



Acoustic Consulting

Metz Solar Farm

Environmental Acoustic Assessment



Revision Record

No.	Author	Reviewed/Approved	Description	Date
1.	K. Dhayam/K.Hewett	K. Hewett	Draft – Revision 1	10/01/2017
2.	K. Dhayam		Draft – Revision 2	11/01/2017
3.	K. Dhayam/K.Hewett	K. Hewett	Issue following comments	12/01/2017

Contents

1	Introduction.....	4
1.1	Scope.....	4
1.2	Site location.....	5
1.2.1	Noise sensitive receivers	7
1.3	Project description	9
2	Noise assessment guidelines and standards	10
2.1	DECC Interim Construction Noise Guideline (ICNG)	10
2.1.1	ICNG noise management levels.....	10
2.2	NSW Industrial Noise Policy (INP).....	11
2.2.1	Intrusiveness criterion	11
2.2.2	Amenity criterion.....	12
2.2.3	Project-specific noise levels.....	12
2.3	NSW Road Noise Policy	12
3	Ambient noise environment	14
3.1	Existing acoustic environment.....	14
3.1.1	Unattended measurements	14
3.1.2	Attended measurements.....	15
3.1.3	Summary of measurements	15
4	Meteorological conditions on site.....	16
4.1	Wind effects	16
4.2	Drainage-flow winds.....	16
4.3	Temperature inversion.....	16
5	Construction noise assessment.....	17
5.1	Overview of construction and decommissioning activities	17
5.2	Plant and equipment noise source levels.....	17
5.3	Assessment methodology	18
5.4	Results and discussion.....	19
6	Operational noise assessment	21
6.1	Assessment methodology	21
6.2	NSW INP – Evaluated noise criteria.....	22

6.3	Results and discussion.....	22
7	Road traffic noise assessment.....	25
7.1	Construction phase	25
7.2	Operational phase	25
8	Conclusion	26
Appendix A	Noise monitoring graphs – 2196 Grafton Road, Argyle	27

Table Index

Table 1: Residential – ICNG noise management levels	11
Table 2: NSW Road Noise Policy noise assessment criteria	13
Table 3: Summary of unattended and attended noise monitoring results at L1.....	15
Table 4: Summary of construction activity/stage.....	18
Table 5: Construction noise assessment – Buffer distances	19
Table 6: NSW INP – Evaluated noise criteria.....	22
Table 7: Predicted substation noise levels at various buffer distances versus criterion	23
Table 8: Predicted inverter noise levels at various buffer distances versus criterion	24

Figure Index

Figure 1 Location of the development footprint and surrounding areas.....	6
Figure 2: Location of noise sensitive receivers.....	8

1 Introduction

TTM Consulting has been engaged by Eco Logical Australia (ELA) to conduct a construction and operational noise impact assessment for a proposed solar farm at Metz in the New England Tablelands region of NSW.

The proposed solar farm is located approximately 18 km east of Armidale, NSW and has a Development Footprint of up to 507 ha. The proposal involves the development of a commercial scale photovoltaic (PV) solar farm with a combined capacity of approximately 100 MW.

1.1 Scope

This report assesses the noise impact related to the construction and operation of the proposed solar farm in Metz, NSW. The scope is as follows:

- Identification of noise sensitive receivers;
- Determination of ambient noise levels surrounding the proposed site. The results of a noise survey undertaken by TTM in May 2015 for the *Clarks Gully Underground Mine Environmental Noise and Blasting Impact Assessment report*, has been used for this assessment, as it is considered relevant and applicable;
- Construction noise assessment:
 - Identification of construction stages and associated activities including specialised machinery and equipment used during the works;
 - Construction noise assessment in accordance with the NSW Interim Construction Noise Guideline¹ (ICNG); and
 - Advice on practical and appropriate in-principle noise mitigation and management, where required;
- Operational noise impact assessment:
 - Obtain noise data for typical sub-station to be used;
 - Obtain noise data for inverters to be used;
 - Operational noise impact assessment in accordance with the NSW Industrial Noise Policy² (INP); and
 - Advice on practical and appropriate in-principle noise mitigation and management, where required.
- Road traffic noise impact assessment:
 - Confirm road traffic generated from the proposed development;

¹ NSW Department of Environment and Climate Change (DECC) (2009), Interim Construction Noise Guideline.

² NSW Environment Protection Authority (2000), NSW Industrial Noise Policy.

- Assess road traffic noise impact in accordance with NSW Road Noise Policy³; and
- Advice on practical and appropriate in-principle noise mitigation and management, where required.

1.2 Site location

The proposal site is located approximately 18 km east of Armidale at “Bayley Park”, within the Armidale Regional Council Local Government Area. The site is immediately north of the Grafton Road and is accessed via Bayley Park Road as shown as shown on Figure 1 below. The proposed solar farm would connect to overhead high-voltage power lines that run west to east through the site and approximately 1 km south of the site.

The Development Site comprises up of to 507 ha, most of which has been historically cleared for grazing purposes and much has been sown with improved pastures. A number of small *Pinus radiata* (Radiata Pine) plantations are located within the northern portion of the proposal site and there are patches of native woodland scattered throughout the proposal site. The site slopes gently toward the south-east, following Limerick Creek, and there are a number of farm dams within the proposal site.

³ NSW Department of Environment, Climate Change and Water (2011), NSW Road Noise Policy.

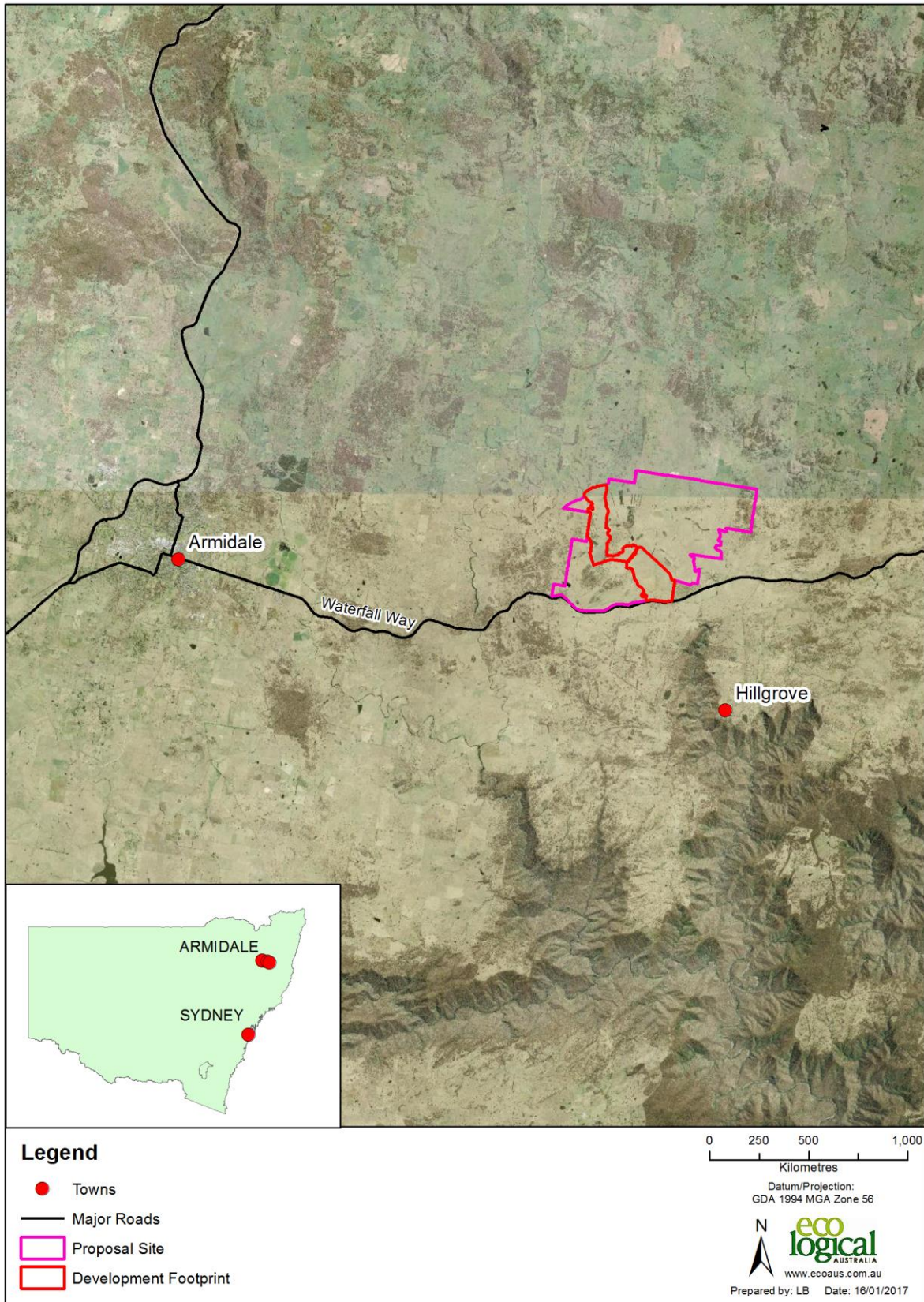


Figure 1 Location of the development footprint and surrounding areas

1.2.1 Noise sensitive receivers

Based on the location of the study area, the nearest noise sensitive receivers have been identified and are as follows:

1. NSR1 – Residential property at 2196 Grafton Road, Argyle. Coordinates: -30.535905, 151.873321; and
2. NSR2 – Residential property south of site and Grafton Road, Argyle. Coordinates: -30.540873, 151.860954.

The location of the NSRs are shown in Figure 2.

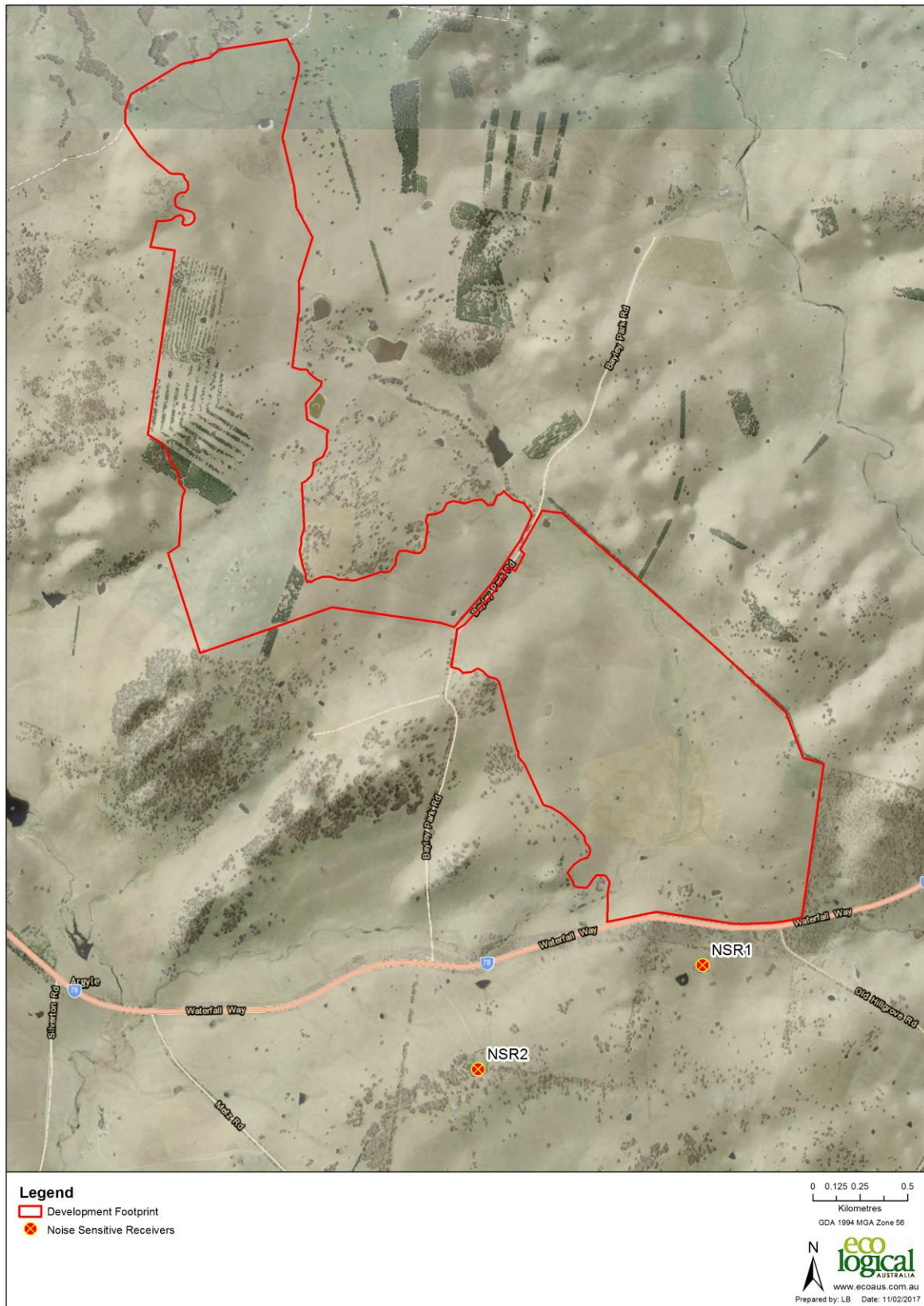


Figure 2: Location of noise sensitive receivers

1.3 Project description

The proposal has a footprint of up to 507 ha and involves the installation of PV panels with a combined capacity of approximately 100 MW. The proposal includes the following elements:

- Approximately 400,000 PV panels;
- Central inverters with a capacity of 2 – 2.5 MW each;
- ‘T-Connection’ into the 132 kV power lines that run through the site; and
- Onsite modular substations at each connection point, including switchgear, communications equipment and parking spaces.

Bayley Park Road will be used for site access and will require ongoing maintenance activities to support delivery vehicles for the construction phase of the project. Maintenance activities will involve dust suppression by water cart and routine grading to ensure the road is suitable for heavy equipment as required.

2 Noise assessment guidelines and standards

The main guidelines, standards and other policy documents relevant to the construction, operational, and road traffic noise impact assessment include:

- NSW Department of Environment and Climate Change (DECC) (2009), Interim Construction Noise Guideline;
- NSW Environment Protection Authority (2000), NSW Industrial Noise Policy; and
- NSW Department of Environment, Climate Change and Water (2011), NSW Road Noise Policy.

2.1 DECC Interim Construction Noise Guideline (ICNG)

The DECC Interim Construction Noise Guideline (ICNG) provides guidelines for the assessment and management of noise from construction works. Construction activities and associated duration for the proposed development mean that it is considered a major construction project. Therefore, the quantitative approach has been adopted for the construction noise assessment.

2.1.1 ICNG noise management levels

The ICNG suggests the following standard hours for construction activities where noise is audible at residential premises:

- Monday to Friday, 7am to 6pm;
- Saturday, 8am to 1pm; and
- No construction work is to take place on Sundays or public holidays.

Time restrictions on construction works are the primary management tool of the ICNG. The construction working hours of the proposed development are expected to be in line with the above standard hours.

The guideline also provides noise management levels for residential premises for both the recommended, and outside standard hours of construction. The noise management levels recommended for residential premises have been extracted from the ICNG and are summarised in Table 1.

Table 1: Residential – ICNG noise management levels

Time of day	Management level, L_{Aeq} (15 min) *	How to apply
<i>Residential</i>		
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise: <ul style="list-style-type: none"> Where the predicted or measured L_{Aeq} (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise: <ul style="list-style-type: none"> 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: <ol 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; and if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	<ul style="list-style-type: none"> A strong justification would typically be required for works outside the recommended standard hours; The proponent should apply all feasible and reasonable work practices to meet the noise affected level; Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community; and For guidance on negotiating agreements see section 7.2.2 of the ICNG.
Note: * Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.		

2.2 NSW Industrial Noise Policy (INP)

For noise emissions generated on the site resulting from the operational activities at the proposed development, the relevant noise criteria are defined in the NSW Industrial Noise Policy (INP).

The policy offers guidelines to minimise noise impact to Noise Sensitive Receivers (NSRs) not associated with the development. Project-specific noise levels (PSNLs) are determined and set at the boundary of relevant NSRs which are not to be exceeded.

The policy states that the most stringent of the intrusive and amenity criteria, described below, sets the PSNL.

2.2.1 Intrusiveness criterion

The INP states:

The intrusiveness of an industrial noise may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted 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 measured in absence of the source by more than 5dB.

The INP recommends methods for determining background noise level. At the planning and approval stage, the long-term method is used which is designed to ensure that the criterion for intrusive noise will be achieved for at least 90% of the time periods (day/evening/night), known as the Rating Background Level (RBL).

The intrusiveness criterion can thus be summarised by:

$$L_{Aeq, 15 \text{ minute}} \leq \text{Rating Background Level plus 5dB}$$

2.2.2 Amenity criterion

The INP sets Acceptable Noise Levels (ANLs) for areas impacted by industrial noise that should ideally not be exceeded to protect against impacts such as speech interference and community annoyance. Any new industrial noise sources should not increase overall industrial noise in an area and cause ‘background creep’, where background noise levels rise overtime as new noise sources are introduced. Where all practical and reasonable noise mitigation has been applied and still the ANL cannot be achieved, the INP suggests a Recommended Maximum noise level which is 5 dB above the ANL.

Where there is an existing level of industrial noise affecting the NSRs, modifications to the ANL are required as defined in Section 2.2 of the INP.

For the solar farm development, the noise sensitive receivers are situated in an area, which would be classified as “Rural” under the NSW INP, and the relevant recommended “acceptable” amenity criteria for $L_{Aeq, period}$ are 50 dB(A), 45 dB(A) and 40 dB(A) for day-time, evening and night-time periods respectively.

Modification to ANLs to account for existing level of industrial noise is also applicable as defined in Section 2.2 of the INP.

2.2.3 Project-specific noise levels

The Project-specific noise level (PSNL) is the target noise emission level from the new noise source as a result of the new development at the boundaries of the identified NSRs. The PSNL is taken to be the lowest and most stringent of the intrusiveness and amenity noise criteria.

The evaluated intrusive, amenity and project specific noise criteria according to the INP are based on the noise survey results presented in Section 3.1.3 and the criteria are presented in Section 6.2.

2.3 NSW Road Noise Policy

The NSW Road Noise Policy sets out noise assessment criteria for existing residences affected by additional road traffic noise on existing freeways/arterial/sub-arterial roads generated by land use development, which are summarised in Table 2.

Table 2: NSW Road Noise Policy noise assessment criteria

Road Type	Period	Criteria
Existing freeways/arterial/sub-arterial roads generated by land use development	Day (7am - 10pm)	60 dB(A) $L_{eq,1 \text{ hour}}$ (external)
	Night (10pm - 7am)	55 dB(A) $L_{eq,1 \text{ hour}}$ (external)

3 Ambient noise environment

TTM previously conducted ambient noise monitoring at a location close to the proposed Metz Solar Farm site and its surroundings for the Clarks Gully Underground Mine, Hillgrove (Report Ref.: 14SYA0041 R01_2 *Clarks Gully Underground Mine, Hillgrove (NSW) Environmental Noise and Blasting Impact Assessment*, Revision 2, dated 28th August 2015).

The most relevant monitoring location was at a residential property located at 2196 Grafton Road, Argyle (NSR1, refer to **Error! Reference source not found.**), which is located at approximately 1.4 km east of the intersection between Grafton Road and Bayley Park Road.

No major developments have been observed since noise monitoring was conducted at NSR1, therefore similar ambient noise levels are expected at the proposed Solar Farm site compared to the noise levels measured for the Clarks Gully Underground Mine, Hillgrove.

3.1 Existing acoustic environment

As observed at the residential property at NSR1, the ambient noise levels are typical of a rural area with the dominant noise source being road traffic noise from Grafton Road. The ambient noise environment also includes noise from farm trucks, birds and insects.

Both attended and unattended noise measurements were conducted at NSR1 generally in accordance with the recommendations outlined in the Australian Standard AS 1055⁴.

3.1.1 Unattended measurements

Unattended noise measurements were conducted at 2196 Grafton Road, Argyle for a period of 8 consecutive days between the 6th and 13th May 2015 using an ARL EL-316 NATA calibrated noise logger (S/N 16-707-010) at NSR1. The noise logger was positioned at 1.5 m above the ground and at least 3.5 m away from any reflecting structure. Average, maximum and statistical noise parameters were recorded at 15 minute intervals.

Weather conditions were also monitored during the monitoring period using data from Hillgrove mine weather station. High wind speeds greater than 5 m/s were observed on Sunday the 10th and Wednesday the 13th May 2015. The associated noise data for high wind speed periods were not included in the results as recommended in the NSW INP.

The logger was calibrated before and after the monitoring period and were found to be within acceptable limits.

The noise monitoring charts have been attached in Appendix A for reference.

⁴ AS 1055.1:1997. Acoustics - Description and measurement of environmental noise - General procedures.

3.1.2 Attended measurements

An attended measurement was also conducted on the 6th May 2015 at approximately 12.20pm at NSR1 (**Error! Reference source not found.**) using a NATA calibrated B&K 2250 Type 1 sound level meter, generally in accordance with the recommendations outlined in the Australian Standard AS 1055. The sound level meter was checked for calibration before and after the measurement and no significant drift was observed.

3.1.3 Summary of measurements

The results of both the attended and unattended measurements at NSR1 are summarised in Table 3.

Table 3: Summary of unattended and attended noise monitoring results at L1

Period	Rating Background Noise Levels, RBL (L _{A90}) in dB(A)	Existing Noise Levels in dB(A)		
		L _{Aeq}	L _{A10}	L _{A1}
Unattended				
Day	31	47	52	61
Evening	24	46	53	61
Night	25	43	49	62
Attended				
Day (6 th May 2015 from 12.22pm to 12.37pm)	37	46	51	55
Note: - Day-time period is from 0700 to 1800 (Monday to Saturday) and 0800 to 1800 (Sundays and Public Holidays) - Evening period is from 1800 to 2200 - Night-time period is from 2200 to 0700 (Monday to Saturday) and 2200 to 0800h (Sundays and Public Holidays)				

The unattended and attended measurement results show typical background noise levels for a rural area where traffic on local roads is the dominant noise source.

During the attended measurements, road traffic was observed to be the dominant noise source in the area. Other typical rural noise sources such as tractors, ride-on mowers, birds and insects were also audible.

NSR1 is the most affected receiver based on its closest proximity to the solar farm study area. The ambient noise levels at NSR2 are expected to be similar to NSR1.

4 Meteorological conditions on site

During temperature inversions⁵, where there is a wind gradient⁶ and where the receiver is down wind or the source, refractions of sound waves back towards the ground will occur. The refraction of sound may increase noise levels at the receiver by focusing sound-wave propagation paths at a single point. These meteorological effects can increase noise levels by 5 to 10 dB, and by as much as 20 dB in extreme conditions, thereby causing a significant noise impact on noise sensitive receivers.

4.1 Wind effects

Wind effects need to be assessed where it is a feature of the area in accordance with the requirements contained in the NSW INP which states the following:

“Wind is considered to be a feature of the area where the source-to-receiver wind speed (at 10 m height) of 3 m/s or below for 30% of the time or more in any assessment period (day, evening, night) in any season exists.”

As detailed in Section 4.1.1 of the Clarks Gully Underground Mine, Hillgrove (Report Ref.: 14SYA0041 R01_2 Clarks Gully Underground Mine, Hillgrove (NSW) Environmental Noise and Blasting Impact Assessment, Revision 2, dated 28th August 2015), wind speeds of 3 m/s or below occur less than 30% of the time during the day-time period.

Constructions activities and operations of the solar farm will only occur during the day-time period and therefore wind effects are not required to be assessed.

4.2 Drainage-flow winds

The drainage-flow wind (or katabatic wind) is the localised drainage of cold-air under the influence of the local topography, and generally travels in the direction of decreasing altitude.

The NSW INP identifies that a default wind drainage value of 2 m/s at 10 m height should be applied where sources are situated at a higher altitude than receivers with no intervening topography.

The drainage-flow wind does not apply to this Project as the topography of the area is relatively flat.

4.3 Temperature inversion

The assessment of impacts from temperature inversion effects are confined to the night-time period only (10 pm to 7 am) as this is the time period when impact is the greatest.

However, as the construction activities and operations of the solar farm are confined to the day-time period only, the assessment of temperature inversion effects is not required.

⁵ Atmospheric conditions where temperatures increase with height above ground level as opposed to the typical decrease in temperature with height.

⁶ Wind velocities increasing with height.

5 Construction noise assessment

5.1 Overview of construction and decommissioning activities

The construction of the entire solar farm is anticipated to take approximately 12 months. Decommissioning will take approximately 6 months.

The main construction activities/stages are as follows:

- Site establishment and preparation for construction (preliminary civil works and drainage, including access road construction);
- Installation of mounting system to support the PV modules;
- PV module attachment;
- Installation of inverters, transformers and other electrical infrastructure;
- Grid connection;
- Commissioning and testing; and
- Removal of temporary construction facilities.

The stages listed above are in approximate order of construction. However, in practice individual components will be run in parallel to allow groups of solar blocks to be commissioned throughout the construction phase.

At the end of the 30 project life the solar farm shall be decommissioned. It is anticipated that equipment and activities associated with decommissioning will be similar to construction, however, the 30 year future timing makes meaningful analysis difficult. For the purposes of this study decommissioning noise management is considered to replicate construction noise management requirements.

5.2 Plant and equipment noise source levels

For each construction stage, the expected plant and machinery information to be used are summarised in Table 4. The table also includes an estimated percentage of use per day which reflects the transient and changing nature of the construction noise activities, dependent upon site-conditions, timelines, delays and other unexpected occurrences, as well as, the source sound levels for each of the items of plant and equipment.

Table 4: Summary of construction activity/stage

Construction activity/stage	Noise impact	Equipment	% use per day	Sound Power Level, dB(A)	Reference
Site establishment and preparation for construction	To be investigated	Material delivery truck	40	107	AS 2436
Installation of mounting system to support the PV modules	To be investigated	Vibratory piling (Small)	80	116 (Minimum)	AS 2436
PV module attachment	Not expected	-	-	-	-
Installation of inverters, transformers and other electrical infrastructure	To be investigated	Material delivery truck	40	107	AS 2436 & site measurements (Trencher only)
		Mobile crane	50	104	
		Vibratory rollers	40	108	
		Grader	50	110	
		Trencher	50	118	
		Excavator	40	107	
		Generator	100	99	
Air compressor (Silenced)	40	101			
Grid connection	Not expected	-	-	-	-
Commissioning and testing	Not expected	-	-	-	-
Removal of temporary construction facilities	To be investigated	Material delivery truck	40	107	AS 2436

5.3 Assessment methodology

The noise impact of construction activities for each applicable construction phase has been predicted for a worst-case scenario. The noise prediction has been based on the following:

- Plant and equipment source sound power level information given in Table 4;
- Distance attenuation; and
- Atmospheric, meteorological and ground attenuation using the CONCAWE⁷ method, where applicable.

The worst-case scenario represents the use of all the plant and equipment for each activity at the same time at one single point. This scenario represents an unrealistic scenario, but does represent the maximum possible impact of construction noise for a short duration before the work moves to another location.

Noise predictions have been made using the CONCAWE prediction method. CONCAWE is a noise prediction method developed for assessing environmental noise propagation, drawn from both acoustic theory and extensive field noise measurements. The CONCAWE predictions consider atmospheric, meteorological and ground attenuation. A worst-case scenario has been modelled to conservatively predict the propagation of

⁷ CONCAWE – the propagation of noise from petroleum and petrochemical complexes to neighbouring communities. Report no.4/81, 1981.

noise from source to receiver. The worst-case scenario includes the effects of temperature inversions and favourable winds onto the noise, which is equivalent to CONCAWE Category 6.

For the construction noise assessment, buffer distances have been predicted between the noise sources and the noise sensitive receivers to meet:

1. ICNG noise management level of 41 dB(A) – Derived from unattended noise measurements, day-time in Table 3; and
2. ICNG highly noise affected limit of 75 dB(A) as shown in Table 1.

5.4 Results and discussion

The buffer distances for each of the construction activities have been predicted to meet the ICNG noise management level and highly noise affected limit and are summarised in Table 5.

Table 5: Construction noise assessment – Buffer distances

Construction activity/stage	Equipment	Approximate buffer distance, m	
		Management level, 41 dB(A)	Highly noise affected, 75 dB(A)
Site establishment and preparation for construction	Material delivery truck	380	< 100
Installation of mounting system to support the PV modules	Vibratory piling (Small)	900	< 100
PV module attachment	-	-	-
Installation of inverters, transformers and other electrical infrastructure	Material delivery truck Mobile crane Vibratory rollers Grader Trencher Excavator Generator Air compressor (Silenced)	800	< 100
Grid connection	-	-	-
Commissioning and testing	-	-	-
Removal of temporary construction facilities	Material delivery truck	380	< 100

The buffer distances in Table 5 show that the Noise Affected Management Level of the RBL + 10dB is exceeded at distances greater than the minimum distance between the nearest site boundary and the nearest noise sensitive receiver (NSR 1 – 257m). However, it should be noted that the site area is large and the vast majority and whole of the site is greater than 900m from NSR 1 and NSR 2 respectively. This means that there will only be a small period of the overall construction time when these activities are taking place within the buffer distances required to meet the Noise Affected Management Level.

Furthermore, it should be recognised that Noise Affected Management Level of 41 dB(A) is a low absolute environmental noise level and is a result of the background level being so low. It is highly unlikely that a construction noise level of 41dB(A) will be intrusive for most people.

The Highly Noise Affected Management Level of 75 dB(A) requires buffer distances of less than 100m. The nearest receiver (NSR 1) is approximately 257m from the nearest site boundary. This would result in a worst-case noise level at NSR 1 of less than 70 dB(A) for the noisiest piling activity and significantly less for all other activities. In practice, due to site constraints, piling will not take place on, or near to the site boundary. Based on preliminary concept designs, it is anticipated that piling and associated construction activities shall be approximately 400 m from NSR1, achieving management level buffer distances for site establishment, preparation and clean-up activities. Accordingly, worst-case noise impacts, while not meeting the Noise Affected Management Level of 41 dB(A), will be well below the highly noise affected limit of 75 dB(A).

In addition, the transient nature of construction noise means that construction activities will only take place for a short period of time at the nearest boundary before moving further away to other parts of the site, reducing noise impact levels as they move.

Given the above, the construction noise impact on the noise sensitive receivers is considered minor to negligible, and therefore, additional noise management beyond good practice is not required.

6 Operational noise assessment

This section of the report addresses the operational noise impact of the proposed development onto noise sensitive receivers. The assessment includes a:

- Prediction of noise emissions from substations and inverters at various buffer distances; and
- Comparison of predicted noise emissions to noise criteria derived from the NSW INP;
- Calculation of minimum buffer distances to ensure compliance with the criteria.

6.1 Assessment methodology

The assessment involves predicting minimum buffer distances for the substation and inverters to meet the NSW INP criteria. The predicted buffer distances consider the following:

- Source sound levels of the substations and the inverters;
- Distance attenuation; and
- Atmospheric, meteorological and ground attenuation using the CONCAWE⁸ method for distances between the source and receiver greater than 100m.

Further, we have made the following assumption in our calculations:

- The source sound levels used in the calculations are as follows:
 - **Substations** – 2 x Siemens power transformers for solar farms 60MVA/66kV – Sound pressure level 75dB(A) @ 1m each i.e. 78dB(A) for both.
 - **Inverters** – SMA type SC 2200-US – Sound power level 94 L_{WA}.
- The substation area is approximately 2500m from the nearest noise sensitive receiver (NSR2).
- In a worst case scenario there are approximately up to 50 inverters spread over the whole site. Given the significant size of the site we have taken the noise source used in the predictions to include 2 inverters, with other inverters being sufficient distance away as not to result in a cumulative noise level at the noise sensitive receivers.
- In an effort to provide conservative results, two inverters have been assumed to be located on the closest boundary to a noise sensitive receiver (NSR1) being approximately 250m away.
- As with the construction noise assessment, a worst-case meteorological scenario has been modelled using CONCAWE Met Category 6 (worst-case) for the substations, and also with Category 4 (zero meteorological

⁸ CONCAWE – the propagation of noise from petroleum and petrochemical complexes to neighbouring communities. Report no.4/81, 1981.

influence - neutral/average case) for the inverters given their closer proximity to the noise sensitive receivers.

6.2 NSW INP – Evaluated noise criteria

Based on the unattended noise measurements, the NSW INP noise criteria have been evaluated and are summarised in Table 6.

Table 6: NSW INP – Evaluated noise criteria

Assessment period	Intrusiveness Criterion, L _{Aeq,15min} , dB(A) (RBL + 5dB)	Amenity Criterion L _{Aeq,15min} , dB(A)	Project-Specific Noise Levels (PSNLs), dB(A)
Day	36	50 [#]	36
Evening	35*	45 [#]	35
Night	35*	40 [#]	35

Note:

- Day-time period is from 0700 to 1800 (Monday to Saturday) and 0800 to 1800 (Sundays and Public Holidays)
- Evening period is from 1800 to 2200
- Night-time period is from 2200 to 0700 (Monday to Saturday) and 2200 to 0800h (Sundays and Public Holidays)
- * The INP states in *Section 3.1.2 Rating Background Level*, that, 'Where the rating background level is found to be less than 30 dB(A), then it is set to 30dB(A)
- # There is no existing industrial noise. Therefore, the amenity Acceptable noise level is as recommended in *Table 2.1 Amenity Criteria*, of the INP

Table 6 shows that the intrusiveness criterion is the most stringent for all time periods and are therefore taken to be the PSNLs. By meeting the PSNLs at the identified NSRs, all other residential properties located further away from the development site are expected to comply with NSW INP noise criteria.

The solar farm is expected to operate during periods of daylight. However, depending on the seasons, daylight may occur in the early morning hours or late afternoon hours, which falls in the night-time and evening periods in accordance with the NSW INP. Referring to Table 6, the most stringent PSNL is in the evening period at 35 dB(A), and will therefore be used to predict the minimum buffer distances.

6.3 Results and discussion

Operational noise levels have been predicted at various distances from substations and inverters to show the impact of buffer distances with respect to the criterion (Table 7 and Table 8). For distances greater than 100m, in addition to distance attenuation the CONCAWE environmental prediction methods for atmospheric, meteorological (category 6 – greatest increase in noise) and ground attenuation has been applied to the prediction.

In addition to using the worst-case meteorological category 6 for the prediction of noise levels from the inverters at the various buffer distances, a neutral/average case (meteorological category 4) where there is no impact on noise levels has been used for comparison. This may help in setting suitable minimum buffer distances.

Table 7: Predicted substation noise levels at various buffer distances versus criterion

Plant Type	Source noise level, dB(A)	Distance from plant, m	Predicted noise level dB(A) Met Category 6 (worst-case)	Compliance with NSW INP? 35 dB L _{Aeq}	
Substations	81 dB(A) at 1 m Combined main substation and two minor substations	50	47	✘	
		100	40	✘	
		160	35	✓	
		200	32	✓	
		Distance of nearest site boundary to receiver (NSR1)	250	30	✓
		300	28	✓	
		400	25	✓	
		500	23	✓	
		1000	14	✓	
		Approximate distance of substation area from nearest receiver (NSR2)	2500	4*	✓

*To reach the INP noise criterion of 35dB(A) at the approximate nearest distance of the substations there would need to be approximately 3000 transformers.

Table 7 shows that substation meets the INP noise criterion of 35dB(A) at approximately 160m. Given that the substation area on the site is approximately 2500m from the nearest noise sensitive receiver (NSR2), no noise impact is expected. Therefore, no buffer distance is recommended.

Table 8: Predicted inverter noise levels at various buffer distances versus criterion

Plant Type	Source noise level, dB(A)	Distance from plant, m	Predicted noise level dB(A) Met Category 6 (worst-case)	Predicted noise level dB(A) Met Category 4 (neutral/average case)	Compliance with NSW INP? 35 dB LAeq		
					Met Category 6	Met Category 4	
Inverter	97 dB L _{WA} 2 x inverters	50	55	55	✗	✗	
		100	48	48	✗	✗	
		200	41	38	✗	✗	
		INP criterion met for Met Category 4 (neutral/average case)	250	38	35	✗	✓
			300	36	33	✗	✓
		INP criterion met for Met Category 6 (Worst-case)	350	35	31	✓	✓
			400	34	29	✓	✓
			500	31	26	✓	✓
			1000	24	18	✓	✓
			2500	12	6	✓	✓

Table 8 shows that when assuming the worst-case meteorological category 6 in the noise prediction for two inverters the INP noise criterion is met at approximately 350m. When the neutral/average case meteorological category 4 is used, where there is assumed to be no meteorological influence on noise propagation the INP criterion is met at 250m.

Therefore, it is recommended that to meet the INP at all times under the worst-case conditions that a buffer distance of 350m is maintained between the nearest inverters and the noise sensitive receivers.

The above predictions and recommendations for buffer distances are contingent of the noise source level data for the substations and inverters supplied to TTM being accurate. Should these change from those presented in Section 6.1., the buffer distances should be reviewed accordingly.

7 Road traffic noise assessment

7.1 Construction phase

During the construction phase of the solar farm, the main traffic will be generated from staff and deliveries as detailed in Section 2 of the Traffic Assessment report prepared by TTM Consulting (Report Ref.: 16SYT0130 *Metz Solar Farm, Bayley Park*, Revision 00, dated 23/12/2016). Heavy vehicles related to the construction activities are expected to be a maximum of 27 vehicles per day. As the construction phase progresses, the number of heavy vehicles will reduce.

Based on the low number of additional vehicles generated per day associated with the construction activities of the solar farm and noise attenuation provided by the distance from the road to the NSR's, construction traffic noise impact onto nearby residential properties is expected to be negligible.

7.2 Operational phase

The proposed Metz Solar Farm, during its operational phase, will generate additional road traffic on Waterfall Way and Bayley Park Road. Traffic generation data has been obtained from the Traffic Assessment report prepared by TTM Consulting (Report Ref.: 16SYT0130 *Metz Solar Farm, Bayley Park*, Revision 00, dated 23/12/2016). The report states that the solar farm is forecast to generate up to eight vehicle movements daily when operational.

Consequently, it is concluded that the generated traffic flows from the operation of the solar farm to be relatively minor and road traffic noise impact will be negligible.

8 Conclusion

The environment acoustic assessment for the proposed Metz Solar Farm provided the following conclusions:

- Construction (including decommissioning noise) assessment:
 - Construction activities may exceed the Interim Construction Noise Guideline 'Noise Affected' management levels depending on the locations of the activities. However, it is recognised that the management level being based on being 10dB(A) above the very low background level, which results in a very low construction noise level of 41 dB(A). Therefore, exceedance of this noise level is not considered to negatively impact the noise sensitive receivers, especially when the works are transient by nature and will quickly move further away from the closest boundary;
 - None of the construction activities will come close to the 'Highly Noise Affected' management level at the noise sensitive receivers; and
 - No additional noise mitigation measures are required beyond general good practice.
- Operational noise assessment:
 - No buffer distance is recommended for the substations, given the substation area is approximately 2500m from the nearest noise sensitive receiver (Table 7).
 - A buffer distance of 350m is recommended to be the minimum distance between one inverter pair and any noise sensitive receivers (Table 8).
- Road traffic noise assessment:
 - Road traffic noise impact during construction and operational phases of the development are expected to be negligible.

Appendix A Noise monitoring graphs – 2196 Grafton Road, Argyle

