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Environmental Noise Impact Assessment
Proposed Mulwala Solar Farm

Savernake Road,

Mulwala, NSW 2647

Prepared for: -

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Attention: Mr. Chris Alderton

Reference: 1802011E- **FINAL.**

Prepared by: -

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Ray Walsh Acoustics, Noise and Sound in association with Harwood Acoustics, was requested by Mr. Chris Alderton, Senior Environmental Consultant of RPS Group Australia Asia Pacific, on behalf of ESCO Pacific Pty. Ltd to carry out a noise impact assessment of a proposed solar farm to be located at Savernake Road, Mulwala, NSW 2647.

Accordingly, Harwood Acoustics has prepared this report for the exclusive use of the Client identified on the title page. The report is prepared in accordance with the brief and scope of works agreed between the Client, Ray Walsh Acoustics, Noise and Sound and Harwood Acoustics and may not be suitable for use beyond that scope.

Ray Walsh Acoustics, Noise and Sound and Harwood Acoustics undertake no duty nor accept any responsibility to any third party who may rely upon this report.

Advice and recommendations provided in this report are in relation to acoustical issues only. No claims of expertise are made, and no liability is accepted, in relation to issues falling outside the field of acoustical consulting. These may include, but are not limited to, structural and waterproofing considerations, fire rating or thermal rating. Relevant authorities and / or experts should be consulted regarding areas other than acoustics.

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1. INTRODUCTION AND SUMMARY

ESCO Pacific Pty. Ltd. proposes to develop the Mulwala Solar Farm at Savernake Road, Mulwala, NSW (the Site).

The Site is located approximately 2 kilometres north of the township of Mulwala within the Federation Local Government Area and comprises agricultural / rural land of approximately 215 hectares in total.

The Site is bound to the east by Savernake Road, to the south and west by Tocumwal Road and to the north by agricultural land. There are clusters of residential receptors located to the south and south east of the Site and isolated residences located to the east and south west, as shown in Figure 1.

It is proposed to construct a utility scale renewable energy project, the 'Mulwala Solar Farm', at the Site that will generate up to 80 MW of electricity. The solar farm will comprise approximately 300,000 solar photovoltaic modules (known more commonly as solar panels). The solar panels will be installed on ground-mounted frames that will slowly track the horizontal daily movement of the sun.

The solar panels and tracking systems will be mounted in rows and electrically connected into arrays. A power conversion unit (PCU) within each array block will convert the DC electricity generated by the solar panels into AC electricity for connection into the electricity grid via a proposed solar substation. A more detailed description of the process, design and configuration is provided in Section 2.2 of this report.

The Secretary's Environmental Assessment Requirements (SEARS) supplied by the NSW Department of Planning and Environment and the NSW Environment Protection Authority require an Environmental Noise Impact Assessment is prepared to accompany the Environment Impact Statement.

Consideration is given to noise emission arising from the ongoing operational phase of the proposal as well as the construction phase.

Acceptable noise limits for the operational phase are derived from the EPA's Noise Policy for Industry 2017 project trigger levels at the nearest residences to the Site, based on the minimum Rating Background noise Levels (RBLs) prescribed in the Policy. Long-term background noise monitoring has not been undertaken at this Site at the request of the proponent, however it is reasonable to assume, given the rural location, that existing background noise levels would be in line with the minimum RBLs given in the Policy.

Project Noise Trigger Levels are therefore 40 dBA $L_{eq,\ 15\ minute}$ during the day, 35 dBA $L_{eq,\ 15\ minute}$ during the evening and 35 dBA $L_{eq,\ 15\ minute}$ at night.

Noise sources associated with the operational phase of the development are the considered to be: -

- NEXTracker motors for the tracking of the panels on the ground mounted frames;
- Inverter systems; and
- Transformer within the solar substation.

The tracking motors and inverter systems will operate during day light hours only and the transformer will operate 24 hours per day.

The selection of the number of items of plant and equipment and specific locations around the Site are not yet finalised and assumptions have been made in Section 5 of this report to undertake noise modelling.

A typical worst-case modelling scenario has been assumed with respect to the number and location of inverter systems. Based on this typical worst-case scenario modelling assumption, the project trigger levels derived from the EPA's Noise Policy for Industry 2017 will be met at all receptors in the proximity of the Site during the day time period.

There is potential for the project trigger level of 35 dBA during the daylight hours prior to 7.00 am and after 6.00 pm to be exceeded in this scenario by up to 5 dB at some receptor locations dependent on the season.

Recommendations are therefore made in Section 8 of this Report to ensure the project trigger levels are met at all receptors, at all times. These recommendations include locating the inverter systems at minimum distances from any given receptor and / or providing a reduction through noise controls such as enclosures or sound barrier screening.

A final assessment will be required once the layout of plant and equipment is finalised. In the event that further noise controls are required, they will not be onerous and the EPA's Noise Policy for Industry 2017 project trigger levels can easily be met for this proposal at all receptor locations.

The construction phase of the development will last up to eight (8) months and will include, site preparation works, potential piling for securing the ground mounted frames, installation of the solar panels, inverter systems and cabling and construction of the substation and administration building.

Calculations show that the level of noise emission from the construction phase will be within noise management levels set by the NSW EPA's *Interim Construction Noise Guideline 2009* at all receptor locations for the majority of the time. There is potential for the noise management levels to be exceeded on occasion, for instance when piling in close proximity to any given dwelling.

A draft Construction Noise and Vibration Management Plan is provided in Appendix B of this Report.

The EPA's Road Noise Policy 2011 criteria will be met during the operational and construction phases at all receptors at all times.

2. SITE AND DEVELOPMENT DESCRIPTION

2.1 Site Description

The Site is located approximately 2 kilometres north of the township of Mulwala within the Federation Local Government Area and comprises agricultural / rural land of approximately 218 hectares in total.

The Site is bound to the east by Savernake Road, to the south and west by Tocumwal Road and to the north by agricultural land. There are clusters of residential receptors located to the south and south east and isolated residences located to the south west and east, as shown in Figure 1. All receptors are listed in keeping with the Statement of Environmental Effects.

The nearest receptors to the Site are shown in Figure 1 below, and as follows: -

R2 – 511 Tocumwal Road (900 metres)

R3 – 279 Tocumwal Road (circa 400 metres)

R4 – 93 Barooga Road (circa 500 metres)

R5 – 290 Savernake Road (circa 235 metres)

R6 – 96 Cypress Way (circa 380 metres)

R7 – 3 Rose Drive (circa 480 metres)

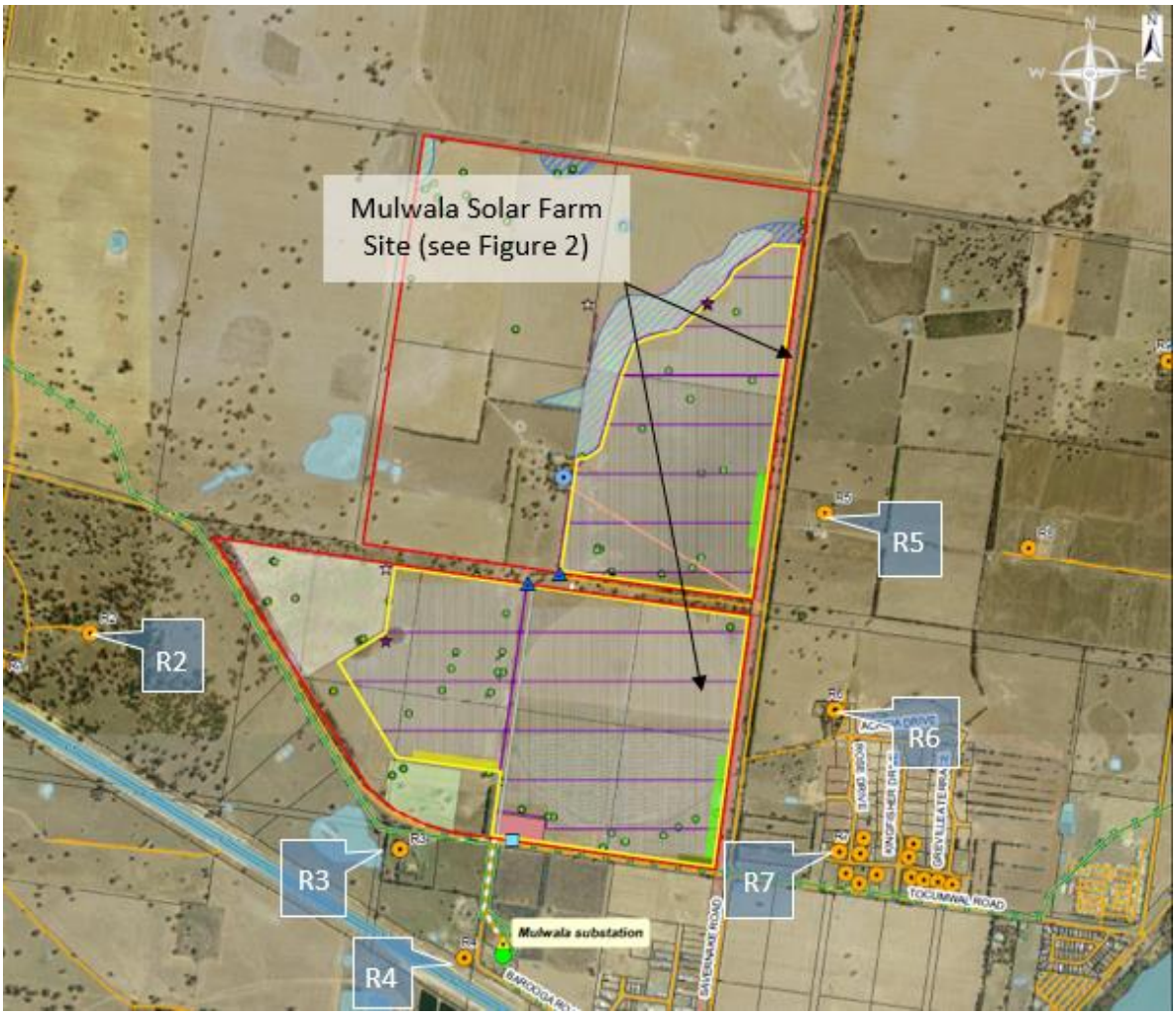

Figure 1. Location Plan – Savernake Road, Mulwala, NSW

(source: ESCO Pacific Pty Ltd 'Mulwala Solar Farm – Project Layout' (part))

All distances are based on the receptor to the closest point of the Site where solar panel arrays are likely to be, as a reference only. Motors and inverter systems will be at varying distances from each receptor and this is taken into account in calculations and predictions in Section 5 of this report.

Figure 2 below shows the entire layout map complete with legend.

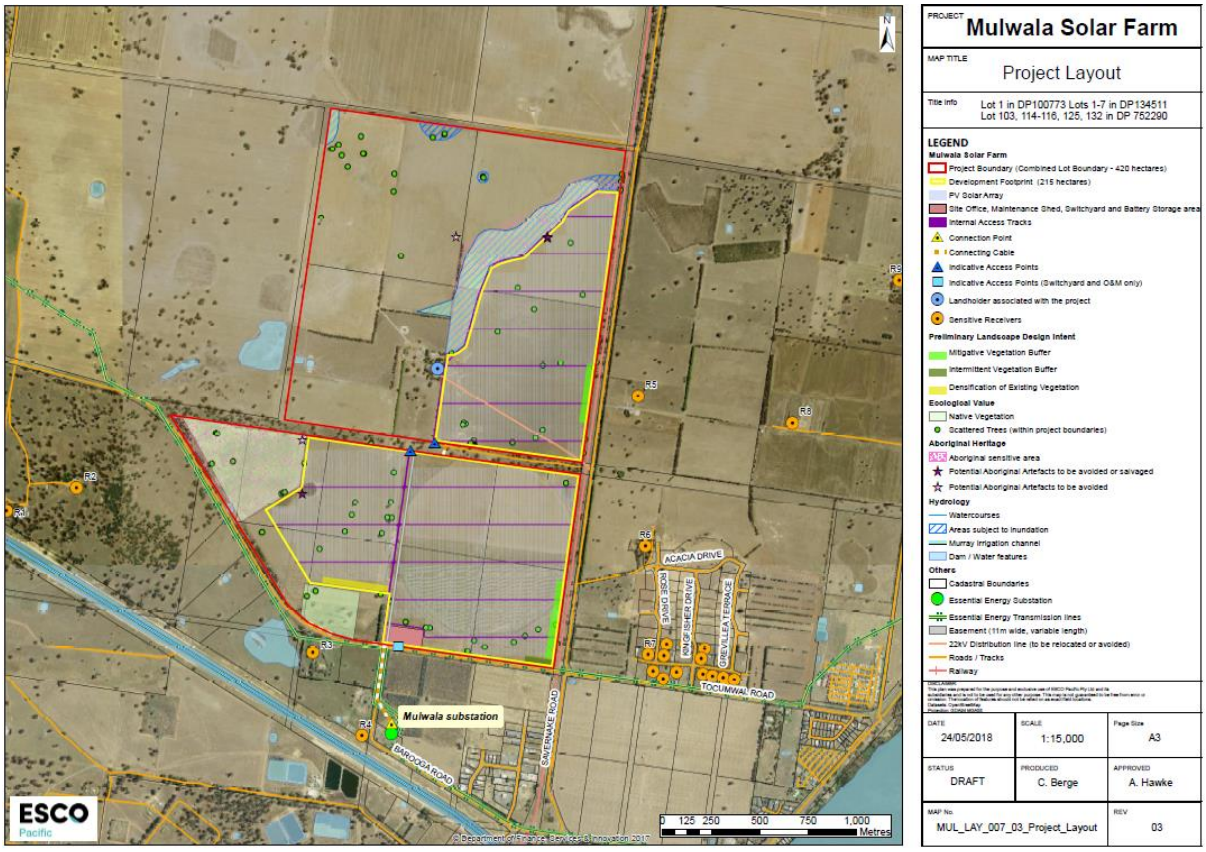

Figure 2. Project Layout

(source: ESCO Pacific Pty Ltd 'Mulwala Solar Farm – Project Layout')

2.2 Development Description

It is proposed to construct a utility scale renewable energy project, the 'Mulwala Solar Farm', that will generate up to 80 MW of electricity at the Site. The solar farm will comprise approximately 300,000 solar photovoltaic modules (known more commonly as solar panels). The solar panels will be installed on ground-mounted frames that will slowly track the horizontal daily movement of the sun.

The solar panels and tracking systems will be mounted in rows and electrically connected into arrays. Above ground DC cabling will connect each module of panels to field combiner boxes located under the panels.

Underground cabling will connect the combiner boxes to inverters, step up transformers and switch gear which will be housed in modified shipping containers; which would be located centrally on the site. A power conversion unit (PCU) within each array block will convert the DC electricity generated by the solar panels into AC electricity for connection into the electricity grid via the proposed solar substation.

A main step up transformer and associated switch equipment within the solar substation will convert the reticulated 33 kV electricity to 132 kV electricity for connection via high voltage cable to Mulwala Substation; which is located to the south of the Site.

The noise sources associated with the operational phase of the development are considered to be as follows: -

- NEXTracker motors for the tracking of the panels on the ground mounted frames (approximately 3,500 small motors);
- Inverter systems in modified containers (up to 40 units); and
- Transformer within the solar substation.

3. NOISE CRITERIA

This section outlines the noise guidelines applicable to this proposal and establishes the project specific noise trigger levels.

3.1 Secretary's Environmental Assessment Requirements (SEARS)

The NSW Department of Planning and Environment and EPA have provided SEARS for the preparation of an Environmental Impact Assessment for this proposal including requirements from the NSW EPA.

State Significant Development (SSD 9039), 'Specific Issues', states: -

> *"**Noise** - including an assessment of the construction noise impacts of the development in accordance with the Interim Construction Noise Guideline (ICNG) and operational noise impacts in accordance with the NSW Noise Policy for Industry 2017 and a draft noise management plan if the assessment shows construction noise is likely to exceed applicable criteria."*

3.2 NSW EPA's Noise Policy for Industry 2017

3.2.1 Introduction

The NSW Environment Protection Authority (EPA) published the NSW Noise Policy for Industry in October 2017 (the Policy). This Policy has now replaced the Industrial Noise Policy (INP) 2000.

This policy sets out the NSW Environment Protection Authority's (EPA's) requirements for the assessment and management of noise from industry in NSW. It aims to ensure that noise is kept to acceptable levels in balance with the social and economic value of industry in NSW.

The Noise Policy for Industry is designed to assist industry and authorities to ensure that potential noise impacts associated with industrial projects are managed effectively.

The purpose of the policy is to ensure noise impacts associated with particular industrial developments are evaluated and managed in a consistent and transparent manner.

It provides noise levels for assessing the potential impact of noise from industry and includes a framework for considering feasible and reasonable noise mitigation measures.

The objectives of the policy are to:

- provide the noise levels that are used to assess both change in noise level and long-term noise levels;
- provide a clear and consistent framework for assessing environmental noise impacts from industrial premises and industrial development proposals;
- promote the use of best-practice noise mitigation measures that are feasible and reasonable where potential impacts have been identified;
- support a process to guide the determination of achievable noise limits for planning approvals and/or licences, taking into account the matters that must be considered under the relevant legislation (such as the economic and social benefits and impacts of industrial development).

3.2.2 Project Noise Trigger Level

Section 2 of the Noise Policy for Industry 2017 sets out the procedure to determine the **project noise trigger levels** relevant to a particular industrial development.

The project noise trigger level provides a benchmark or objective for assessing a proposal or site. It is not intended for use as a mandatory requirement. The project noise trigger level is a level that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response; for example, further investigation of mitigation measures.

The project noise trigger level, feasible and reasonable mitigation, and consideration of residual noise impacts are used together to assess noise impact and manage the noise from a proposal or site. It is the combination of these elements that is designed to ensure that acceptable noise outcomes are determined by decision makers.

The **project noise trigger level** is the lower (that is, the more stringent) value of the project **intrusiveness noise level** and project **amenity noise level**.

3.2.3 Project Intrusiveness Noise Level

The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the **L_{Aeq} descriptor**), measured over a 15-minute period, does not exceed the background noise level by more than 5 dB, when the background noise is beyond a minimum threshold. This intrusiveness noise level seeks to limit the degree of change a new noise source introduces to an existing environment.

The intrusiveness noise level is determined as follows:

$L_{Aeq,\ 15\ minute}$ = rating background noise level (RBL) + 5 dB

Where:

$L_{Aeq,\ 15\ minute}$	*Represents the equivalent continuous energy average A-weighted sound pressure level of the source over 15 minutes.*

And:

Rating background	*Represents the background level to be used for assessment noise level purposes, as determined by the method outlined in Fact Sheets A and B.*

Intrusiveness noise levels are not used directly as regulatory limits. They are used in combination with the amenity noise level to assess the potential impact of noise, assess reasonable and feasible mitigation options and subsequently determine achievable noise requirements.

Minimum assumed RBLs are applied in the Policy and these result in minimum intrusiveness noise levels. These are shown in Table 2.1 in the Policy and are replicated in Table 1 below.

Table 1 Minimum assumed RBLs and project intrusiveness noise levels (Derived from EPA Table 2.1)

Time of Day	Minimum Assumed Rating Background Level dBA	Minimum Project Intrusiveness Noise Level ($L_{eq,\ 15\ minute}$, dBA)
Day (7 am to 6 pm)	**35**	**40**
Evening (6 pm to 10 pm)	**30**	**35**
Night (10 pm to 7 am)	**30**	**35**

3.2.4 Amenity Noise Levels and Project Amenity Noise Levels

To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise levels within an area from **all** industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 2.2 where feasible and reasonable. (EPA Table 2.2 is replicated in Table 2 below).

The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance.

The recommended amenity noise levels represent the objective for **total** industrial noise at a receiver location, whereas the **project amenity noise level** represents the objective for noise from a **single** industrial development at a receiver location.

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

> **Project amenity noise level for industrial developments = recommended amenity noise level (Table 2.2) minus 5 dB**

Amenity noise levels are not used directly as regulatory limits. They are used in combination with the project intrusiveness noise level to assess the potential impact of noise, assess reasonable and feasible mitigation options, and subsequently determine achievable noise requirements.

Table 2 Amenity Noise Levels (EPA Table 2.2)

Receiver	Noise Amenity Area	Time of Day	L_{Aeq}, dBA
(see Table 2.3 to determine which residential receiver category applies)			**Recommended amenity noise level**
Residential	Rural	Day Evening Night	50 45 40
	Suburban	Day Evening Night	55 45 40
	Urban	Day Evening Night	60 50 45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks *	See column 4	See column 4	5 dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School classroom – internal	All	Noisiest 1-hour period when in use	35 (see notes for table)
Hospital ward internal external	All	 Noisiest 1-hour Noisiest 1-hour	 35 50
Place of worship – internal	All	When in use	40
Area specifically reserved for passive recreation (e.g. national park)	All	When in use	50
Active recreation area (e.g. school playground, golf course)	All	When in use	55
Commercial premises	All	When in use	65
Industrial premises	All	When in use	70
Industrial interface (applicable only to residential noise amenity areas)	All	All	Add 5 dB(A) to recommended noise amenity area

Notes: The recommended amenity noise levels refer only to noise from industrial sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor levels except where otherwise stated.

Types of receivers are defined as follows:

- rural residential
- suburban residential
- urban residential
- industrial interface – an area that is in close proximity to existing industrial premises and that extends out to a point where the existing industrial noise from the source has fallen by 5 dB or an area defined in a planning instrument. Beyond this region the amenity noise level for the applicable category applies. This category may be used only for existing situations.
- commercial – commercial activities being undertaken in a planning zone that allows commercial land uses
- industrial – an area defined as an industrial zone on a local environment plan; for isolated residences within an industrial zone the industrial amenity level would usually apply.

Time of day is defined as follows:

- day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays
- evening – the period from 6 pm to 10 pm
- night – the remaining periods.

3.2.5 Assessment Locations

For a **residence**, the project noise trigger levels are to be assessed at the reasonably most-affected point on or within the residential property boundary or, if that is more than 30 metres from the residence, at the reasonably most-affected point within 30 metres of the residence, but not closer than 3 metres to a reflective surface and at a height of between 1.2–1.5 metres above ground level. This should not be read to infer that the project noise trigger level (or a limit in a statutory document) applies only at the reasonably most-affected location.

3.3 Background Noise Levels

In order to establish the project specific intrusiveness noise level (see Section 3.1.3 of this Report), it is necessary to determine the background noise levels in the vicinity of all potentially affected residential receptors.

The background noise level is defined by the EPA as 'the underlying level of noise present in ambient noise, generally excluding the noise source under investigation when extraneous noise is removed'.

The background noise level is represented by the $L_{AF90,\ 15min}$ descriptor when undertaking short-term monitoring. In comparison, the rating background noise level (RBL) (as defined in Section A1.2 of the Policy) is the single-figure background noise level derived from monitoring over a representative period of time, typically one full week.

The rating background noise level is used for assessment purposes.

In this instance, long term background noise measurements have not been undertaken at the request of the proponent, as it is reasonable to assume, due to its rural location, that these are likely to be at or below the minimum background levels shown in Table 1 of this report, at least on some occasions.

3.4 Project Noise Trigger Levels

The most relevant criteria are as follows: -

All residential receptors

- (35 + 5 =) **40 dBA** $L_{eq,\ 15\ minute}$ during the day;
- (30 + 5 =) **35 dBA** $L_{eq,\ 15\ minute}$ during the evening; and
- (30 + 5 =) **35 dBA** $L_{eq,\ 15\ minute}$ during the night.

3.5 On Road Traffic Noise Criteria – Road Noise Policy

The NSW EPA published the NSW Road Noise Policy in March 2011 and the Policy replaced the Environmental Criteria for Road Traffic Noise (ECRTN) in July 2011.

The Policy contains strategies to address the issue of road traffic noise from, among other things, traffic generating developments.

3.5.1 Noise Assessment Criteria – Residential Land Uses

Table 3 of Section 2.3.1 of the Policy *'Noise assessment criteria – residential land uses'* sets out the assessment criteria for residences to be applied to particular types of project, road category and land use.

The relevant parts of the EPA's Table 3 are replicated in Table 3 below.

Table 3 Road Traffic Noise Assessment Criteria (EPA Table 3, section 2.3.1)

Road Category	Type of Project / Land Use	Assessment Criteria, dBA	
		Day (7 am – 10 pm)	**Night (10 pm – 7 am)**
Local Roads	6. Existing residences affected by **additional traffic** on existing local roads generated by land use developments	$L_{Aeq\ (1\ hour)}$ 55 (external)	$L_{Aeq\ (1\ hour)}$ 50 (external)

3.5.2 Relative Increase Criteria

Section 2.4 of the policy states: -

"In addition to the assessment criteria outlined in Policy Table 3 [Report Table 3 above]*, any increase in the total traffic noise level at a location due to a proposed project or traffic-generating development must be considered. Residences experiencing increases in total traffic noise level above the relative increase criteria in Table 6 should also be considered for mitigation as described in Section 3.4.*

For other existing sensitive land uses as outlined in Table 4, the relative increase criteria should be applied to the respective L_{Aeq}, (period) for that land use type, except for open space. For road projects where the main subject road is a local road, the relative increase criterion does not apply."

Table 6 of the EPA's Policy is replicated in Table 4 below.

Table 4 Relative Increase Criteria

Road Category	Type of Project / Land Use	Assessment Criteria, dBA	
		Day (7 am – 10 pm)	Night (10 pm – 7 am)
Freeway / arterial / sub arterial roads and transitways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road	Existing Traffic $L_{Aeq\ (15\ hour)}$ + 12 dB (external)	Existing Traffic $L_{Aeq\ (9\ hour)}$ + 12 dB (external)

The Policy further states: -

"In Policy Table 6 above [Report Table 4]*, the 'existing' traffic noise level refers to the level from all road categories which would occur for the relevant 'no build' option as described in Section 2.5.3. Where the existing $L_{Aeq,\ (period)}$ road traffic noise level is found to be less than 30 dB(A), it is deemed to be 30 dB(A). A relative increase of 12 dB represents slightly more than an approximate doubling of perceived loudness (AS2659.1–1988) and is likely to trigger community reaction, particularly in environments where there is a low existing level of traffic noise. The relative increase criteria are primarily intended to protect existing quiet areas from excessive changes in amenity due to noise from a road project.*

A similar approach is adopted in both the United States Federal Highway Administration's Noise Abatement Criteria (United States Department of Transportation 1982) and the VicRoads Traffic Noise Reduction Policy (VicRoads 2005)."

3.6 Construction Noise Criteria

The NSW EPA published the *Interim Construction Noise Guideline* in July 2009. While some noise from construction sites is inevitable, the aim of the Guideline is to protect the majority of residences and other sensitive land uses from noise pollution most of the time.

The Guideline presents two ways of assessing construction noise impacts; the quantitative method and the qualitative method.

The quantitative method is generally suited to longer term construction projects and involves predicting noise levels from the construction phase and comparing them with noise management levels given in the guideline.

The qualitative method for assessing construction noise is a simplified way to identify the cause of potential noise impacts and may be used for short-term works, such as repair and maintenance projects of short duration.

In this instance the majority of infrastructure is existing and there will be no significant bulk earth works, piling, etc. The construction works will involve some civil works, pouring of concrete slabs, erection of new structures and installation of plant and equipment.

Consideration is given to the potential for noise impact from construction activities on residential receptors in Section 6 of this report.

Table 2 in Section 4 of the Guideline sets out noise management levels at affected residences and how they are to be applied during normal construction hours. The noise management level is derived from the rating background level (RBL) plus 10 dB in accordance with the Guideline. This level is considered to be the 'noise affected level' which represents the point above which there may be some community reaction to noise.

Based on the minimum assumed background noise level during the day as outlined in Section 3.3 of this Report, the Construction Noise Management Levels are shown in Table 5 below.

Table 5 **L_{eq} Noise Management Levels from Construction Activities**

Receptor Location	Noise Management Level	How to Apply
All receptors	**45 dBA** (35 + 10)	The noise affected level represents the point above which there may be some community reaction to noise. ▪ Where the predicted or measured $L_{Aeq\ (15\ min)}$ noise level 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: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

* Section 6, "work practices" of The *Interim Construction Noise Guideline*, states: - *"there are no prescribed noise controls for construction works. Instead, all feasible and reasonable work practices should be implemented to minimise noise impacts.*

This approach gives construction site managers and construction workers the greatest flexibility to manage noise".

Definitions of the terms feasible and reasonable are given in Section 1.4 of the Guideline.

The 'highly noise affected' level of 75 dBA represents the point above which there may be strong community reaction to noise. This level is provided in the Guideline and is not based on the RBL.

Consideration is also given to The Australian Standard AS2436–2010 *"Guide to noise and vibration control on construction, demolition and maintenance sites"* provides guidance on noise control in respect to construction, demolition and maintenance sites.

The Standard also provides guidance for the preparation of noise and vibration management plans.

Section 1.5 'Regulatory Requirements' of the Standard states: -

> *"Legislation associated with the control of noise and vibration on and from construction, demolition and maintenance sites in Australia is generally the responsibility of the relevant State or Territory government, local council or a designated statutory authority."*

Consequently, the Standard does not provide specific noise criterion but rather sets out practical methods for determining the potential for noise and vibration impact on the community from construction, demolition and maintenance sites.

4. MODIFYING FACTOR ADJUSTMENTS

Where a noise source contains certain characteristics, such as tonality, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. On the other hand, some sources may cause less annoyance where only a single event occurs for a limited duration.

Fact Sheet C of the Noise Policy for Industry 2017 outlines the correction factors to be applied to the source noise level at the receiver before comparison with the project noise trigger levels, to account for the additional annoyance caused by these modifying factors.

The modifying factor corrections should be applied having regard to:

- the contribution noise level from the premises when assessed/measured at a receiver location, and
- the nature of the noise source and its characteristics (as set out in this fact sheet).

Table C1 sets out the corrections to be applied. The corrections specified for tonal, intermittent and low-frequency noise are to be added to the measured or predicted noise levels at the receiver before comparison with the project noise trigger levels. The adjustments for duration are to be applied to the criterion.

Table C1 of Fact Sheet C is replicated in the attached Appendix A.

In this instance noise sources such as the inverters and the transformer have the potential to display tonal characteristics particularly in the near field, however given the distances to receptors and the low levels of noise predicted, no consideration is given to adjustments for tonality at this stage.

5. SOLAR FARM NOISE EMISSION – OPERATIONAL PHASE

The main sources of noise associated with the proposed Solar Farm will be as follows: -

- NEXTracker motors;
- SC2200 Inverter systems; and
- Transformer at solar substation.

5.1 Mechanical Plant and Equipment Source Noise Levels

Sound power level data has been provided for the NEXTracker motors by the manufacturer and for the SC2200 Inverter units by ESCO Pacific Pty. Ltd. The sound power level of the transformer is derived from our database of carrying out noise assessments of similar items of plant and equipment over the past 16 years.

Table 6 below shows the 'A' frequency weighted sound power levels, in decibels re: 1 pW, for typical plant and equipment.

Table 6 $L_{eq,\ 15\text{-}minute}$ **Sound Power Levels – Typical Mechanical Plant & Equipment**

Description	Individual Sound Power Level $L_{eq,\ 15\ minute}$ (dBA)
NEXTracker motors (each)	**50**
SC2200 Inverter (each)	**94**
Transformer	**75**

5.2 Noise Level Predictions

5.2.1 Modelling Equations

For all outdoor noise sources, the external noise level at each receptor has been calculated from the formula: -

$$L_{eq} = L_w + Dc - A$$

Where:

L_w is the sound power level of the noise source;
Dc is directivity correction; and
A is the attenuation that occurs during the propagation from source to receiver.

The term A in the equation includes attenuation from geometric divergence (distance loss), atmospheric absorption, ground absorption, barrier effects and miscellaneous other effects.

This model derives from the International Standard ISO 9613-2 (1996(E)) *'Acoustic – Attenuation of sound during propagation outdoors Part 2 General method of calculation'*.

The method described in the Standard is general in the sense that it may be applied to a wide variety of noise sources and covers the major mechanism of sound attenuation. The method allows for propagation conditions with the wind blowing from the source to the receiver.

5.2.2 Noise Modelling Scenario

The specific location of plant, particularly the higher noise producing inverter units, is not finalised at the time of writing this report.

The following assumptions have therefore been made for the purpose of noise modelling: -

- A total of 3,500 NEXTracker motors across the entire Site;
- Up to 40 inverter units across the entire Site;
- Closest inverter to any given residence is at a minimum distance of 600 metres;
- Full sound power of 94 dBA (see Table 6) attributed to each unit with a maximum attenuation of 3 dB from acoustical shielding to reach receptor;
- No further attenuation from any modified shipping containers;
- Distance attenuation and ground absorption at each receptor only;
- No consideration is given to modifying adjustments for tonality or low frequency noise.

This is considered to be a conservative, realistic worst-case scenario for the purpose of noise modelling in the absence of a finalised layout at this stage.

5.2.3 Predicted Noise Levels

The predicted noise levels at each receptor are shown in Table 7 below.

Table 7 Predicted L_{eq} Noise Levels – All receptors Day & Evening Operation

Description	Predicted Noise Level $L_{eq,\ 15\ minute}$ (dBA) at Receptor Location					
	R3	R4	R7	R6	R5	R2
Acceptable Noise Limit – Day	**40**	**40**	**40**	**40**	**40**	**40**
Solar farm noise emission – Daylight hours	33	32	32	32	31	28
Complies	Yes	Yes	Yes	Yes	Yes	Yes
Acceptable Noise Limit – Evening & Prior to 6am (summer time)	**35**	**35**	**35**	**35**	**35**	**35**
Solar farm noise emission – Daylight hours	33	32	32	32	31	28
Complies	Yes	Yes	Yes	Yes	Yes	Yes
Acceptable Noise Limit – Night	**35**	**35**	**35**	**35**	**35**	**35**
Solar farm noise emission – Night (transformer only)	<15	<10	<10	<10	<15	<10
Complies	Yes	Yes	Yes	Yes	Yes	Yes

It can be seen from Table 7 that the project trigger level of 40 dBA is met at all receptors during the day time (7.00 am to 6.00 pm). The project trigger level 35 dBA during the daylight hours prior to 7.00 am and after 6.00 pm is met at all receptors.

This is providing recommendations made in Section 8 of this Report are implemented and adhered to.

6. CONSTRUCTION NOISE EMISSION

The construction works will consist of the following phases: -

- Site preparation works including civil works involving grading, compaction, stormwater and sediment controls;
- Installation of steel mounting structures involving piling;
- Installation of solar panels onto the mounting structures;
- Installation of power conversion stations;
- Connection of solar panels to combiner boxes;
- Installation of cabling, connection of combiner boxes to power conversion stations;
- Connection of power conversion stations to onsite power reticulation systems;
- Connection of onsite reticulation system to Mulwala Substation;
- Commissioning and testing.

The construction phase will last approximately eight (8) months.

Table 8 below shows a schedule of sound power levels for typical construction equipment potentially to be used on this project.

Table 8 Likely Construction Equipment – L_{eq} Sound Power Levels

Description	L_{eq} Sound Power Level (dBA)
Auger Piling rig	118
Directional Drilling Rig	106
Rotary Bore Piling	111
Trencher	110
Dewatering Pump	90
D8 Dozer	110
Scraper / Grader	105
Excavator 30 tonne	110
Dump Truck	107
Single Drum Roller	104
Diesel Welding Rig	95

Table 9 below shows the predicted level of potential noise emission from various construction activities at the nearest residential receptor locations.

Table 9 Predicted L_{eq} Noise Levels at nearest Residential Area – Construction Phase

Description	Predicted Noise Level $L_{eq,\ 15\ minute}$ (dBA) at Receptor Location					
	R3	**R4**	**R7**	**R6**	**R5**	**R2**
Construction Noise Management Level	**45**	**45**	**45**	**45**	**45**	**45**
Piling (various methods)	41 - 53	39 - 51	39 - 51	42 - 54	46 - 58	31 - 43
Complies	No + 8 dB	No + 6 dB	No + 6 dB	No + 9 dB	No + 13 dB	Yes
Earthworks Phase	39 - 46	37 - 44	37 - 44	40 - 47	44 - 51	29 - 36
Complies	No + 1 dB	Yes	Yes	No + 2 dB	No + 6 dB	Yes
Installation / Commissioning	31	<30	<30	32	36	<25
Complies	Yes	Yes	Yes	Yes	Yes	Yes

Predictions in Table 9 assume the following: -

- Range of noise levels based on quietest and loudest individual items of plant operating during each phase;
- Various plant operating at the closest point of the Site to each receptor as a worst-case scenario;
- Attenuation from distance loss and ground absorption only.

The predictions in Table 9 give an indication of potential noise levels arising during the construction phase at each Receptor at the closest location to that receptor.

Noise emission from the construction phases will vary considerably at each receptor throughout the construction phase given the size of the Site and varying distances at which plant may operate. For the majority of the time, the level of noise emission will be well below the noise management level.

Recommendations are made in Section 8 of this Report to further manage construction noise emission.

7. ON ROAD TRAFFIC NOISE

A draft Traffic Impact Assessment has been prepared by Peter Meredith Consulting titled 'Mulwala Solar Farm', issue A, dated May 2018 (the TIA).

Section 5.2 of the TIA provides predictions of traffic generation rates of the development, and states: -

*"**During Construction***

- *156 vehicle movements per week during peak construction via Savernake Road and Lambruck Lane;*
- *39 vehicle movements per day;*
- *Allow 4 vehicle movements AM and PM peak hour movements (10 % of daily traffic).*

During Operations

- *14 vehicle movements per week via Savernake Road and Lambruck Lane;*
- *Two movements per day;*
- *Allow two vehicle movements AM and PM peak hour movements;*
- *Allow one vehicle per week via access driveway at the switching yard on Tocumwal Road"*

During Decommissioning

It is anticipated that traffic generation for the decommissioning will be no greater than traffic generation for construction:

- *156 vehicle movements per week;*
- *39 vehicle movements per day;*
- *Allow 4 vehicle movements AM and PM peak hour movements"*

These predicted flows are low and the impact of on-road traffic noise on the surrounding residential properties will be negligible.

For the purpose of predicting on-road traffic noise levels from the proposal formulae are given in the Calculation of Road Traffic Noise (CoRTN) from the UK Department of Transport and Welsh Office (1988) for the calculation of on-road vehicle noise. However, the calculation procedure given in CoRTN is untested for small traffic flows (under 200) and typically yields lower levels than occur in practice.

Therefore, a calculation based on the sound exposure level for various vehicles has been carried out. The sound exposure level (L_{Ae}) is a summation of the sound energy produced during a single event (i.e. a motor vehicle pass-by, train pass-by, etc).

The author has measured the level of noise emission from numerous heavy vehicles, including trucks, as well as cars, four wheel drives, etc.

The average maximum measured sound exposure levels of a range vehicles, normalised to a distance of 15 metres is as follows: -

- Truck – 84 dBA;
- Car – 67 dBA; and
- Ute / 4WD – 70 dBA.

Once established, a sound exposure level (L_{Ae}) can be used to calculate an energy average, sound pressure level ($L_{eq,\ time}$) using the following formula: -

$$L_{eq,\ 1\ hour} = L_{ae} - 10\ log_{10}(T) + 10\ log_{10}(N)$$

Where T is time in seconds (1 hour in this instance – in accordance with the assessment criteria, see Table 3 and N is the number of vehicle trips. The calculated level can then be adjusted to various distances from the 15-metre assessment location.

The nearest residence to either road where vehicles may pass is Receptor R3 at a distance of 145 metres.

The predicted noise level from on road vehicle movements during peak flow is less than **44 dBA** ($L_{eq,\ 1\ hour}$) at the nearest residences. This assumes vehicle movements in the hour are truck movements as a worst-case scenario.

This is well below the acceptable limits of 55 dBA ($L_{eq,\ 1\ hour}$) during the day and 50 dBA ($L_{eq,\ 1hour}$) at night and is therefore acceptable.

8. NOISE CONTROL RECOMMENDATIONS

Predictions made in Section 6 of this Report are based on the following noise control recommendations being implemented and adhered to.

8.1 Operational Phase

- There should be no inverter units located any closer than 600 metres from any residential receptor location;
- There should be no more than a total of eighteen (18) units located between 600 and 800 metres from any residential receptor location.

If this is not practicable additional attenuation of noise emission from some inverter units may be required.

This can easily be achieved through acoustical screening or enclosures or judicious location of the units. This may be confirmed prior to construction, or during commissioning as required.

Any additional acoustical treatment, if required, will not be onerous to ensure the noise design goals are met.

8.2 Construction Phase

The level of noise emission from the Construction Phase will be well below the construction noise management level at all receptor locations for the majority of the construction phase, given the size of the development site.

There is potential for the management levels to be exceeded whist plant and equipment are operating in close proximity to any given residence on occasion.

A draft Construction Noise and Vibration Management Plan has been prepared in accordance with Australian Standard AS2436-2010 and the EPA's *Interim Construction Noise Guideline 2009* and is provided in Appendix B of this Report.

9. CONCLUSION

An assessment of the potential noise emission arising from the operational and construction phases of a proposed solar farm to be located at Savernake Road, Mulwala, NSW has been undertaken.

Calculations and predictions show that the level of noise emission from the operational phase of the development will meet the EPA's Noise Policy for Industry 2017 project trigger levels at all residential receptor locations. This is providing the recommendations made in Section 8 of this report are implemented.

The level of noise emission from the construction phase of the proposal will be well below the noise management levels set by the NSW EPA's *Interim Construction Noise Guideline 2009* for the majority of the process. A construction noise and vibration management plan should be prepared prior to any works to minimise the impact of noisy events being carried out in close proximity to any receptors.

The level of potential noise emission from on road vehicle movements will be within the noise limits set by the NSW EPA's *Road Noise Policy 2011* at all receptors.

Matthew Harwood, MAAS

Principal Acoustic Consultant

Attachments: -

Appendix A – Modifying Factor Corrections (EPA 2017)
Appendix B – Construction Noise and Vibration Management Plan

Important Note

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Recommendations made in this report are intended to resolve acoustical problems only, therefore all other properties such as aesthetics, air flows, chemical, corrosion, combustion, construction details, decomposition, expansion, fire rating, fumes, grout or tile cracking, loading, shrinkage, smoke, ventilation etc. are outside Ray Walsh Acoustics Noise & Sound's and Harwood Acoustic's fields of expertise and ***must*** *be checked with the supplier or suitably qualified specialist before purchase.*

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Table A1 **Modifying Factor Corrections** (from Table C.1 of the NSW Noise Policy for Industry 2017)

Factor	Assessment/ Measurement	When to Apply	Correction	Comments
Tonal Noise	One-third octave band analysis using the objective method for assessing the audibility of tones in noise – simplified method (*ISO1996.2-2007 – Annex D*).	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: • 5 dB or more if the centre frequency of the band containing the tone is in the range 500–10,000 Hz • 8 dB or more if the centre frequency of the band containing the tone is in the range 160–400 Hz • 15 dB or more if the centre frequency of the band containing the tone is in the range 25–125 Hz.	5 dB	Third octave measurements should be undertaken using unweighted or Z-weighted measurements. **Note:** Narrow-band analysis using the reference method in *ISO1996-2:2007, Annex C* may be required by the consent/regulatory authority where it appears that a tone is not being adequately identified, e.g. where it appears that the tonal energy is at or close to the third octave band limits of contiguous bands.
Low Frequency Noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements in the range 10–160 Hz	Measure/assess source contribution C- and A-weighted Leq,T levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and: • where any of the one-third octave noise levels in Table C2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2 dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period • where any of the one-third octave noise levels in Table C2 are exceeded by more than 5 dB and cannot be mitigated, a 5-dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2-dB(A) positive adjustment applies for the daytime period.	2 or 5 dB	A difference of 15 dB or more between C- and A-weighted measurements identifies the potential for an unbalance spectrum and potential increased annoyance. The values in Table C2 are derived from Moorhouse (2011) for DEFRA fluctuating low-frequency noise criteria with corrections to reflect external assessment locations.

Table A1 **Modifying Factor Corrections** (from Table C.1 of the NSW Noise Policy for Industry 2017) *Cont…*

Factor	Assessment/ Measurement	When to Apply	Correction	Comments
Intermittent Noise	Subjectively Assessed but should be assisted with measurement to gauge the extent of change in noise level.	The source noise heard at the receiver varies by more than 5 dB(A) and the intermittent nature of the noise is clearly audible.	5 dB	Adjustment to be applied for **night-time only**.
Duration	Single-event noise duration may range from 1.5 m to 2.5 h	One event in any 24-hour period	0 to -20dBA	The acceptable noise trigger level may be increased by an adjustment depending on duration of noise (see Table C.3)
Maximum adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated	Maximum correction of 10 dBA[2] (excluding duration correction)	

Notes:

1. Corrections to be added to the measured or predicted levels, except in the case of duration where the adjustment is to be made to the criterion.

2. Where a source emits tonal and low-frequency noise, only one 5-dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.

3. Where narrow-band analysis using the reference method is required, as outlined in column 5, the correction will be determined by the ISO1996-2:2007 standard.

This draft Construction Noise and Vibration Management Plan has been prepared in accordance with Australian Standard AS2436-2010 and the EPA's *Interim Construction Noise Guideline 2009*.

This may be amended to form a detailed, site specific plan once the work processes, key personnel and site constraints are known.

Construction Hours

Recommended standard hours of construction are as follows: -

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

Noisy Equipment/Machinery

- All plant and machinery should be selected with consideration to low noise options where practicable and available.

Periods of Respite

- It is recommended that noisy construction activities such as piling along the eastern and southern boundaries of the Site only operate for 2 to 3 hours at a time. This will reduce the noise impact at the nearby residences.

Work Practices

- It is recommended that workers and contractors be trained in work practices to minimise noise emission such as the following:
    - Select the lower noise option where practicable (for example piling).
    - Employ the use of broadband audible reversing alarms on all mobile plant.
    - Avoid dropping materials from a height.
    - Avoid shouting and talking loudly outdoors.
    - Avoid the use of radios outdoors that can be heard at the boundary of residences.
    - Select silenced compressors, generator enclosures, etc where possible.
    - Turn off equipment when not being used.
    - Carry out work only within the recommended hours of operation.

Heavy Vehicles and Staff Vehicles

- 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).
- Locate site vehicle entrances away from residences where practicable.
- Optimise the number of vehicle trips to and from the site – movements can be organised to amalgamate loads rather than using a number of vehicles with smaller loads.
- Staff parking areas should be located as far from residential receptors as practicable.

Community Relations

- A Liaison Officer should maintain liaison between the neighbouring community and the contractor and communication lines should be opened early, prior to commencement of any works.
- Communication should be made with all affected residences via a range of media including, for example, individual contact and letter box drops.
- Inform the neighbours about the nature of the construction stages.
- The neighbours should be notified when the excessively noisy operations (such as the use of the drilling rig) are to be carried out.
- Consultation and cooperation between the contractor and the neighbours and the removal of uncertainty and rumour can help to reduce adverse reaction to noise.

Managing a Noise Complaint

- The Liaison Officer should receive and manage noise complaints. All complaints should be treated promptly and with courtesy.
- Should a justified noise complaint not be resolved, noise monitoring may be carried out at the affected receptor location and appropriate measures be taken to reduce the noise emission as far as reasonably practicable.
- Where it is not practicable to stop the noise, or reduce the noise, a full explanation of the event taking place, the reason for the noise and times when it will stop should be given to the complainant.

The following guidelines are recommended in Section 6 of the *Interim Construction Noise Guideline* to manage a noise complaint:

- Provide a readily accessible contact point, for example, through a toll-free information and complaints line.

- Give complaints a fair hearing.
- Have a documented complaints process, including an escalation procedure so that if a complainant is not satisfied there is a clear path to follow.
- Call back as soon as possible to keep people informed of action to be taken to address noise problems.
- Call back at night-time only if requested by the complainant to avoid further disturbance.
- Provide a quick response to complaints, with complaint handling staff having both a good knowledge of the project and ready access to information.
- Implement all feasible and reasonable measures to address the source of complaint.
- Keep a register of any complaints, including details of the complaint such as date, time, person receiving complaint, complainant's contact number, person referred to, description of the complaint, work area (for larger projects), time of verbal response and timeframe for written response where appropriate.

Vibration Monitoring

Given the significant distances from the Site to the residential receptors, it is unlikely that vibration from the construction works will be perceptible.

However, a further assessment may be made once the type of piling or drilling process for the installation of the solar panel mounting frames is determined.

- Vibration monitoring may be undertaken in the initial stages when piling along the south eastern boundary of the Site near to Receptors R5 and R6 (refer Figure 1).
- Or if complaints are received.
- The vibration measurements can be carried out using either an attended or an unattended vibration monitor.
- An unattended vibration monitor should be fitted with an alarm in the form of a strobe light or siren to make the plant operator aware immediately when the vibration limit is exceeded.
- The vibration monitor should be set to trigger the alarm when the overall Peak Particle Velocity (PPV) exceeds **15 mm/s** at the nearest residential building.

Again, a final assessment of the need for vibration monitoring should be undertaken prior to the commencement of works once the type of equipment and extent of activities are known.