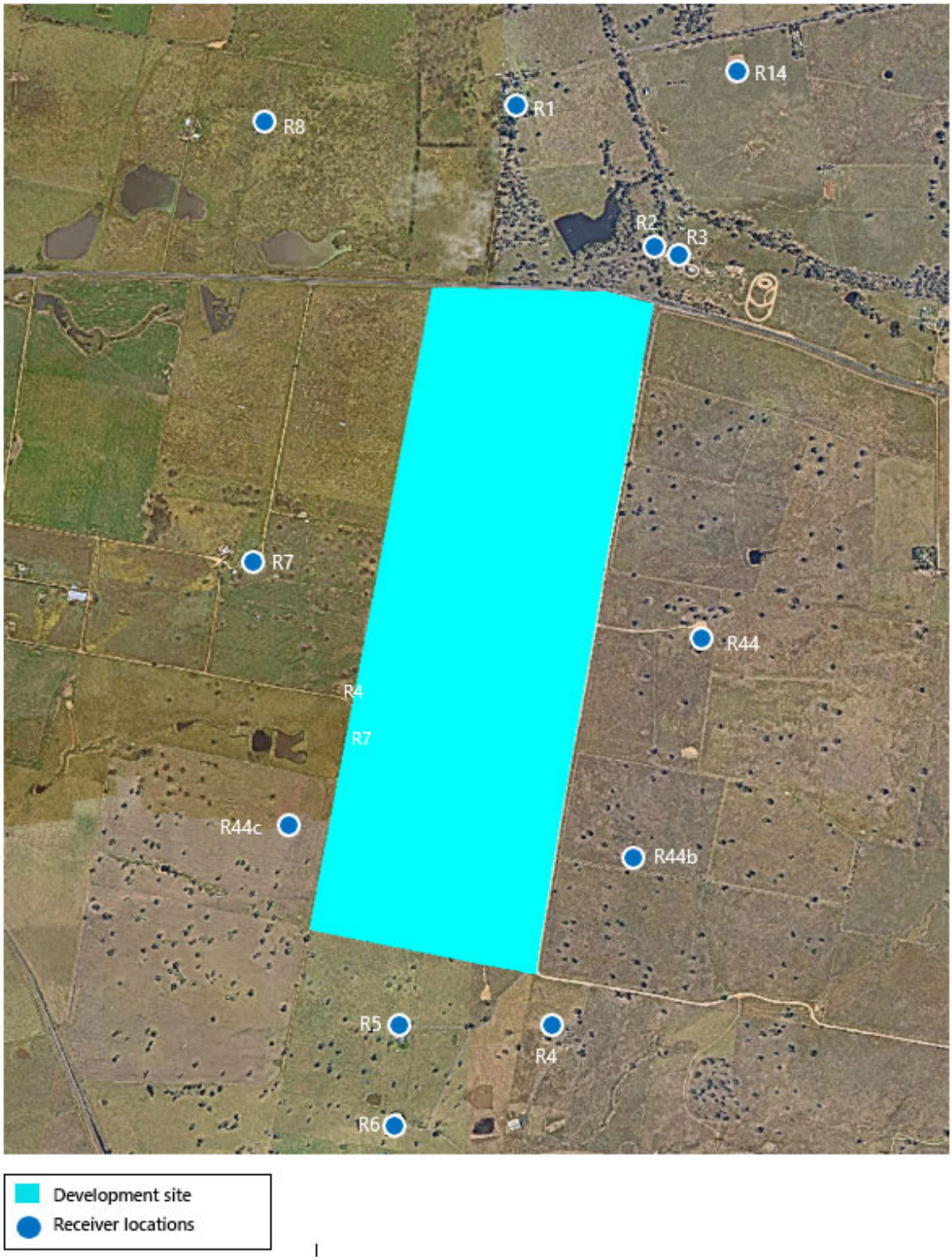


Figure 3-1 Project site and closest sensitive receivers (Renzo Tonin, 2022).

3.2. Background noise levels

Assessment criteria and noise management levels for the construction are derived from the existing noise environment of the sensitive receivers. The NSW Policy for Industry (NPfI) (EPA 2017) outlines methods for determining the background noise level of an area. For this assessment, the NPfI's minimum Rating Background Noise Level (RBL) from Table 2.1 of the NPfI has been adopted to describe the RBL of the areas around the Project. Based on the identified receivers, existing environment and land zoning on and adjacent to Project site, the noise environment is classified as rural. The RBL to be adopted for all receiver locations as part of this assessment are described below (Table 3-2).

Background noise varies over the course of any 24-hour period, typically from a minimum at 3am in the morning to a maximum during morning and afternoon traffic peak hours. Therefore, the NPfI requires that the level of background and ambient noise be assessed separately for the daytime, evening and night-time periods, as outlined in Table 3-2.

It is anticipated, however that at certain periods of the year that background noise levels would exceed the levels described in the NPfI guideline. As such this assessment of impacts is likely to be conservative and represents a worst-case scenario.

Table 3-2 Applicable RBLs for each time of day

Time of day	NPfI [1] defined period	Minimum RBL[2] dB(A) [3]
Day	7am to 6pm, Monday to Saturday. 8am to 6pm Sundays & Public Holidays.	35
Evening	6pm to 10pm, Monday to Sunday & Public Holidays.	30
Night	10pm to 7am, Monday to Saturday. 10pm to 8am Sundays & Public Holidays.	30

[1] Noise Policy for Industry.

[2] Rating Background Levels.

[3] Decibels; the units that sound is measured in. dB(A) denotes 'A-weighted decibels'. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. Practically, all noise is measured using the A filter.

4. Noise criteria

4.1. Construction noise criteria

The NSW Interim Construction Noise Guideline (ICNG DECC 2009) deals with managing construction noise impacts. According to the guideline, a quantitative assessment of noise impacts is warranted when works are likely to impact an individual or sensitive land use for more than three weeks in total. The construction of the Glanmire Solar Farm would be 12 months with peak construction for four months and therefore meets the requirements of a quantitative assessment.

The guideline specifies noise targets, or 'noise management levels', for residences and other noise sensitive receivers (Table 4-1). The RBL is used when determining the management level. The RBL is the overall single-figure background noise level measured in each relevant assessment period. Residential receivers are considered 'noise affected' where construction noise levels are greater than the noise management levels identified below.

Table 4-1 Noise Management Levels at residential receivers.

Time of day	Management Level
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected Rating Background Level + 10dB(A)
	Highly noise affected 75dB(A)
Outside recommended standard hours	Noise affected Rating Background Level + 5dB(A)

Table 4-2 identifies the adopted construction Noise Management Levels (NMLs) for the nearest noise sensitive residential receivers (refer to Figure 3-1). The NMLs for the receiver locations are derived from the RBLs represented by the background noise levels and NSW ICNG (DECC 2009) criteria (Table 4-1). Furthermore, during standard construction hours, a highly affected noise objective of 75 dB(A) applies at all receivers.

Table 4-2 Construction Noise Management Levels at residential recievers.

Location description	Day L_{A90} Background Noise Level (RBL)	Day Noise Management Level (NML) $L_{A90\ (15min)}$
All residential receivers	35	45

4.2. Road traffic noise criteria

Noise impact from the potential increase in traffic on the surrounding road network due to construction is assessed against the NSW 'Road Noise Policy' (RNP) (DECCW 2011). The RNP sets out criteria to be applied to particular types of road and land uses. Great Western Highway is categorised as an arterial road, the applicable criteria is outlined in Table 4-3.

Table 4-3 RNP Road Traffic Noise Criteria, dB(A)

Road Category	Type of Proposal /Land Use	Assessment Criteria dB(A)	
		Day 7am-10pm	**Night 10pm-7am**
Freeway/arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq,(15\ hour)}$ 60 (external)	$L_{Aeq,(9\ hour)}$ 55 (external)

5. Environmental impacts and assessment

5.1. Construction noise sources

Equipment used during construction would include earth-moving equipment for civil works, diesel generators, trucks and cranes with similar noise outputs to farm machinery such as tractors. Pile driving for the solar panel foundations would be undertaken using a machine which screws or hammers poles into the ground, similar to that used for driving farm fence poles into the ground.

Several key activities on the site that are likely to produce the most noise include:

- General construction works
- Civil construction works
- Mechanical/electrical construction works

The equipment associated with these activities would dominate the noise from the works and has been used to predict the likely noise associated with each activity. The equipment and their sound power level to be used within the Project site are in Table 5-1.

Table 5-1 Typical construction equipment and sound power levels

Plant item	Plant description	Number of items	L_{Aeq} Sound power Levels, dB(A) re.1pW (single item)
General construction works			
1	Mobile crane	1	110
2	Delivery truck/trailer	1	108
3	Power generator	1	100
4	Telehandler	1	98
5	Light vehicle	1	88
Civil construction works			
6	Dozer	3	109
7	Vibratory roller	As required	109
8	Backhoe/excavator	2	107
9	Grader	2	107
10	Laser bucket	1	107
11	Concrete truck	1	106
12	Dump truck	1	105

Plant item	Plant description	Number of items	L_{Aeq} Sound power Levels, dB(A) re.1pW (single item)
13	Water truck	3	104
Mechanical/electrical construction works			
14	Piling rig	6	114
15	Drilling rig	2	112
16	Mobile crane	1	110
17	Flatbed truck	3	105
18	Hand tools	As required	100
19	Forklift	3	90
20	Ute	As required	88

5.2. Construction noise assessment

Noise emissions were predicted by modelling the noise sources, receiver locations, topographical features of the intervening area, and possible noise control treatments using the CadnaA (version 2021 MR 1) noise modelling computer program. The program calculates the contribution of each noise source at each specified receptor point and allows for the prediction of the total noise from a site.

The noise prediction models takes into account:

- Location of noise sources and receiver locations.
- Height of sources and receivers.
- Separation distances between sources and receivers.
- Ground type between sources and receivers (soft).
- Attenuation from barriers (natural and purpose built).

Noise levels at any receivers resulting from construction would depend on the above and the type and duration of construction being undertaken. Furthermore, noise levels at receivers would vary substantially over the total construction program due to the transient nature and large range of plant and equipment that could be used.

Table 5-2 presents construction noise levels likely to be experienced at the nearby affected receivers based on the construction activities and plant and equipment associated with the Project. The model shows the predicted noise levels at each receiver by plant item as well as by modelling up to 3 (noisiest) plant operating concurrently. Predicted exceedances of the set criteria are shown in blue highlight. It is noted that predicted are based on the loudest plant and equipment or the three loudest plant and equipment operating concurrently and at a location closest to the corresponding receiver location. This scenario is conservative and would not typically occur on site.

Table 5-2 Predicted LAeq 15 min construction noise levels at receiver locations, dB(A)

Plant item	Plant description	Predicted $L_{ep,\ 15min}$ construction noise levels											
		R1	R2	R3	R4	R5	R6	R7	R8	R14	R44	R44b	R44c
Noise management level (criteria)		**45**	**45**	**45**	**45**	**45**	**45**	**45**	**45**	**45**	**45**	**45**	**45**
General construction works													
1	Mobile crane	<20-27	<20-45	<20-46	<20-45	<20-40	<20-32	<20-35	<20-30	<20-48	<20-33	<20-42	<20-48
2	Delivery truck/trailer	<20-25	<20-43	<20-44	<20-43	<20-38	<20-30	<20-33	<20-28	<20-46	<20-31	<20-40	<20-46
3	Power generator	<20	<20-35	<20-36	<20-35	<20-30	<20-22	<20-25	<20-20	<20-38	<20-23	<20-32	<20-38
4	Telehandler	<20	<20-33	<20-34	<20-33	<20-28	<20-20	<20-23	<20	<20-36	<20-21	<20-30	<20-36
5	Light vehicle	<20	<20-23	<20-24	<20-23	<20	<20	<20	<20	<20-26	<20	<20-20	<20-26
Up to 3 (noisiest) plant operating concurrently		<20-29	<20-47	<20-48	<20-48	<20-43	<20-35	<20-37	<20-32	<20-51	<20-36	<20-44	<20-51
Civil construction works													
6	Dozer	<20-26	<20-44	<20-45	<20-44	<20-39	<20-31	<20-34	<20-29	<20-47	<20-32	<20-41	<20-47
7	Vibratory roller	<20-26	<20-44	<20-45	<20-44	<20-39	<20-31	<20-34	<20-29	<20-47	<20-32	<20-41	<20-47
8	Backhoe/excavator	<20-24	<20-42	<20-43	<20-42	<20-37	<20-29	<20-32	<20-27	<20-45	<20-30	<20-39	<20-45
9	Grader	<20-24	<20-42	<20-43	<20-42	<20-37	<20-29	<20-32	<20-27	<20-45	<20-30	<20-39	<20-45
10	Laser bucket	<20-24	<20-42	<20-43	<20-42	<20-37	<20-29	<20-32	<20-27	<20-45	<20-30	<20-39	<20-45

Plant item	Plant description	Predicted $L_{ep,\ 15min}$ construction noise levels											
		R1	R2	R3	R4	R5	R6	R7	R8	R14	R44	R44b	R44c
11	Concrete truck	<20-23	<20-41	<20-42	<20-41	<20-36	<20-28	<20-31	<20-26	<20-44	<20-29	<20-38	<20-44
12	Dump truck	<20-22	<20-40	<20-41	<20-40	<20-35	<20-27	<20-30	<20-25	<20-43	<20-28	<20-37	<20-43
13	Water truck	<20-21	<20-39	<20-40	<20-39	<20-34	<20-26	<20-29	<20-24	<20-42	<20-27	<20-36	<20-42
Up to 3 (noisiest) plant operating concurrently		<20-30	<20-48	<20-49	<20-49	<20-44	<20-36	<20-38	<20-33	<20-52	<20-37	<20-45	<20-52
Mechanical/electrical construction works													
14	Piling rig	<20-31	<20-49	<20-50	<20-49	<20-44	<20-36	<20-39	<20-34	<20-52	<20-37	<20-46	<20-52
15	Drilling rig	<20-29	<20-47	<20-48	<20-47	<20-42	<20-34	<20-37	<20-32	<20-50	<20-35	<20-44	<20-50
16	Mobile crane	<20-27	<20-45	<20-46	<20-45	<20-40	<20-32	<20-35	<20-30	<20-48	<20-33	<20-42	<20-48
17	Flatbed truck	<20-22	<20-40	<20-41	<20-40	<20-35	<20-27	<20-30	<20-25	<20-43	<20-28	<20-37	<20-43
18	Hand tools	<20	<20-35	<20-36	<20-35	<20-30	<20-22	<20-25	<20-20	<20-38	<20-23	<20-32	<20-38
19	Forklift	<20	<20-25	<20-26	<20-25	<20-20	<20	<20	<20	<20-28	<20	<20-22	<20-28
20	Ute	<20	<20-23	<20-24	<20-23	<20	<20	<20	<20	<20-26	<20	<20-20	<20-26
Up to 3 (noisiest) plant operating concurrently		<20-34	<20-52	<20-53	<20-52	<20-47	<20-39	<20-42	<20-37	<20-55	<20-40	<20-49	<20-55

Based on the predicted construction noise levels presented in the table above, the construction management levels will be exceeded when works are conducted at the closest proximity and when the three noisiest plant items are operating concurrently, for Receivers R2, R3, R4, R14, R44b and R44c by up to 10 dB(A). It is noted that R44b and R44c are possible future residences and may not be built and occupied during the construction phase of the Project. Predicted construction noise levels at all other receivers will comply with the construction management levels.

Furthermore, construction noise levels at all receivers are predicted to be below the highly noise affected level of 75 dB(A).

It should be noted that the exceedances predicted are based on the loudest plant and equipment or the three loudest plant and equipment operating concurrently and at a location closest to the corresponding receiver location. This scenario would not typically occur on site.

For Receivers R2, R3, R4, R14, R44b and R44c, it is expected that exceedance of the noise management level would likely occur when the construction works are conducted within approximately 700 m of the dwelling / building. Construction works conducted within approximately 700 m of the dwelling / building would typically be completed over two to three days. Construction works conducted beyond 700 m of the dwelling / building of Receivers R2, R3, R4, R14, R44b and R44c would comply with the noise management level. In light of the short duration of predicted noise exceedances, it is recommended that a feasible and reasonable approach towards noise management measures be applied, in consultation with the potentially affected residents.

5.3. Road traffic noise assessment

The peak daily vehicle movements during the construction stage of the Project have been estimated to be:

Light Vehicle	107
MRV/HRV	13
AV/B-Double	47
Total	**167**

Vehicle movements will only occur during the daytime period when construction works occur.

Table 5-3 Predicted road traffic noise contribution levels along public roads, dB(A).

Receiver	Road	Criteria	Traffic movements	Speed (km/h)	Distance to Road	Predicted Noise Level	Comply? (Yes/No)
Residences on Great Western Highway	Arterial	$L_{Aeq,\ (15\ hour)}$ 60	refer to above	100	20m	56 dB(A)	Yes

From Table 5-3 it can be seen that road traffic noise level contributions from the truck movements associated with the construction works are at least 4dB(A) below the applicable noise criteria based on dwellings being 20 m from the road. Therefore, traffic noise levels as a result of the construction works for the solar farm would not adversely contribute to the existing traffic noise levels at the most affected residences along the surrounding roads and require no specific mitigation.

6. Mitigation measures

6.1. Construction hours

Standard construction hours would be adhered to unless safety justifies work outside these times:

- Monday to Friday 7am to 6pm,
- Saturday 8am to 1pm,
- No work on Sundays or Public Holidays.

6.2. Consultation

Consultation would occur as part of noise management including:

- The construction contractor would establish contact with residents affected by construction noise and communicate the construction program and progress on a regular basis, particularly when noise generating activities are planned.
- Communication with the local community would be maintained throughout the construction period.
- The construction contractor would provide a community liaison phone number and permanent site contact so that noise complaints can be received and addressed in a timely manner.
- Upon receipt of a noise complaint, monitoring would be undertaken and reported as soon as possible. If exceedances are detected, the situation would be reviewed to identify means to attempt to reduce the impact to acceptable levels.

Where noise level exceedances cannot be avoided, consideration must be given to providing periods of repose for residents in negotiation with the residents.

6.3. Engineering noise controls

Implementation of noise control measures, such as those suggested in Australian Standard 2436-2010 “Guide to Noise Control on Construction, Demolition and Maintenance Sites”, are expected to reduce predicted construction noise levels.

Appendix A presents noise control methods, practical examples and expected noise reductions according to AS2436 and according to Renzo Tonin & Associates’ opinion based on experience with past projects. Additionally Appendix A identifies possible noise control measures, which are applicable for the construction plant likely to be used on site.

These will be considered during the procurement of plant and equipment for construction and during construction works.

6.4. Respite periods

Where noise level exceedances cannot be avoided, then consideration may be given to providing periods of repose for residents, where feasible and reasonable.

Some items of plant may exceed noise limits even after noise treatment is applied. To reduce the overall noise impact, the use of noisy plant may be restricted to within certain time periods, where

feasible and reasonable and to be negotiated with the residents. For example, between 10am and 3pm (with one-hour break for lunch between 12pm and 1pm), noisy activities could occur with no noise level restrictions over a limited time period. Residents would be notified of the potential noise impact during this time period so that they can organise their day around the noisy period. Allowing the construction activities to proceed, despite the noise exceedance may be the preferred method in order to complete the works expeditiously.

6.5. Noise management and mitigation measures

Table 6-1 below outlines general mitigation measures to be implemented during construction. The measures include:

- Training.
- Physical noise controls.
- Minimisation measures.

These mitigation measures come from the following documents:

- Project Construction and Operational Noise and Vibration Assessment (Renzo Tonin and Associates (2022)
- Project EIS (NGH, 2022)
- ICNG (DECC, 2009)
- RNP (DECCW, 2011)

As noted, this plan would need to be updated prior to implementation to address any Project conditions of consent and final mitigation measures.

Table 6-1 Noise mitigation measures

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
General					
NMP01	Training will be provided to all Project personnel, including relevant sub-contractors on noise management practices and the requirements from this plan through inductions, toolboxes, and targeted training	Induction package Toolbox training material Targeted training material	Pre-construction Construction	Elgin Energy Pty Ltd Contractors	RNP ICNG
NMP02	A noise management plan would be prepared and implemented as part of the CEMP.	Personnel	Pre-construction	Elgin Energy Pty Ltd Contractors	EIS N3
Work hours					
NMP03	Standard construction hours would be adhered to unless safety justifies work outside these times: • Monday to Friday 7am to 6pm, • Saturday 8am to 1pm, • No work on Sundays or Public Holidays.		Pre-construction Construction	Elgin Energy Pty Ltd Contractors	ICNG
Plant and equipment					
NMP04	Once the selection of equipment has been finalised, a review should be undertaken to ensure that the noise levels do not exceed the assumed	Procurement Noise consultants	Pre-construction	Elgin Energy Pty Ltd Contractors	N2

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	levels in this assessment.				
NMP05	Bored piling (rather than impact piling) would be considered if practical, as an alternative to install the steel post foundations.		Pre-construction	Elgin Energy Pty Ltd Contractors	N3
NMP06	Where possible less noisy plant and equipment will be used.	Procurement Noise consultants	Pre-construction	Elgin Energy Pty Ltd Contractors	N5
NMP07	Where practicable, noise generating equipment will be strategically positioned to take advantage of natural screening from geographical features or other structures to reduce the transmission of noise between work sites and receiver locations		Pre-construction Construction	Elgin Energy Pty Ltd Contractors	RNP ICNG
NMP08	All construction plant and equipment used on the site will be, in addition to other relevant requirements: • Fitted with properly maintained noise suppression devices in accordance with the manufacturer's specifications • Maintained in an efficient condition including exhaust systems • Operated in a proper and efficient manner Machines found to produce excessive noise compared to industry best practice would be removed from the site or stood down until repairs	Personnel Inspection forms Maintenance records	Pre-construction Construction	Elgin Energy Pty Ltd Contractors	RNP ICNG N5

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	or modifications can be made.				
NMP09	Avoid, when possible, the use of engine compression brakes	Procurement Availability of plant and equipment	Pre-construction Construction	Elgin Energy Pty Ltd Contractors	RNP
NMP10	Preference will be given to hydraulic and electric powered plant over combustion engine or pneumatic powered plant, when possible	Procurement Availability of plant and equipment	Pre-construction Construction	Elgin Energy Pty Ltd Contractors	ICNG
NMP11	Use of broadband reversing alarms, or “quackers”, on mobile equipment in accordance with the relevant health and safety regulations	Procurement	Construction	Elgin Energy Pty Ltd Contractors	N5 ICNG
Behaviour controls					
NMP12	Workers should avoid shouting, using loud radios, throwing materials, using horns for signalling, warming up plant, and slamming vehicle doors	Personnel	Construction	Elgin Energy Pty Ltd Contractors	ICNG N5
NMP13	Plan traffic flow, parking, and loading/unloading areas to minimise reversing movements within the site	Personnel Traffic Management Plan	Construction	Elgin Energy Pty Ltd Contractors	RNP N5
NMP14	Where practical, machines would be operated at low speed or power and switched off when not being used rather than left idling for prolonged		Construction	Elgin Energy Pty Ltd Contractors	RNP N5

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	periods				
NMP15	Avoid any unnecessary noise when carrying out manual operations and when operating plant.N5		Construction	Elgin Energy Pty Ltd Contractors	N5
NMP16	Where possible, materials dropped from heights into or out of trucks will be minimised	Personnel	Construction	Elgin Energy Pty Ltd Contractors	N5
NMP17	Metal to metal contact on material will be avoided where possible.	Personnel	Construction	Elgin Energy Pty Ltd Contractors	N5
NMP18	Plan worksites and activities to minimise noise and vibration. Place as much distance between plant or equipment and sensitive receivers.	Personnel Worksite plan	Construction	Elgin Energy Pty Ltd Contractors	Best practice RNP ICNG
NMP19	Keeping engine covers closed while equipment is operating.	Personnel	Construction	Elgin Energy Pty Ltd Contractors	N5
NMP20	Workers will be using Project nominated UHF/VHF radio channels for Project communications and vehicle call outs. Workers will remain respectful of other users and the system, and only engage in work relevant communications.	Personnel	Construction	Elgin Energy Pty Ltd Contractors	Best practice
Traffic and access					

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
NMP21	Keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (for example, minimising the use of engine brakes, and no extended periods of engine idling)	Traffic Management Plan Driver induction	Pre-construction Construction	Elgin Energy Pty Ltd Contractors	N5 RNP ICNG
NMP22	Where possible, amalgamate deliveries to reduce traffic numbers and congestion.	Traffic Management Plan Driver induction	Pre-construction Construction	Elgin Energy Pty Ltd Contractors	RNP ICNG

7. Compliance management

7.1. Training

All site personnel will undergo the site induction training relating to noise management issues. The induction training will address elements related to noise management including:

- Existence and requirements of this NMP.
- Relevant legislation.
- Standard construction working hours.
- Location of sensitive receivers.
- Roles and responsibilities for noise management.
- Noise mitigation and management measures.

7.2. Monitoring and inspections

The aim of a monitoring procedure is to ensure works are being carried out in accordance with the NMP.

Regular onsite inspections will be undertaken to identify:

- Equipment has quality mufflers installed.
- Equipment is well maintained and fitted with adequately maintained silencers which meet the design specifications.
- Silencers and enclosures are intact and closed, rotating parts are balanced, loose bolts are tightened, frictional noise is reduced through lubrication and cutting noise reduced by keeping equipment sharp.
- Site personnel are using only necessary power to complete the task.
- Plant and equipment that is noisier than other similar machines.
- Care is being taken to place material in trucks rather than being dropped.
- Plant emitting noise strongly in one direction is orientated so that the noise is directed away from noise sensitive areas if practicable.
- Machines that are used intermittently are being shut down in the intervening periods between works or throttled down to a minimum.

Noise monitoring may be required in response to a compliant or ensure compliance with noise management levels. Noise monitoring will be undertaken by an Acoustic Consultant or the Environmental Site Representative during the construction phase of the Project.

7.3. Complaints Resolution

The aim of the complaints resolution process is to respond promptly to complaints, identify any feasible and reasonable measures that may further reduce impacts following a complaint, and to provide feedback to the community on the above process within a reasonable timeframe.

The proponent would:

- Take prompt and direct actions to develop good relations with people living and working in the vicinity of a construction site at the beginning of a Project and this would be maintained throughout the Project, as this is of paramount importance.

- Keep people living and working in the vicinity of a construction site informed of progress.
- Appoint a person to liaise with the community who is adequately trained and experienced in such matters.

The complaints resolution process should implement the following noise elements:

- Establishment of a complaints mechanisms for the community via either telephone or email.
- Notification of the relevant Project contact details through the community consultation process.
- Take all complaints seriously and deal with them expeditiously.
- Assess whether the issue can be resolved easily and take immediate action if possible.
- If not, ensures that the appropriate consultation has been undertaken for the activity.
- Ensures the on-site inspections of the NMP have been carried out regularly for the activity.
- Assesses the construction site and activities to determine whether there is any reason to believe the noise exposure of receivers is higher than anticipated.
- Undertake monitoring of noise levels where this cannot be confirmed, with the aim of establishing if the exposure of receivers is higher than anticipated by the NMP.
- Take remedial action if any of the above cannot be confirmed.
- Advise of complainant of action taken.
- Maintain a record of the above to enable review by an independent authority such as EPA.

8. Review and improvement

8.1. Continuous improvement

Continuous improvement of this Plan will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets for the purpose of identifying opportunities for improvement.

The continuous improvement process will be designed to:

- Identify areas of opportunity for improvement of environmental management and performance
- Determine the cause or causes of non-conformances and deficiencies
- Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies
- Verify the effectiveness of the corrective and preventative actions
- Document any changes in procedures resulting from process improvement
- Make comparisons with objectives and targets.

8.2. NMP Update and amendment

Changes to the Project may result in the need to update or revise this Plan. This will occur as needed.

Only the Environmental Site Representative, or delegate, has the authority to change any of the environmental management documentation.

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure.

9. Conclusion

Renzo Tonin and Associates (2022) has completed an environmental noise and vibration assessment of the proposed Glanmire Solar Farm. Noise emissions from the construction phase of the Project were predicted to exceed the construction noise management levels at the nearest affected receivers in limited situations, modelled on a worst case scenario basis. The assessment did not identify any highly affected receivers.

Feasible and reasonable noise control solutions to reduce noise impacts to sensitive receivers are included in this draft NMP and will be implemented specifically to address modelled exceedances R2, R3, R4, R14, R44b and R44c, as well as the overall noise management of the construction site.

The draft NMP provides a framework document that the construction contractor can use to develop and implement action plans for each individual construction activities. It has been prepared in advance of the detailed design, to demonstrate the framework for noise management during construction and would be updated prior to implementation.

10. References

AS 2436, 2010, *Guide to noise and vibration control on construction, demolition and maintenance sites*, Standards Australia.

DECC, 2009, *Interim Construction Noise Guideline*, Department of Environment, Climate Change and Water, Sydney, New South Wales.

DECCW, 2011, *NSW Road Noise Policy,* Department of Environment, Climate Change and Water, Sydney, New South Wales.

NGH, 2022, *Environmental Impact Statement Glanmire Solar Farm*. Prepared for Elgin Energy Pty Ltd.

Renzo Tonin and Associates, 2022, Construction and Operational Noise and Vibration Assessment *Glanmire Solar Farm*. Prepared for Elgin Energy Pty Ltd.

APPENDIX A EFFECTIVENESS OF NOISE CONTROLS

Sourced from Renzo Tonin and Associates (2022) Construction and Operational Noise and Vibration Assessment *Glanmire Solar Farm.*

Implementation of noise control measures, such as those suggested in Australian Standard 2436-2010 “Guide to Noise Control on Construction, Demolition and Maintenance Sites”, are expected to reduce predicted construction noise levels. Reference to Australian Standard 2436-2010, Appendix C, Table C1 suggests possible remedies and alternatives to reduce noise emission levels from typical construction equipment. Table C2 in Appendix C presents typical examples of noise reductions achievable after treatment of various noise sources. Table C3 in Appendix C presents the relative effectiveness of various forms of noise control treatment.

Table 10-1 below presents noise control methods, practical examples and expected noise reductions according to AS2436 and according to Renzo Tonin & Associates’ opinion based on experience with past projects. The Renzo Tonin & Associates’ listed noise reductions are conservatively low and should be referred to in preference to those of AS2436.

Table 10-2 below identifies possible noise control measures, which are applicable for the construction plant likely to be used on site.

Table 10-1 Relative Effectiveness of Various Forms of Noise Control, dB(A)

Noise control method	Practical examples	Typical noise reduction possible in practice		Maximum noise reduction possible in practice	
		AS 2436	Renzo Tonin & Associates	AS 2436	Renzo Tonin & Associates
Distance	Doubling of distance between source and receiver	6	6	6	6
Screening	Acoustic barriers such as earth mounds, temporary or permanent noise barriers	5 to 10	5 to 10	15	15
Acoustic Enclosures	Engine casing lagged with acoustic insulation and plywood	15 to 25	10 to 20	50	30
Engine Silencing	Residential class mufflers	5 to 10	5 to 10	20	20
Substitution by alternative process	Use electric motors in preference to diesel or petrol	-	15 to 25	-	40

Table 10-2 Noise Control Measures for Likely Construction Plant

Plant description	Screening	Acoustic enclosures	Silencing	Alternative process
Dozer	✔	x	✔	x
Grader	✔	x	✔	x
Excavator	✔	x	✔	x
Roller	✔	x	✔	x
Bobcat	✔	x	✔	x
Front End Loader	✔	x	✔	x
Road truck (delivers	✔	x	✔	x
Concrete truck	✔	x	✔	x
Drilling Rig	✔	✔	✔	x
Crane	✔	x	✔	x