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Barnawartha Solar Farm and Energy Storage

Desktop Noise Impact Assessment

Barnawartha Solar Pty Ltd

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ARP Australian Solar Pty. ltd

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Document prepared by:

Aurecon Australasia Pty Ltd
ABN 54 005 139 873
Aurecon Centre
Level 8, 850 Collins Street
Docklands, Melbourne VIC 3008
PO Box 23061
Docklands VIC 8012
Australia

T +61 3 9975 3000
F +61 3 9975 3444
E melbourne@aurecongroup.com
W aurecongroup.com

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Author signature		Approver signature	
Name	Heath Miller	Name	Greta Thraves
Title	Lead Acoustic Engineer	Title	Associate

Executive summary

ARP Australian Solar, in partnership with Wirsol Energy, are proposing to install a 64MWac solar energy farm and 64MW battery storage facility in Barnawartha, Victoria. Aurecon has been engaged to undertake a preliminary noise impact assessment for the operation of the facility in accordance with applicable Victorian regulations.

The site is located in Barnawartha, approximately 20km from Wodonga. The surrounding area is generally rural in nature with limited noise from existing commerce or industry. The site and surrounds are zoned as Farming Zone (FZ). The existing noise environment is expected to be dominated by sporadic road traffic noise on Murray Valley Highway.

Noise generating equipment on the site has been identified as inverters, batteries and external transformers.

At this stage, indicative equipment has been identified, however detailed acoustic data is not available from the suppliers. Equipment sound power levels have been assumed to undertake this assessment. These assumed levels should be used in project specifications to set maximum allowable equipment sound power levels.

Initial calculations indicate that based on the assumed equipment noise levels, environmental noise emissions from the site can comply with the applicable Victorian Noise Protocol limits.

Further acoustic review should be undertaken as the design progresses to ensure that equipment selections and layouts achieve the acoustic requirements for the site. Close coordination is required with equipment suppliers to ensure that the equipment sound power levels do not exceed the values assumed in this assessment.

Once equipment selections and layouts are finalised, it is recommended that a computational noise model of the site is developed to confirm environmental noise emissions comply with the applicable Victorian statutory requirements.

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Glossary of terms

Term	Definition
Ambient Noise Level	The prevailing noise level at a location due to all noise sources but excluding the noise from the specific noise source under consideration. Generally measured as a dB(A) noise level.
The Act	Victorian *Environment Protection Act 2017*
Background Noise Level	The A-weighted sound pressure level that is exceeded for 90 per cent of the measurement period, L_{A90}.
BESS	Battery energy storage system
Background relevant area:	A noise sensitive area within a rural area where background levels may be higher than usual. This includes areas where freeway or highway traffic is a significant audible background noise source.
CCBDG:	Environment Protection Authority, Victoria (EPA VIC) 2020 Publication 1834, Civil construction, building and demolition guide
Commercial, industrial and trade premises	As defined in the Environment Protection Regulations 2021: Any premises except the following — (a) residential premises (other than common plant under the control of an owners' corporation) (b) a street or road, including every carriageway, footpath, reservation and traffic island on any street or road (c) a railway track used by rolling stock in connection with the provision of a freight service or passenger service— (i) while travelling on a railway track or tramway track; or (ii) while entering or exiting a siding, yard, depot or workshop (d) a railway track used by rolling stock in connection with the provision of a passenger service, while in a siding, yard, depot or workshop and is — (i) powering up to commence to be used in connection with the provision of a passenger service; or (ii) shutting down after being used in connection with the provision of a passenger service (e) the premises situated at Lower Esplanade, St Kilda and known as "Luna Park" and being the whole of the land more particularly described in Certificate of Title Volume 1204 Folio 109 *Note:* *The maintenance, cleaning or loading of rolling stock stabled in a siding, yard, depot or workshop are* *included within the meaning of commercial, industrial and trade premises.*
Decibel	Sound pressure levels are expressed in decibels as a ratio between the measured sound pressure level and the reference pressure.
dB(A)	The A-weighted sound pressure level in decibels, denoted dB(A) is the unit generally used for the measurement of environmental, transportation or industrial noise. The A-weighting scale approximates the sensitivity of the human ear when exposed to normal levels and correlates well with subjective perception of typical sounds. An increase or decrease in sound level of approximately 10 dB(A) corresponds to a subjective doubling or halving in loudness. A change in sound level of 3 dB(A) is considered subjectively just noticeable and a change of 1 to 2 dB(A) is subjectively not noticeable.

Frequency	The rate of repetition of a sound wave. The unit of frequency is Hertz (Hz), defined as one cycle per second. Human hearing ranges approximately from 20 Hz to 20,000 Hz. Octave bands are the most commonly used frequency bands. For more detailed analysis each octave band may be split into three one-third octave bands or narrow frequency bands.
Habitable Room	Any room of a dwelling or residential building other than a bathroom, laundry, toilet, pantry, walk-in wardrobe, corridor, stair, lobby, photographic darkroom, clothes drying room and other space of a specialised nature occupied neither frequently nor for extended periods.
$L_{Aeq,T}$	The equivalent continuous A-weighted sound pressure level is the value of the A-weighted sound pressure level of a continuous steady sound that has the same acoustic energy as a time-varying A-weighted sound pressure level when determined over the same measurement period, T.
L_{A90}	A-frequency weighted sound pressure level, measured using the Fast time-weighting, that is exceeded for 90 per cent of the time interval considered
Noise Sensitive Area	As defined in the Environment Protection Regulations (2021): – (a) that part of the land within the boundary of a parcel of land that is • within 10 metres of the outside external walls of any of the following buildings: (A) a dwelling (including a residential care facility but not including a caretaker's house); (B) a residential building; (C) a noise sensitive residential use, or • within 10 m of the outside of the external walls of any dormitory, ward, bedroom, or living room of one or more of the following buildings: (A) a caretaker's house; (B) a hospital; (C) a hotel; (D) a residential hotel; (E) a motel; (F) specialist disability accommodation; (G) a corrective institution; (H) a tourist establishment; (I) a retirement home (J) a residential village • within 10 m of the outside of the external walls of a classroom or any room in which learning occurs in the following buildings (during their operating hours): (A) a childcare centre; (B) a kindergarten; (C) a primary school; (D) a secondary school (b) subject to paragraph (c), in the case of a rural area only, that part of the land within the boundary of (i) a tourist establishment or (ii) a campground or (iii) a caravan park, or (c) despite paragraph (b), in the case of rural area only, where an outdoor entertainment event or outdoor entertainment venue is being operated, that part of the land within the boundary of the following are not noise sensitive areas for the purposes of that event or venue: (i) a tourist establishment or (ii) a campground or (iii) a caravan park.
NIRV:	EPA Victoria Guideline Publication 1411 Noise from industry in regional Victoria, Recommended Maximum noise levels from commerce, industry and trade premises in regional Victoria
Noise Protocol	EPA Victoria Publication 1826.4, Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues, May 2021
Noise Regulations:	Victorian Environment Protection Regulations 2021
SEPP N–1	State Environment Protection Policy (control of noise from industry commerce and trade) No. N–1
Sensitive Room (EPA 1826.2)	Any habitable room (as defined in the Environment Protection Act 2017) within a Noise Sensitive Area or any learning room within a kindergarten, childcare centre, primary or secondary school.
Sound Pressure Level (SPL)	The sound pressure expressed in decibels.
Tonality	Sound containing a prominent discrete frequency or frequencies.

1 Introduction

1.1 Project Background

ARP Australian Solar in partnership with Wirsol Energy is proposing to install a ~64MWac solar energy farm and 64MW battery storage facility in Barnawartha, Victoria. Aurecon has been engaged to undertake a preliminary noise impact assessment for the operation of the facility in accordance with applicable Victorian regulations.

For this project, a desktop noise assessment will be undertaken in accordance with the Victorian Environment Protection Regulations 2021 together with *Publication 1826.4: Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues.*

The scope of this assessment includes:

- Establish noise limits and targets for the development in accordance with the applicable Victorian regulations and guidelines.
- Predict noise emissions from the proposed site infrastructure and assess against the defined limits and targets.
- Provide high-level options for noise mitigation, if applicable.

As vibration dissipates quickly over distance, and there are no vibration intensive sources proposed on site, vibration from the ongoing operation of the proposed infrastructure is considered negligible and is therefore not assessed in this document.

1.2 Surrounding environment

The site is located in Barnawartha, approximately 20km from Wodonga. The proposed site is to the south of Murray Valley Highway and to the west of Coyles Road.

The surrounding area is generally rural in nature with limited noise from existing commerce or industry. The site and surrounds are zoned as Farming Zone FZ. The existing noise environment is expected to be dominated by sporadic road traffic noise on Murray Valley Highway.

The site and surrounds are characterised by rural farming uses. The nearest noise sensitive area is the residential property located in the centre of the site on Hermitage Road, owned by the landholder. This dwelling has been included as a sensitive receptor for this assessment show in Figure 1 as NSA5.

The site and surrounds can be seen in Figure 1.

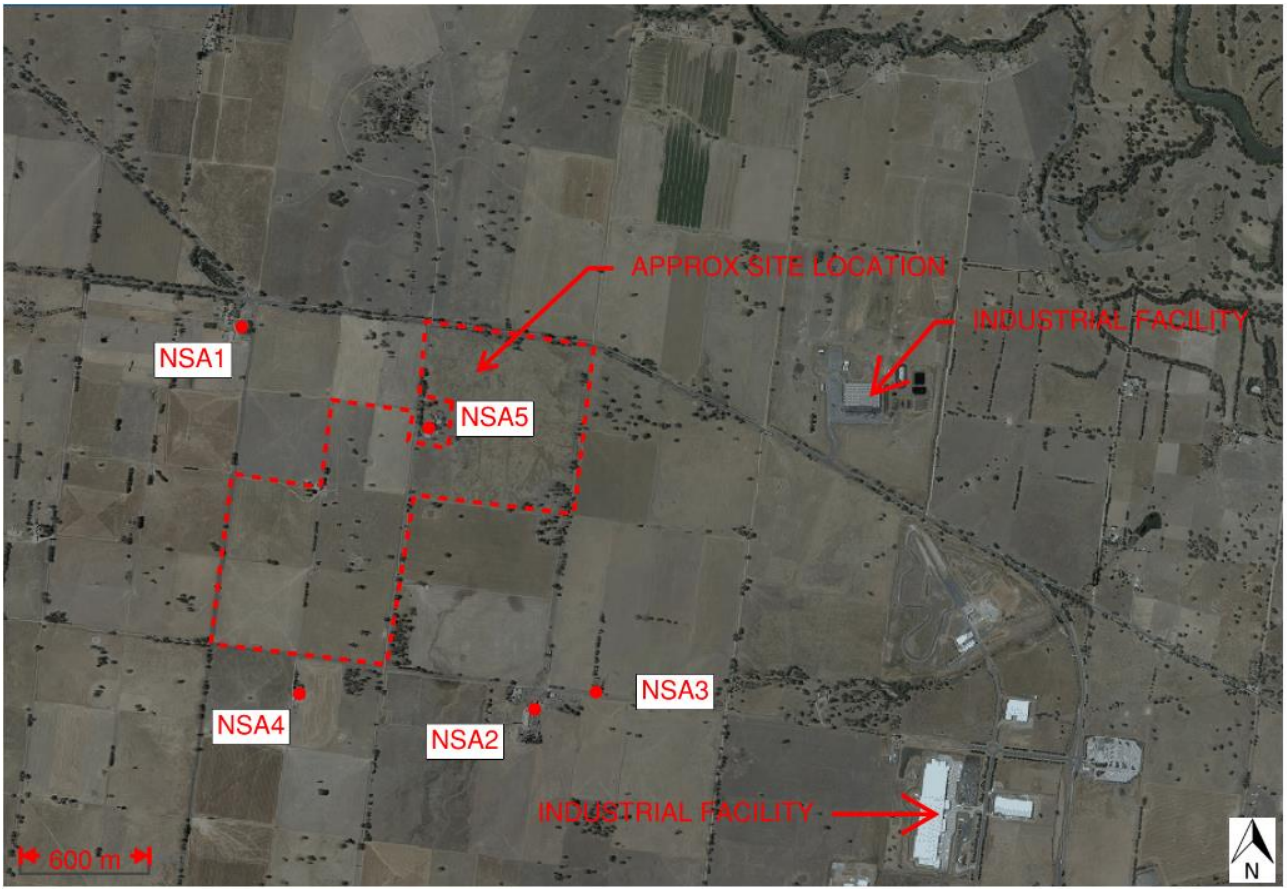

Figure 1 Surrounding industry and noise sensitive areas

The following noise sensitive areas (NSAs) have been identified based on review of site aerial photos.

Table 1 NSA addresses

Noise sensitive area	Address
NSA1	2227 Murray Valley Hwy
NSA2	271 Baxter Whelans Rd
NSA3	230 Baxter Whelans Rd
NSA4	375 Baxter–Whelans Rd
NSA5	49 Hermitage Rd

2 Regulatory framework

2.1 Environment Protection Act 2017

The *Environment Protection Act 2017* (Vic) mandates that businesses have a general environmental duty (GED) to manage their activities to minimise the risk of environmental damage. Under the Act, the GED requires that *'any person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must minimise those risks, so far as reasonably practicable'*.

The requirement to demonstrate that the GED is being complied with is in addition to compliance with the noise limits set out in the Noise Protocol. Businesses must be able to demonstrate that they are complying with both the GED and the applicable noise limits.

Victorian EPA guideline 1856 'Reasonably Practicable' (EPA, 2020) provides guidance concerning what must be considered when assessing the proportionate controls to mitigate or minimise the risk of harm. These measures include a hierarchy of controls, defined as follows:

- Eliminate risk: Can you eliminate the risk
- Likelihood of the risk: What's the chance that harm will occur?
- Degree of harm (consequence): How severe could the harm be on human health or the environment?
- State of knowledge: What do you know, or what can you find out, about the risks your activities pose?
- Available suitable controls: What technology, processes or equipment are available to control the risk What controls are suitable for use in your circumstances?
- Costs of suitable controls: How much does the control cost to put in place compared to how effective it would be in reducing the risk?

Guideline 1856 requires that these factors be considered to determine what is reasonably practicable to control risks of environmental damage.

Environmental noise emissions from industrial activities, if not adequately managed, have the potential to cause harm. Therefore, the GED requires that all reasonably practicable measures be put in place to minimise the risks of that harm occurring.

In addition to the GED, Section 166 of the Act describes an obligation on any individual not to emit an *unreasonable noise* or permit an unreasonable noise to be emitted.

Unreasonable Noise is defined in Section 3(1) of the Act as noise that *is (a) unreasonable having regard to the following – (i) its volume, intensity or duration; (ii) its character; (iii) the time, place or other circumstances in which it is emitted; (iv) how often it is emitted; (v) any prescribed factors; or (b) is prescribed to be unreasonable noise.*

Table 2 provides commentary on each of the potential control measures for the site.

Table 2 General environmental duty

Control measure	Comment
Eliminate Risk	Activities will inherently generate noise during operation however mitigation measures will be considered as part of the design including specification of low noise equipment
Likelihood of risk	The site will be designed to ensure that noise impacts from the proposed development would not lead to an increase in noise levels at surrounding properties
Degree of harm	There are varying degrees of harm associated with noise, ranging from: ▪ Hearing loss / permanent damage. ▪ Sleep disturbance. ▪ Audibility and annoyance. At noise levels exceeding 85dB $L_{Aeq(8hr)}$ / 140 dB L_{Cmax} irreversible hearing damage may occur. Harm associated with hearing loss / permanent damage is covered by Worksafe Victoria compliance codes[1] and is not expected to be exceeded on site. Harm associated with sleep disturbance includes changes in the pattern of sleep stages, reduction in the proportion of REM sleep, reduced perceived sleep quality and after effects such as headache and tiredness. Sleep disturbance is generally only considered to occur when people are exposed to noise levels >30dB $L_{Aeq(8hr)}$ or >45dB L_{Amax} inside bedrooms at night[2].. Provided that noise levels inside bedrooms do not regularly exceed these levels, impacts on sleep disturbance are generally considered to be acceptable. These levels are not expected to be exceeded at the nearby NSAs. The degree of audibility of noise depends on the level of noise emitted together with the ambient background noise levels. Where there is a low level of ambient noise at a receiver location, noise emissions are more likely be audible at times. This may occur where there is limited surrounding activity from roads and other noise sources. The audibility of noise can be classified as follows[3]: ▪ 0 to 3 dB above background noise levels: not audible ▪ 3 to 5 dB above background noise levels: marginally audible ▪ >5 dB above background noise levels: generally audible Other factors such as the frequency content, tonality, impulsiveness and other characteristics may also impact the audibility of noise.

[1] Worksafe Victoria Compliance Code Noise, Edition 2, December 2019
[2] WHO Guidelines for Community Noise, 1999
[3] Engineering noise control: theory and practice, D Bies and CH Hanson, Fourth Edition, 2009

Control measure	Comment
State of knowledge	Undertaking detailed reviews of environmental noise emissions from the site (such as this report) is part of the general environmental duty to understand the likely noise emission from the site and identifying mitigation measures to reduce noise impacts.
Available suitable controls	It is considered that best practice to review available suitable controls to minimise risk associated with noise would be developing and maintaining a site noise management plan. The site noise management plan would include but not be limited to: ■ Regular review of available technology assessing whether low-noise alternatives exist. ■ Regular equipment maintenance to reduce noise. ■ General plans for community consultation and procedures to address noise complaints. ■ Noise monitoring plans. ■ Training for site staff and equipment operators regarding requirements to minimise risks associated with noise.
Cost of suitable controls	Costs associated with low noise equipment will be reviewed as the design progresses. It is considered that with appropriate management measures, risks of environmental harm can be appropriately managed

2.2 Victorian Environment Protection Regulations

Airborne noise from fixed infrastructure must comply with the Regulations and the general environmental duty under the Act and subordinate legislation including EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues,* May 2021 (Noise Protocol).

2.2.1 Time periods

The time periods defined in the Regulations are summarised in Table 3.

Table 3 Time periods

Period	Day	Time
Day	Monday to Saturday	7 a.m. to 6 p.m.
Evening	Monday to Saturday	6 p.m. to 10 p.m.
	Sunday / Public Holidays	7 a.m. to 10 p.m.
Night	Monday to Sunday / Public Holidays	10 p.m. to 7 a.m.

2.3 Noise Protocol

The *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* (Noise Protocol) provides a protocol for determining noise limits for new and existing commercial and industrial premises. The Noise Protocol also sets the methodology for assessing the effective noise level to determine unreasonable and aggravated noise under the Environment Protection Regulations.

The noise limits are applicable to the combined level of noise associated with all commerce industry and trade.

Part 117 of the Regulations excludes a number of types of noise from the assessment including noise from mobile farm machinery, aircraft, construction activity and non-commercial vehicles. Extraneous noise must also be excluded from any measured noise levels which includes any noise that is not part of the commercial, industrial or trade premises such as local traffic, insects, or bird chirping.

2.3.1 Zoning

The EPA provides definitions of Major Urban areas in regional areas. Wodonga is the nearest defined Major Urban Area in regional Victoria and the EPA provides maps detailing the boundary of the Major Urban Area. The site location and nearby noise sensitive areas are outside of the Major Urban Area and therefore the rural method defined in the noise protocol is applicable.

The site and surrounds are zoned as FZ. Land use zoning of the site and surrounds is show in Figure 2.

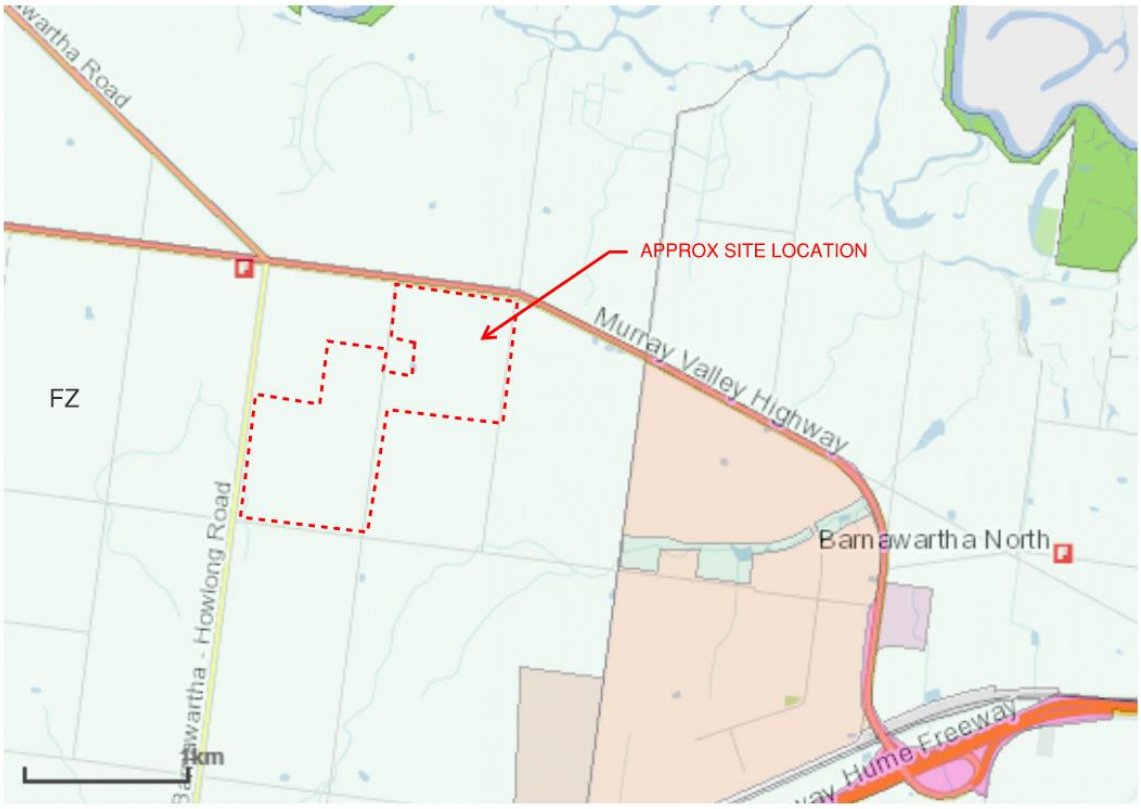

Figure 2 Site location

2.3.2 Noise survey

At this stage a noise survey has not been undertaken. The acoustic environment in the surrounding area is expected to be characteristically rural.

Background relevant areas are defined in the noise protocol as *"a noise sensitive area in a rural area where background levels may be higher than usual".* On this basis the nearest sensitive receivers are not expected to be in a background relevant area.

2.3.3 Base noise limit

As defined in the Environment Protection Regulations 2021 Part 118(2)(b) the lowest decibel value that may be set as the noise limit in a rural area are as follows:

- Day:45 dBA
- Evening: 37 dBA
- Night: 32 dBA

2.3.4 Noise limits

Noise is assessed at a location in a noise sensitive area (NSA) where the maximum effective noise level occurs or, for proposed premises, is predicted to occur.

Part 117 of the Regulations excludes a number of types of noise from the assessment including noise from mobile farm machinery or noise from wind turbines or wind energy facilities. Extraneous noise must also be excluded from any measured noise levels which includes any noise that is not part of the commercial, industrial or trade premises such as local traffic, insects, or bird chirping.

The noise generator and receivers are covered by the same contiguous zone and therefore no distance adjustment is applicable to the site and the noise limits are equal to the zone levels.

Table 4 summarises the applicable noise limits at the identified NSAs.

Table 4 Noise Limits

Receiver	Period	Noise limit $L_{eq(30min)}$ dBA
FZ	Day	46
	Evening	41
	Night	36

2.3.5 Managing noise from multiple sites

Part 119 of the Environment Protection Regulations states that

> *"If 2 or more commercial, industrial and trade premises (whether existing or proposed) emit, or are likely to emit, noise that contributes to the effective noise level, a person in management or control of one or more of those premises must take all reasonable steps to ensure that the contribution from each of the premises, when combined, does not exceed the noise limit for the noise sensitive area."*

Therefore, where there is more than one premises contributing to the noise received at a noise sensitive area, each premises would need to contribute a level lower than the applicable noise limit to avoid the cumulative noise level exceeding the noise limit.

Reviewing the site and surrounds there is not expected to be any existing commercial or industrial activities in the area that would contribute significant noise to the nearby NSAs.

2.3.6 Effective noise levels

The Noise Protocol defines an effective noise level which is determined for commercial, industrial and trade premises as a 30–minute equivalent sound pressure level $L_{Aeq,30\ min}$ adjusted where relevant for duration, noise character and measurement position. Noise character adjustments include factors such as duration, tonality, impulsivity and intermittency.

For the solar farm, tonality is considered to be the most likely noise characteristic that would require an adjustment to be applied. Tonal humming noise is often associated with electrical equipment such as transformers. Where tonal noise is audible at the noise sensitive areas, an adjustment of +2 to +5 dBA may need to be applied.

3 Project description

The proposed development consists of a solar farm consisting of 64MW AC solar panels and 64MW of battery storage together with associated inverters, transformer, switchroom building, and an operations and maintenance building.

A preliminary schedule of equipment has been developed by the project engineers based on indicative equipment selections.

The switchroom and operations buildings would include small air conditioning systems including outdoor condensing units. Noise emissions from this equipment is not expected to result in a significant contribution to the nearby NSAs, however further acoustic review should be undertaken as the design progresses and final equipment selections are made. In accordance with the GED, appropriately low–noise equipment should be selected.

The overall site layout can be seen in Figure 3. Noise generating equipment is distributed throughout the project area.

General Notes

1. BASIC INDICATIVE LAYOUT/DESIGN. FOR PLANNING SUBMISSION ONLY. NOT FOR CONSTRUCTION OR CALCULATION PURPOSES. DESIGN IS NOT FINALISED. SOURCE DRAWING IS BARNSF-GN-LAY-0219.
2. GAS PIPELINE AND COMMS EASEMENT (NOT TO SCALE). ENSURE ADEQUATE STANDOFF OF FENCE AND PERIMETER ROAD.
3. 30M OFFSET FROM PROJECT LANDOWNER PROPERTY BDRY TO SOLAR PANELS INC VEGETATION SCREENING.
4. 30M OFFSET FROM SOLAR PANEL TO NEIGHBOURING PROP BDRY.
5. 30M OFFSET FROM SOLAR PANEL TO NEIGHBOURING PROP BDRY INC VEGETATION SCREENING.
6. RETAINED TREES AREA.
7. APPROX 100 X 50M AREA RESERVED FOR SUBSTATION AND BUILDINGS. REFER TO DWG BARNSF-GN-GAD-0209 FOR INDICATIVE LAYOUT WITHIN.
8. ALT ENTRY TO BE >30M SOUTH OF MURRAY VALLEY HWY COYLES RD INTERSECTION.
9. CONNECTING CABLE TO BE BORED UNDER HERMITAGE RD.
10. EXISTING AUSNET OHL TO AUSNET OHL S OF BAXTER-WHELANS RD. REFER TO SHEET 2
11. 1 X 45,000L WATER TANK TO BE LOCATED CLOSE TO GATE INSIDE EACH SITE PRIMARY ACCESS POINT. EACH PRIMARY ACCESS POINT TO HAVE BUSINESS IDENTIFICATION SIGN AND CFA WATER TANK DIRECTION SIGN ON OR NEAR GATE FACING OUTWARDS (REF BARNSES-GN-GAD-0228).
12. INTERNAL ROADS 4M. PERIMETER FIRE BREAK 10M INC ROAD.
13. INDICATIVE DESIGN SPECS:
    - 13.1. LOCATION: BARNAWARTHA, VICTORIA, AUSTRALIA
    - 13.2. UTM CONVERGENCE: 0.1821 °
    - 13.3. ALTITUDE: 162.11 M
    - 13.4. USABLE AREA: 128.93 HA
    - 13.5. PERIMETER FENCE: 7.37 KM
    - 13.6. RATED POWER @ POC: 64MW
    - 13.7. BATTERY CAPACITY: TBC. INDICATIVE 64-192MWH. LOCATION: DISPERSED, NEXT TO PCU.

LEGEND
- Project area
- Retained trees area
- Substation, switchroom, building/facility
- Colors indicate solar field connection to each power station
- Mounting structure
- Roads
- Medium voltage trenches
- Fences
- Medium voltage lines
- Existing Ausnet overhead line
- New build overhead line within Ausnet easmt
- Vegetation screen location
- Water tank
- CFA direction to water tank sign
- Business identification sign

No.	Revision/Issue	Date
1	Original	30 Mar 2022
2	Addressed DELWP RFI's	10 Jun 2022

Firm Name and Address
WIRSOL
YOUR PARTNER IN RENEWABLE ENERGY
Wirsol Energy
201/39 East Esplanade, Manly, NSW, Australia, 2095

ARP Solar

Project Name and Address
BARNAWARTHA SOLAR FARM

INTERSECTION HERMITAGE RD AND BAXTER-WHELANS RD, BARNAWARTHA, VICTORIA, AUSTRALIA 3688

Drawing number: BARNSF-GN-LAY-0226-V2	Sheet: 1 of 2
Drawing title: Indicative basic overall site layout - Planning submission	
Scale: 100m	

At this stage, final equipment selections have not been confirmed. In order to undertake a preliminary assessment of potential noise emissions, noise spectra of key items of equipment have been assumed based on indicative selections.

The sound power levels used as a basis the assessment are provided in Table 5. When equipment selections are confirmed, further acoustic review must be undertaken to ensure that the selected equipment does exceed the assumed sound power levels and to confirm whether noise character adjustments apply. Further detailed acoustic review and modelling should be undertaken as the design progresses.

Table 5 Assumed equipment sound power levels

	Number of	Location	Equipment sound power level (dB) at frequency (Hz)								Total, dBA
			63	125	250	500	1000	2000	4000	8000	
Solar Panels	148,000	Distributed	N/A(1)								
HV Transformer(3)	1	Substation	91	93	88	88	82	77	72	65	88
Battery / HVAC(2)	133	Distributed	80	80	73	69	64	62	59	55	72
Inverter unit (PCUs)(4)	18	Distributed	66	66	79	80	81	82	75	75	86
MV transformers	18	Distributed	78	80	75	75	69	64	59	52	75

(1) Solar panels are expected to be passive non-noise generating equipment
(2) Based on manufacturer data confirming 60 dBA at 1.5m
(3) Transformer sound power levels based on maximum sound power level from AS2374.6 for 1MVA transformer. Where transformers have an audible tonal characteristic at NSAs, a +5dB night period penalty may be required.
(4) Based on manufacturer data confirming 78 dBA at 1m

4 Environmental noise emissions

At this stage high level calculations have been undertaken to establish indicative noise emissions from the equipment proposed on the site. Due to the preliminary stage of the design, a computational noise model has not been developed and empirical calculations have been used to predict noise levels at the surrounding NSAs.

For the purposes of this assessment, all equipment has been assumed to operate 24/7 and therefore the most critical period for compliance with the environmental noise criteria is the night period from 10.00pm to 7.00am. Further analysis of likely operational modes of the equipment is recommended during subsequent design stages to further clarify the noise emissions from the site.

4.1 Calculation method

For this assessment, noise emissions from the proposed solar farm site are calculated using ISO 9613-2[4] via manual calculations. At this stage a computational noise model has not been developed for the site. The calculation method used incorporates the following:

- Noise attenuation over distance.
- Frequency dependent air absorption.
- Frequency dependent ground absorption.
- 1/1 octave band frequency source noise levels (63 – 8000 Hz).

The following conditions have been considered for the development and environmental noise calculations:

- Air absorption is based on 10°C (favourable propagation).

[4] ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*

- Ground absorption factor of 1.0 (absorptive ground) was adopted due to the open farming fields between the source and NSAs.
- A receptor height of 1.5 m was adopted.
- All noise sources on site run concurrently over a 24–hour period.

For this assessment, the following limitations apply:

- Topography between the source and receiver was not considered (online street view imagery show the area is relatively flat).
- Shielding between on-site noise sources was not considered.

4.2 Results

Results of the noise calculations are provided below in Table 6.

Table 6 Predicted noise levels

Receiver		Predicted noise level, dBA L_{eq}	Limit, dBA	Complies?
NSA1	2227 Murray Valley Hwy	24	36	Yes
NSA2	271 Baxter Whelans Rd	25		Yes
NSA3	230 Baxter Whelans Rd	25		Yes
NSA4	375 Baxter–Whelans Rd	32		Yes
NSA5	49 Hermitage Rd	36		Yes

Predicted noise contributions from the transformers indicate that a tonal adjustment is not required to be included.

5 Discussion

A desktop review of noise emissions from the proposed Barnawartha Solar Farm and Energy Storage development has been undertaken. The preliminary results indicate that with appropriate equipment specification, noise emissions to the nearby NSAs can achieve the applicable noise limits.

As this is a preliminary assessment, the site layout and operational equipment may change due to design development which could affect noise emissions from the site. It is recommended that additional detailed noise studies are undertaken for the site when equipment suppliers are confirmed. These studies may involve computational noise modelling to accurately predict the noise emissions from the site.

Document prepared by

Aurecon Australasia Pty Ltd
ABN 54 005 139 873
Aurecon Centre
Level 8, 850 Collins Street
Docklands, Melbourne VIC 3008
PO Box 23061
Docklands VIC 8012
Australia

T +61 3 9975 3000
F +61 3 9975 3444
E melbourne@aurecongroup.com
W aurecongroup.com

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