

APPENDIX H NOISE ASSESSMENT

OXLEY SOLAR FARM

Construction & Operational Noise & Vibration Assessment

22 February 2021

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1 Introduction

Renzo Tonin & Associates was engaged to conduct an environmental noise and vibration assessment of the proposed Oxley Solar Farm, located approximately 14 km south-east of Armidale in New South Wales (NSW), 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 Oxley Solar Farm project includes the construction and operation of a solar photovoltaic (PV) plant and associated infrastructure, with a capacity of approximately 225 MW. The subject site is located north and south of Gara Road, just west of the intersection with Silverton Road, approximately 14 km south-east of Armidale in NSW, within the Armidale Regional Council Local Government Area (LGA). Silverton Road runs south from Waterfall Way which connects Armidale to the coast.

Key development and infrastructure components would include:

- Approximately 715,000 PV solar panels mounted on either fixed or tracking systems, both of which are considered feasible.
 - Fixed-tilted structures in a north orientation at an angle of 32 degrees; or
 - East-west horizontal tracking systems.
- Approximately 45 power control units (PCU) composed of two inverters, a transformer and associated control equipment to convert DC energy generated by the solar panels to 33kV AC energy.
- Steel mounting frames with driven or screwed pile foundations.
- An onsite 132kV substation containing two transformers and associated switchgear to facilitate connection to the national electricity grid via the existing 132kV transmission line onsite.
- Underground power cabling to connect solar panels, combiner boxes and PCUs.
- Underground auxiliary cabling for power supplies, data services and communications.
- Buildings to accommodate a site office, 33kV switchgear, protection and control facilities, maintenance facilities and staff amenities.
- About 1km of access track off Waterfall Way to the site which would require construction to the proposed onsite substation site.
- Internal access tracks for construction, operation and maintenance activities.
- An energy storage facility with a capacity of up to 30 MWh (ie. 30 MW power output for one hour) and comprising of lithium ion batteries with inverters.
- Perimeter security fencing up to 2.3m high.
- Native vegetation planting to provide visual screening for specific receivers, if any are required.

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

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 2.1.

Table 2.1 – Receiver Locations

| ID | Address | Description |
|-----|----------------------------------|--|
| R3 | 686 Gara Road, Metz | Residential property located approximately 185m west of the development area |
| R4 | 111 Blue Hole Road, Castle Doyle | Residential property located approximately 310m west of the development area |
| R5 | 445 Silverton Road Metz | Residential property located approximately 320m east of the development area |
| R6 | 8 Argyle-Mining Vale Road, Metz | Residential property located approximately 950m north-east of the development area |
| R7 | 109 Blue Hole Road, Castle Doyle | Residential property located approximately 610m west of the development area |
| R8 | 52 Argyle-Mining Vale Road, Metz | Residential property located approximately 900m north-east of the development area |
| R9 | 1392 Grafton Road, Metz | Residential property located approximately 800m east of the development area |
| R10 | 597 Gara Road, Metz | Residential property located approximately 760m west of the development area |
| R11 | 692 Silverton Road, Metz | Residential property located approximately 720m east of the development area |
| R13 | 761-765 Silverton Road, Metz | Residential property located approximately 780m west of the development area |

| ID | Address | Description |
|-----|------------------------------------|---|
| R17 | 1060 Grafton Road, Metz | Residential property located approximately 2,300m east of the development area |
| R22 | 771 Silverton Road, Metz | Residential property located approximately 1,450m south of the development area |
| R26 | 1474 Castledoye Road, Castle Doyle | Residential property located approximately 1,600m south of the development area |

Figure 1 provides details of the site, surrounds and receiver locations.

2.4 Hours of Operation

2.4.1 Construction

The construction phase of the proposal 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

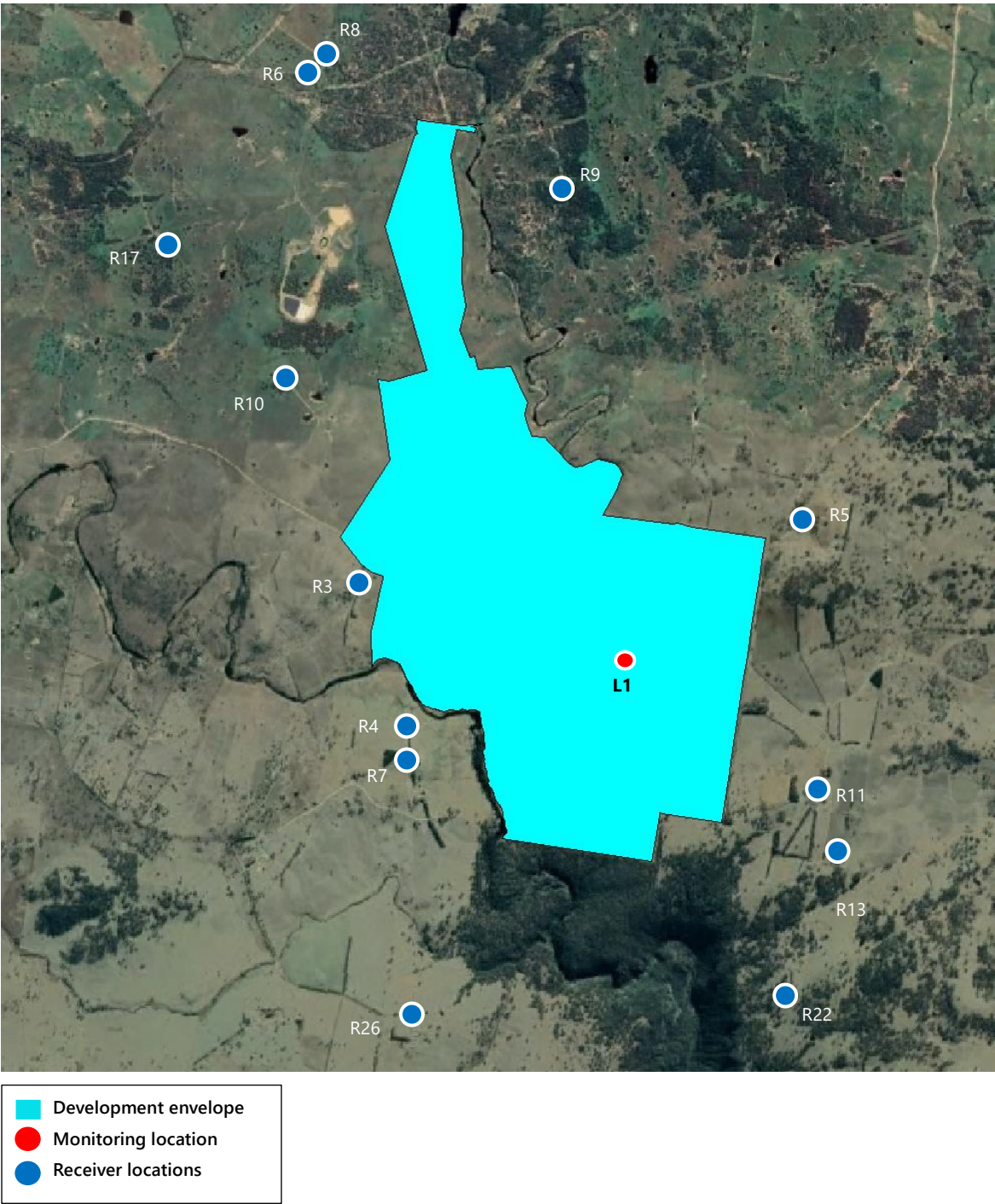
2.4.2 Operation

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



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.

3.1 Noise Monitoring Location

Noise monitoring is to be undertaken at the nearest or potentially most affected receiver locations; or if this is not available, then at a location considered to have a noise environment representative of the nearest or potentially most affected receiver locations. In this case the representative location where noise monitoring was undertaken is presented in Table 3.1.

Table 3.1 – Noise Monitoring Location

| ID | Address | Description |
|----|---------------------|--|
| L1 | 914 Gara Road, Metz | Noise monitor was installed in the 'free field' (ie. away from building facades) on the subject site. Noise data represents the background and ambient noise environment for receivers surrounding the project area. |

To quantify the existing ambient noise environment, long-term (unattended) noise monitoring was conducted at Location L1 between Monday 4th and Thursday 21st May 2020.

Appendix A of this report presents a description of noise terms. Appendix B details the noise monitoring methodology and the graphical recorded outputs from long term noise monitoring are included in Appendix C. The graphs in Appendix C were analysed to determine an assessment background level (ABL) for each day, evening and night period in each 24 hour period of noise monitoring, and based on the median of individual ABLs an overall single Rating Background Level (RBL) for the day, evening and night period is determined over the entire monitoring period in accordance with the NPfI.

3.2 Existing Background & Ambient Noise Levels

Existing background and ambient noise levels are presented in Table 2.1 below. The noise monitor was positioned outdoors in the 'free-field' (ie. away from building facades). Construction and operation

noise from the site should be assessed in the free-field at the potentially most affected residential boundaries and therefore, the representative noise levels listed in Table 2.1 are directly applicable.

Table 3.2 – Measured Existing Background (L_{90}) & Ambient (L_{eq}) Noise Levels, dB(A)

| Location | L_{90} Background Noise Levels | | | L_{eq} Ambient Noise Levels | | |
|--------------------------|----------------------------------|---------|-------|-------------------------------|---------|-------|
| | Day | Evening | Night | Day | Evening | Night |
| L1 – 914 Gara Road, Metz | 24 | 22 | 20 | 45 | 32 | 38 |

The identified receivers surrounding the subject site are all classified as rural under NPfl guidelines. It was found that the background noise levels were typical for a rural area.

Based on Table 2.1 on page 10 of the NPfl, where background noise levels are less than the minimum assumed RBLs of 35dB(A) during the day period, 30dB(A) during the evening period and 30dB(A) during the night period, the minimum assumed RBL's are adopted instead for all receiver locations nominated in Table 3.2. Therefore, the background noise levels have been set at the levels detailed in the fourth column of Table 3.3 below.

Table 3.3 – Applicable RBL, dB(A)

| Time of Day | Measured Existing Background (L_{90}), dB(A) | Minimum RBLs, dB(A) ¹ | Applicable RBL, dB(A) |
|-------------|--|----------------------------------|-----------------------|
| Day | 24 | 35 | 35 |
| Evening | 22 | 30 | 30 |
| Night | 20 | 30 | 30 |

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

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 NPfl, 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 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays | Noise affected RBL + 10dB(A) | The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq(15\text{ min})}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details. |
| | Highly noise affected 75dB(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: <ul style="list-style-type: none"> • 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 + 5dB(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 2.1, 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 Noise Management Level $L_{Aeq(15\text{min})}$ |
|---------------------------|--|--|
| 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) |
|------------|------------------------|-----------------|--|
| 1 | Small pile driving rig | 6 | 114 |
| 2 | Crane | 2 | 110 |
| 3 | Drum roller | 2 | 109 |
| 4 | Padfoot roller | 2 | 109 |
| 5 | Wheeled loader | 2 | 109 |
| 6 | Dump truck | 4 | 108 |
| 7 | 30t Excavator | 8 | 107 |
| 8 | Grader | 4 | 107 |
| 9 | Chain trencher | 2 | 104 |
| 10 | Water truck | 4 | 104 |
| 11 | Telehandler | 4 | 98 |
| 12 | Forklift | 4 | 90 |

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 2020 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 proposed development site. 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 $L_{Aeq,15min}$ Construction Noise Levels at Receiver Locations, dB(A)

| Plant Item | Plant Description | Predicted $L_{eq}(15min)$ Construction Noise Levels | | | | | | | | | | | | |
|---|------------------------|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | | R3 | R4 | R5 | R6 | R7 | R8 | R9 | R10 | R11 | R13 | R17 | R22 | R26 |
| Noise Management Level ¹ | | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 |
| 1 | Small pile driving rig | <20-55 | <20-45 | <20-39 | <20-42 | <20-40 | <20-41 | <20-40 | <20-34 | <20-41 | <20-29 | <20-34 | <20-29 | <20-45 |
| 2 | Crane | <20-51 | <20-41 | <20-35 | <20-38 | <20-36 | <20-37 | <20-36 | <20-30 | <20-37 | <20-25 | <20-30 | <20-25 | <20-41 |
| 3 | Drum roller | <20-50 | <20-40 | <20-34 | <20-37 | <20-35 | <20-36 | <20-35 | <20-29 | <20-36 | <20-24 | <20-29 | <20-24 | <20-40 |
| 4 | Padfoot roller | <20-50 | <20-40 | <20-34 | <20-37 | <20-35 | <20-36 | <20-35 | <20-29 | <20-36 | <20-24 | <20-29 | <20-24 | <20-40 |
| 5 | Wheeled loader | <20-50 | <20-40 | <20-34 | <20-37 | <20-35 | <20-36 | <20-35 | <20-29 | <20-36 | <20-24 | <20-29 | <20-24 | <20-40 |
| 6 | Dump truck | <20-49 | <20-39 | <20-33 | <20-36 | <20-34 | <20-35 | <20-34 | <20-28 | <20-35 | <20-23 | <20-28 | <20-23 | <20-39 |
| 7 | 30t Excavator | <20-48 | <20-38 | <20-32 | <20-35 | <20-33 | <20-34 | <20-33 | <20-27 | <20-34 | <20-22 | <20-27 | <20-22 | <20-38 |
| 8 | Grader | <20-48 | <20-38 | <20-32 | <20-35 | <20-33 | <20-34 | <20-33 | <20-27 | <20-34 | <20-22 | <20-27 | <20-22 | <20-38 |
| 9 | Chain trencher | <20-45 | <20-35 | <20-29 | <20-32 | <20-30 | <20-31 | <20-30 | <20-24 | <20-31 | <20-19 | <20-24 | <20-19 | <20-35 |
| 10 | Water truck | <20-45 | <20-35 | <20-29 | <20-32 | <20-30 | <20-31 | <20-30 | <20-24 | <20-31 | <20-19 | <20-24 | <20-19 | <20-35 |
| 11 | Telehandler | <20-39 | <20-29 | <20-23 | <20-26 | <20-24 | <20-25 | <20-24 | <20-18 | <20-25 | <20-13 | <20-18 | <20-13 | <20-29 |
| 12 | Forklift | <20-31 | <20-21 | <20-15 | <20-18 | <20-16 | <20-17 | <20-16 | <20-10 | <20-17 | <20-5 | <20-10 | <20-5 | <20-21 |
| Up to 3 (noisiest) plant operating concurrently | | <20-57 | <20-47 | <20-48 | <20-41 | <20-45 | <20-42 | <20-44 | <20-43 | <20-36 | <20-43 | <20-31 | <20-36 | <20-32 |

Notes: 1. Bold font represents exceedance of the NML

Based on the predicted construction noise levels presented in the table above, the construction management level will be exceeded when works are conducted at the closest proximity and/or when the three noisiest plant items are operating concurrently, to Receivers R3, R4 and R5 by up to 12dB(A). Predicted construction noise levels at all other receivers will comply with the construction management level.

Furthermore, construction noise levels at all receivers are predicted to be below the highly noise affected level of 75dB(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 R3, R4 and R5, it is expected that exceedance of the noise management level would likely occur when the construction works are conducted within approximately 700m of the dwelling / building. Construction works conducted within approximately 700m of the dwelling / building would typically be completed over two to three days. Construction works conducted beyond 700m of the dwelling building of Receivers R3, R4 and R5 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 700m of the dwelling building of R3, R4 and R5, 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.

5 Operational Noise Assessment

5.1 Operational Noise Criteria

Noise impact from the general operation of the proposed solar farm 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 $L_{Aeq,15min}$ descriptor) does not exceed the background noise level measured in the absence of the source by more than 5dB(A). The project intrusiveness noise level, which is only applicable to residential receivers, is determined as follows:

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

Based on the RBLs set in Table 3.3, the intrusiveness noise level for the residential receivers are determined in Table 5.1.

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

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

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:

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

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.

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

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 ($L_{Aeq, 15min}$) 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 | |
|------------------|-------------------------------|-------------|-------------------------|------------------|
| | | | $L_{Aeq, Period}$ | $L_{Aeq, 15min}$ |
| 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 |
| R3 | 686 Gara Road, Metz | 40 | 35 | 35 |
| R4 | 111 Blue Hole Road, Castle Doyle | 40 | 35 | 35 |
| R5 | 445 Silverton Road Metz | 40 | 35 | 35 |
| R6 | 8 Argyle-Mining Vale Road, Metz | 40 | 35 | 35 |
| R7 | 109 Blue Hole Road, Castle Doyle | 40 | 35 | 35 |
| R8 | 52 Argyle-Mining Vale Road, Metz | 40 | 35 | 35 |
| R9 | 1392 Grafton Road, Metz | 40 | 35 | 35 |
| R10 | 597 Gara Road, Metz | 40 | 35 | 35 |
| R11 | 692 Silverton Road, Metz | 40 | 35 | 35 |
| R13 | 761-765 Silverton Road, Metz | 40 | 35 | 35 |
| R17 | 1060 Grafton Road, Metz | 40 | 35 | 35 |
| R22 | 771 Silverton Road, Metz | 40 | 35 | 35 |
| R26 | 1474 Castledoyle Road, Castle Doyle | 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

The proposed solar farm considers two options for the configuration of the PV panels:

1. Fixed configuration, where the panels would be placed on fixed frames running in rows from east to west and tilted to the north; or
2. Single axis tracking, where the panels would be in rows configured in a north to south direction and the panels would track the sun from east to west throughout the day.

The single axis tracking system involves the panels being driven by motors to track the arc of the sun to maximise the solar effect. Hence, the tracking motors are a potential source of mechanical noise and therefore, has been included for a more conservative assessment. Up to a total of 9,300 tracking units (ATI DuraTrack Tracker or equivalent) will be to be evenly distributed across the solar farm area.

In addition to the trackers, the site will require the operation of up to 45 PCUs (SMA MV Power Station or equivalent) with each PCU containing two (2) inverters and one (1) transformer, which will be evenly distributed across the solar farm area.

A new substation will also be located in on the site. The dominant noise source from the new substation will be from two (2) 100MVA transformers (generic brand). There will also be a battery storage system (generic brand) located in this area.

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 proposed solar farm 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 | Tracker motor (9,300 in total) | 81 (each) ¹ |
| 2 | PCU inverter (90 in total) | 88 (each) ¹ |
| 3 | PCU transformer (45 in total) | 83 (each) ¹ |
| 4 | Substation transformer (2 in total) | 96 (each) ¹ |
| 5 | Battery storage unit | 87 (each) ¹ |
| 6 | Light vehicle (5 in total) | 88 (each) ¹ |

Notes: 1. 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, 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 NPfl, where the character of the noise in question is assessed as particularly annoying (ie. if it has an inherently tonal, low frequency, impulsive or intermittent characteristic), then an adjustment of 5dB(A) for each annoyance aspect, up to a total of 10dB(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 NPfl 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 5dB(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 2020 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).

Furthermore, in accordance with the NPfl noise predictions were prepared for each of the following meteorological conditions:

1. Calm & isothermal conditions (acoustically neutral) – no wind and no temperature inversion
2. Slight to gentle breeze – 3m/s wind velocity at 10m from ground level between each noise source and each noise receiver (as per NPfl 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

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 $L_{Aeq,15min}$ 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 | |
| Receiver R3 | 40 | 35 | 35 | 24 | 31 | 30 | Yes |
| Receiver R4 | 40 | 35 | 35 | 23 | 29 | 28 | Yes |
| Receiver R5 | 40 | 35 | 35 | 23 | 29 | 28 | Yes |
| Receiver R6 | 40 | 35 | 35 | <20 | <20 | <20 | Yes |
| Receiver R7 | 40 | 35 | 35 | 21 | 28 | 27 | Yes |
| Receiver R8 | 40 | 35 | 35 | <20 | <20 | <20 | Yes |
| Receiver R9 | 40 | 35 | 35 | 20 | 27 | 26 | Yes |
| Receiver R10 | 40 | 35 | 35 | 22 | 29 | 28 | Yes |
| Receiver R11 | 40 | 35 | 35 | 21 | 28 | 26 | Yes |
| Receiver R13 | 40 | 35 | 35 | <20 | 26 | 25 | Yes |
| Receiver R17 | 40 | 35 | 35 | <20 | 20 | 21 | Yes |
| Receiver R22 | 40 | 35 | 35 | <20 | 20 | <20 | Yes |
| Receiver R26 | 40 | 35 | 35 | <20 | <20 | <20 | Yes |

Notes: 1. Applicable for the night time period only

Based on the predicted operational noise levels presented in the table above, predicted noise levels at the nearest receivers comply with the nominated criteria under all scenarios and meteorological conditions.

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:

- $L_{Aeq,15min}$ 40dB(A) or the prevailing RBL plus 5dB, whichever is the greater, and/or
- L_{AFmax} 52dB(A) or the prevailing RBL plus 15dB, 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 $L_{Aeq,15min}$ noise levels shown in Table 5.5. Hence, it is expected that both the $L_{Aeq,15min}$ and L_{AFmax} will be well below the nominated sleep disturbance criteria of 40dB(A) and 52dB(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 185m 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

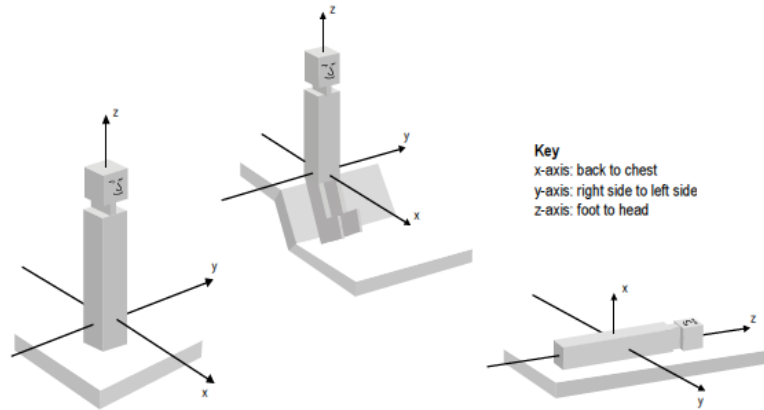
The vibration criteria are defined as a single weighted root mean square (rms) acceleration source level in each orthogonal axis. Section 2.3 of the guideline states:

"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 2. 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 2 – 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 Location | Approx. Distance to Nearest Buildings from Works | Type of Nearest Sensitive Buildings | Assessment on Potential Vibration Impacts | Vibration Monitoring |
|-------------------|--|-------------------------------------|---|----------------------|
| Receiver R3 | 185m | Residential | Very low risk of adverse comments | Not required |
| Receiver R4 | 310m | Residential | Very low risk of adverse comments | Not required |
| Receiver R5 | 320m | Residential | Very low risk of adverse comments | Not required |
| Receiver R6 | 950m | Residential | Very low risk of adverse comments | Not required |
| Receiver R7 | 610m | Residential | Very low risk of adverse comments | Not required |
| Receiver R8 | 900m | Residential | Very low risk of adverse comments | Not required |
| Receiver R9 | 800m | Residential | Very low risk of adverse comments | Not required |
| Receiver R10 | 760m | Residential | Very low risk of adverse comments | Not required |
| Receiver R11 | 720m | Residential | Very low risk of adverse comments | Not required |
| Receiver R13 | 780m | Residential | Very low risk of adverse comments | Not required |
| Receiver R17 | 2,300m | Residential | Very low risk of adverse comments | Not required |
| Receiver R22 | 1,450m | Residential | Very low risk of adverse comments | Not required |
| Receiver R26 | 1,600m | 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.

Two access points are proposed for site access, the Grafton Road Access being most suitable for heavy vehicles and the Gara Road access being limited to access by light vehicles. 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.

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

| Vehicle Type | Vehicle Movements Per Day (two-way) |
|--------------------|-------------------------------------|
| Semi-Trailers | 46 |
| B-Doubles | 4 |
| Oversized vehicles | 2 |
| Standard trucks | 10 |
| Water tankers | 30 |
| Buses | 40 |
| Cars | 60 |
| Total | 192 |

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, Grafton Road is categorised as an arterial road and Gara Road is categorised as a sub-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 7am – 10pm | Night 10pm – 7am |
| 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 hour) 60 (external) | L _{Aeq} (9 hour) 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 Grafton Road and Gara Road are unknown.

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

| Receiver | Criteria | Traffic Movements | Speed (km/h) ¹ | Distance to Road ² | Predicted Noise Level | Exceed? |
|----------------------------|--------------------------|-------------------------------|---------------------------|-------------------------------|-----------------------|---------|
| Residences on Grafton Road | L_{Aeq} , (15 hour) 60 | As per Table 7.1 ³ | 100 | 20m | 56 | No |
| Residences on Gara Road | L_{Aeq} , (15 hour) 60 | As per Table 7.1 ⁴ | 100 | 20m | 43 | No |

- Notes:
1. Based on posted speed limit
 2. Based on closest typical distance from facade of dwelling to the road
 3. Includes semi-trailers, B-doubles and oversized vehicles, standard trucks, water tankers and buses
 4. Includes cars

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 4dB(A) below the applicable noise criterion based on dwellings being 20m 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 20m.

Furthermore, as the predicted levels are 4dB(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 2dB(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 Oxley Solar Farm.

Noise emissions from the construction phase of the project were predicted to exceed the nominated criteria at the three (3) 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 the nearest affected receivers.

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 L _{eq} 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 Long Term Noise Monitoring Methodology

B.1 Noise Monitoring Equipment

A long-term unattended noise monitor consists of a sound level meter housed inside a weather resistant enclosure. Noise levels are monitored continuously with statistical data stored in memory for every 15-minute period.

Long term noise monitoring was conducted using the following instrumentation:

| Description | Type | Octave Band Data | Logger Location(s) |
|---------------------|--------|------------------|--------------------|
| RTA04 (CESVA SC310) | Type 1 | 1/1 | L1 |

Notes: All meters comply with AS IEC 61672.1 2004 "Electroacoustics - Sound Level Meters" and designated either Type 1 or Type 2 as per table, and are suitable for field use.

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

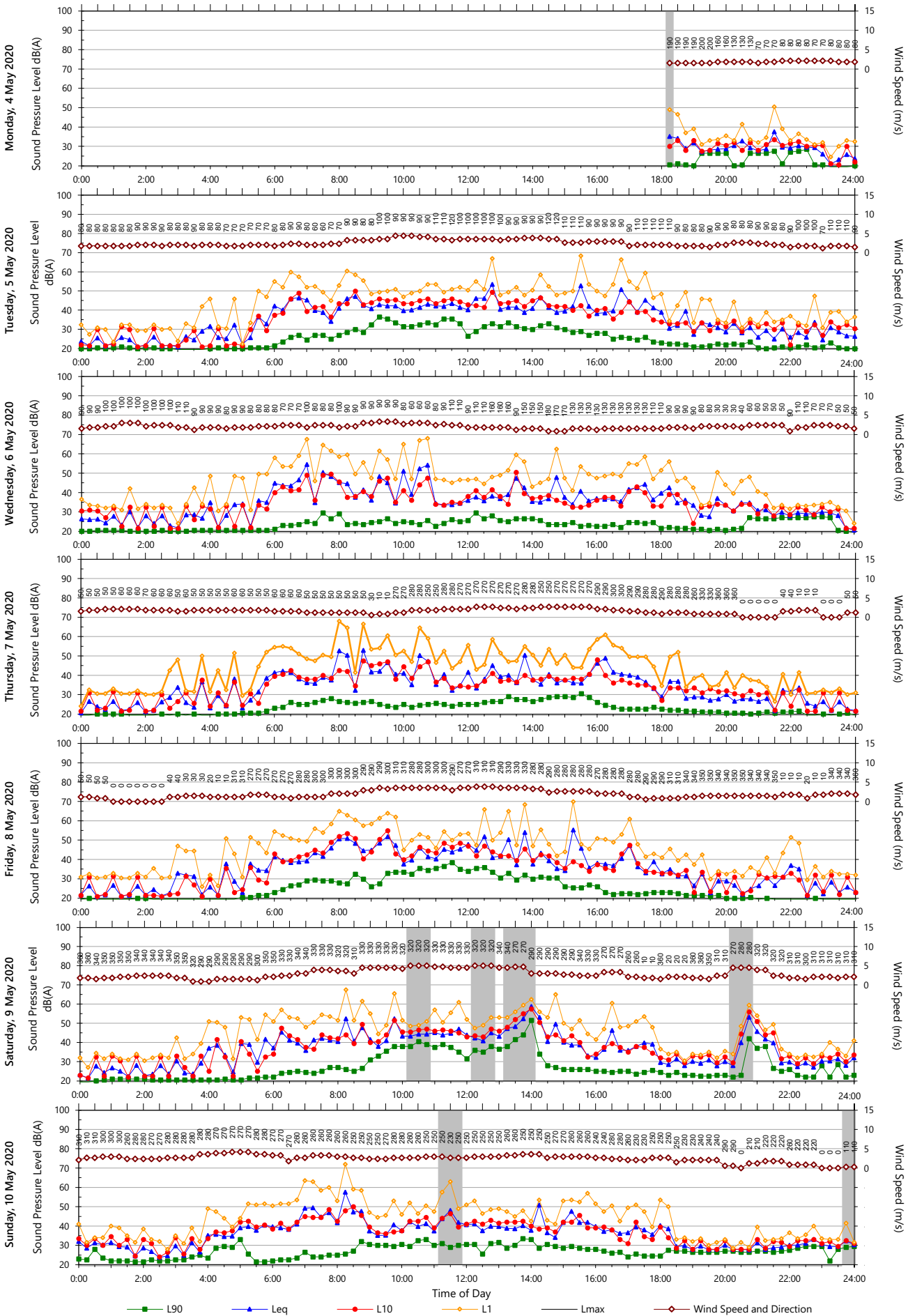
B.2 Meteorology During Monitoring

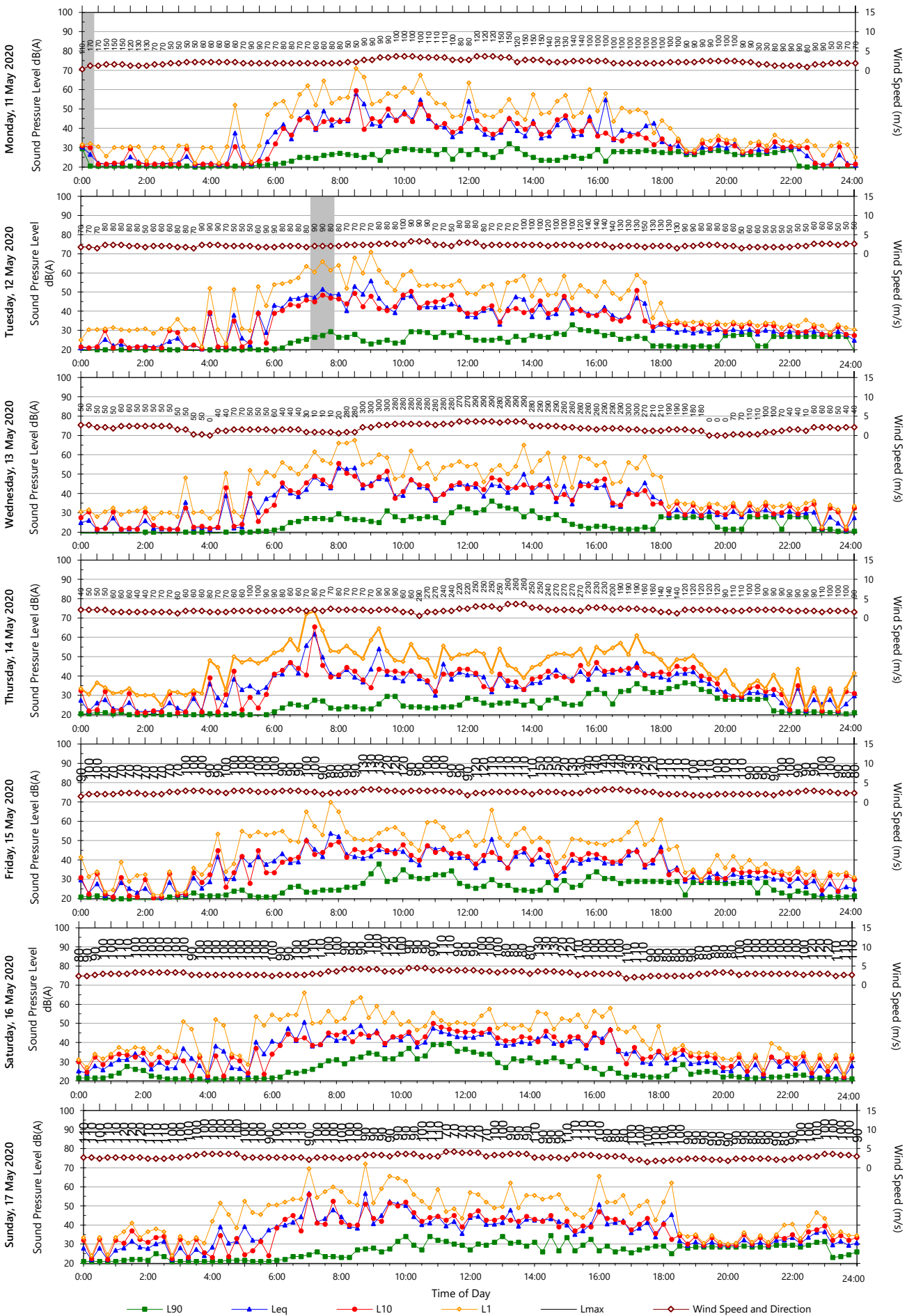
Measurements affected by extraneous noise, wind (greater than 5m/s) or rain were excluded from the recorded data in accordance with the NSW INP. Determination of extraneous meteorological conditions was based on data provided by the Bureau of Meteorology (BOM), for a location considered representative of the noise monitoring location(s). However, the data was adjusted to account for the height difference between the BOM weather station, where wind speed and direction is recorded at a height of 10m above ground level, and the microphone location, which is typically 1.5m above ground level (and less than 3m). The correction factor applied to the data is based on Table C.1 of ISO 4354:2009 '*Wind actions on structures*'.

B.3 Noise vs Time Graphs

Noise almost always varies with time. Noise environments can be described using various descriptors to show how a noise ranges about a level. In this report, noise values measured or referred to include the L_{10} , L_{90} , and L_{eq} levels. The statistical descriptors L_{10} and L_{90} measure the noise level exceeded for 10% and 90% of the sample measurement time. The L_{eq} level is the equivalent continuous noise level or the level averaged on an equal energy basis. Measurement sample periods are usually ten to fifteen minutes. The Noise -vs- Time graphs representing measured noise levels, as presented in this report, illustrate these concepts for the broadband dB(A) results.

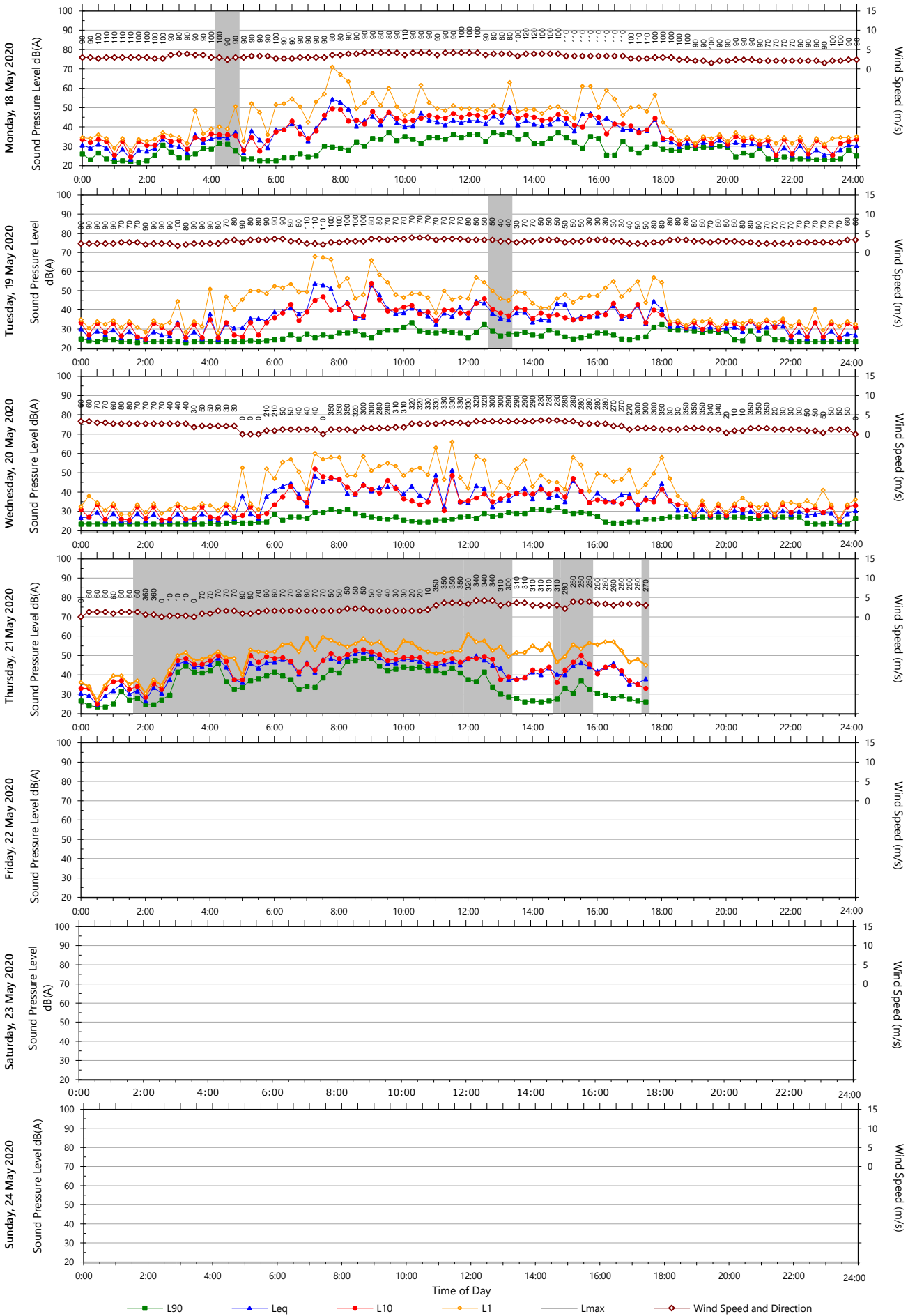
APPENDIX C Long Term Noise Monitoring Results





Unattended Monitoring Results

Location: Oxley Solar Farm



Data File: R:\AssocSydProjects\TL001-TL050\TL049 wc Oxley Solar Farm EIS\4 Field Work\Logger\2020-05-04_18-00-00_001_RTA.xls

Template: QTE-26 Logger Graphs Program (r31)