APPENDIX G
NOISE AND VIBRATION ASSESSMENT REPORT

RAPT CONSULTING

Ramboll

Noise and Vibration Impact Assessment – Stubbo Solar Farm, November - 2020

Relationships Attention Professional Trust

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Revision	Date	Author	
Rev 0	30 September 2020	Gregory Collins	
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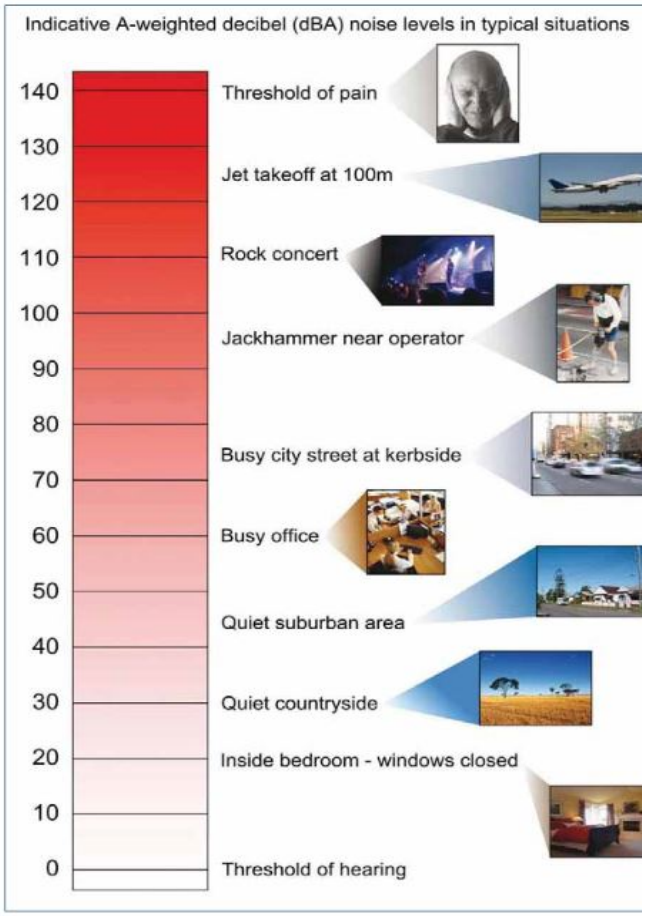
Glossary of Acoustic Terms

Term	Definition
dB	Decibel is the unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics. The picture below indicates typical noise levels from common noise sources. 
dB(A)	Frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at very low and very high frequencies.
$L_{Aeq(period)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
$L_{A10(period)}$	The sound pressure level that is exceeded for 10% of the measurement period.
$L_{A90(period)}$	The sound pressure level that is exceeded for 90% of the measurement period.
L_{Amax}	The maximum sound level recorded during the measurement period.

Noise sensitive receiver	An area or place potentially affected by noise which includes: A residential dwelling. An educational institution, library, childcare centre or kindergarten. A hospital, surgery or other medical institution. An active (e.g. sports field, golf course) or passive (e.g. national park) recreational area. Commercial or industrial premises. A place of worship.
Rating Background Level (RBL)	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period.
Feasible and Reasonable (Noise Policy for Industry Definition)	**Feasible** mitigation measure is a noise mitigation measure that can be engineered and is practical to build and/or implement, given project constraints such as safety, maintenance and reliability requirements. Selecting **Reasonable** measures from those that are feasible involves judging whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the mitigation measure. To make a judgement, consider the following: Noise impacts Noise mitigation benefits Cost effectiveness of noise mitigation Community views.
Sound power level (SWL)	The sound power level of a noise source is the sound energy emitted by the source. Notated as SWL, sound power levels are typically presented in dB(A).

1. Introduction

1.1 Background

UPC Renewables Australia Pty Ltd proposes to develop the Stubbo Solar Farm, a grid-connected photovoltaic (PV) solar farm of up to 400 megawatts in the New South Wales Central West Orana region (the project). The project would be located approximately 90 kilometres east of Dubbo, in the Mid-Western Regional Council Local Government Area.

The project would include the construction, operation and decommissioning of a 400-megawatt solar farm that would supply electricity to the National Electricity Market. Key infrastructure for the project would include:

- single axis tracking photovoltaic modules (solar panels) across the development footprint
- power conversion units (PCUs)
- onsite substation containing two main transformers and associated switchgear
- transmission infrastructure, including:
    - up to 33-kilovolt overhead and/or underground electrical reticulation connecting the power generating infrastructure to the onsite substation
    - onsite connection from the substation to the existing 330-kilovolt transmission line (Line 79) operated by TransGrid
- a battery energy storage system (BESS)
- operational and maintenance ancillary infrastructure including:
    - staff office, meeting facilities and amenities
    - car parking
    - a temperature-controlled spare parts storage facility
    - supervisory control and data acquisition (SCADA) facilities
    - a workshop and associated infrastructure
    - permanent security fencing
- access roads, both to the project and internal access roads
- temporary facilities required during the construction and decommissioning phases, such as:
    - construction compounds and laydown areas suitable for plant and equipment
    - site office and amenities
    - parking areas
    - containers for storage
    - access tracks and associated infrastructure, including gates and fencing.

The permanent and temporary components associated with construction and operation would be located within the development footprint for the project, which would cover an area of approximately 1243.3 hectares. Designated environmental exclusion zones (EEZ) would be included within the development footprint, intended to minimise impacts of the development in the areas of highest environmental value. An indicative project layout and surrounding area is provided in Figure 1.

The project is expected to require up to 400 full-time employees during peak construction and approximately 10 full-time employees would be required during operation and ongoing maintenance of the solar farm. The capital value of the project would be in excess of $30 million. Accordingly, the project is a State Significant Development (SSD) under the *State Environmental Planning Policy (State and Regional Development) 2011* (SEPP SR&D) and Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.2 SEARs and where addressed

In preparing this Noise and Vibration Impact Assessment (NVIA), the Secretary's Environmental Assessment Requirements (SEARs), issued for the project (SSD 10452) on 5 May 2020, have been addressed. The key matters raised by the SEARs for consideration in the traffic and transport assessment and where this report addresses these matters are outlined in Table 1-1.

Table 1-1: SEARs and where addressed

Requirement	Where addressed
The EIS must address the following specific matters:	
Noise – including an assessment of the construction noise impacts of the development in accordance with the *Interim Construction Noise Guideline* (ICNG),	**Section 4.1** to **Section 4.2**
operational noise impacts in accordance with the *NSW Noise Policy for Industry* (2017),	**Section 4.4**
cumulative noise impacts (considering other developments in the area),	**Section 4.1**
and a draft noise management plan if the assessment shows construction noise is likely to exceed applicable criteria;	N/A

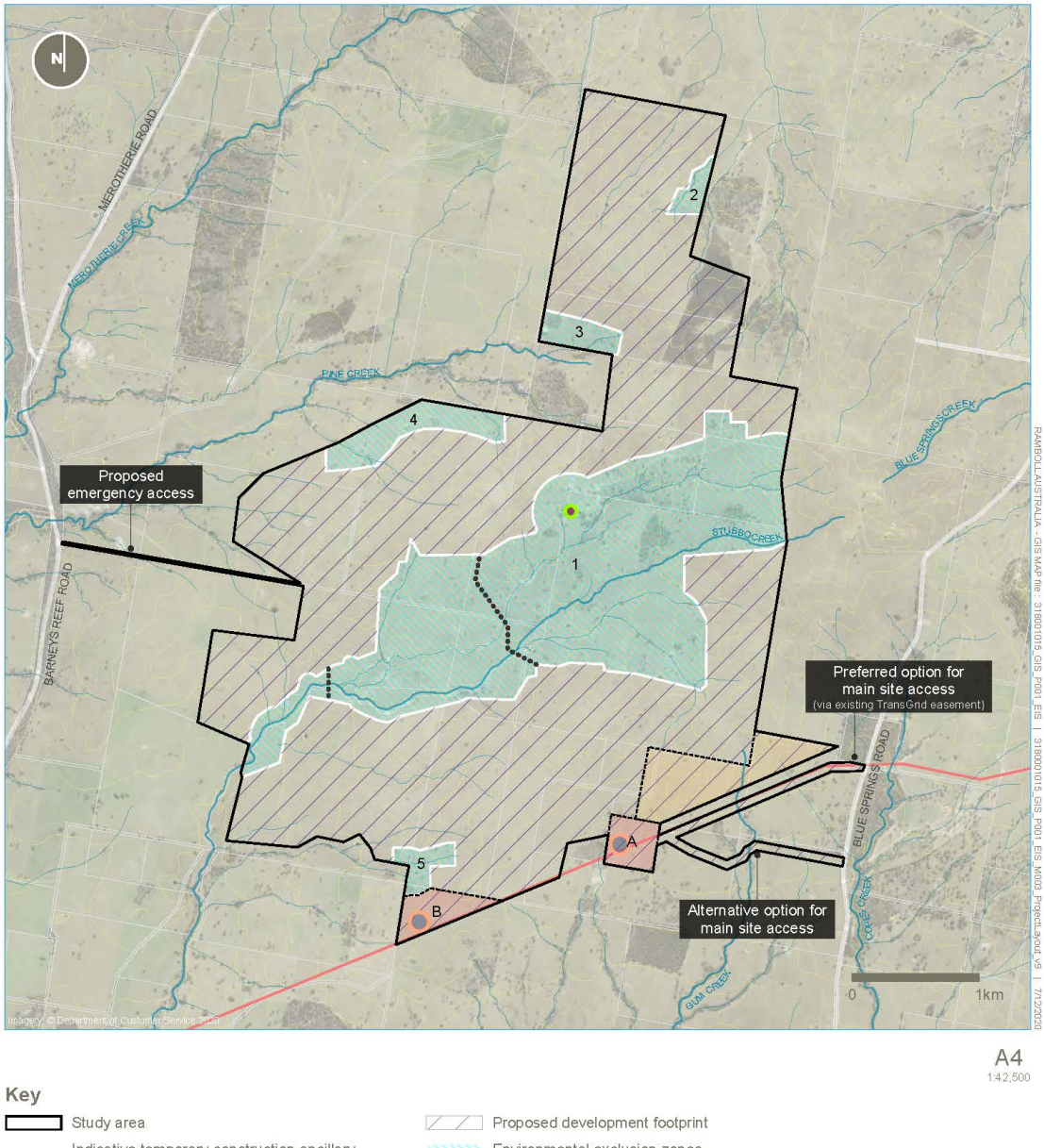


Figure 1 Indicative Site Layout and Surrounding Area

1.3 Assessment objectives

This NVIA assesses the potential impacts of the construction, operation and decommissioning of the Stubbo Solar Farm. The purpose of this NVIA is to assess potential noise and vibration from the project and to recommend mitigation measures where required.

The outcomes of this assessment include recommendations for potential noise and vibration mitigation and management measures designed to achieve an acceptable noise amenity for residential (dwelling) occupants and other sensitive receivers surrounding the study area.

1.4 Scope

The NVIA scope of work included:

- Initial desk top review to identify noise sensitive receptors from aerial photography
- Undertake noise measurements to determine ambient and background noise levels
- Establish project noise goals for the construction and operation of the proposed project
- Identify the likely principal noise sources during construction, operation and decommissioning and their associated noise levels
- assessment of potential noise, vibration and sleep disturbance impacts associated with construction, operation and decommissioning aspects of the project
- provide recommendations for feasible and reasonable noise and vibration mitigation and management measures, where noise or vibration objectives may be exceeded.

1.5 Relevant Guidelines

The relevant policies and guidelines for noise and vibration assessments in NSW that have been considered during the preparation of this NVIA include:

- Interim Construction Noise Guideline (ICNG), Department of Environment and Climate Change, 2009
- Assessing Vibration: A Technical Guideline, Department of Environment and Conservation (DEC), 2006
- British Standard BS7385.2 - 1993 *Evaluation and Measurement for Vibration in Buildings*, Part 2 - Guide to damage levels from ground borne vibration 1993
- DIN 4150: Part 3-1999 Structural vibration – Effects of vibration on structures 1999
- NSW Road Noise Policy (RNP), Department of Environment, Climate Change and Water (DECCW), 2011
- Noise Policy for Industry (NPfI), Environment Protection Authority (EPA), 2017.

1.6 Limitations

The purpose of this report is to provide an independent noise and vibration impact assessment for the project.

It is not the intention of the assessment to cover every element of the acoustic environment, but rather to conduct the assessment with consideration to the prescribed work scope.

The findings of the assessment represent the findings apparent at the date and time of the assessment undertaken. It is the nature of environmental assessments that all variations in environmental conditions cannot be assessed and all uncertainty concerning the conditions of the ambient environment cannot be eliminated. Professional judgement must be exercised in the investigation and interpretation of observations.

In conducting this assessment and preparing the report, current guidelines for noise were referred to. This work has been conducted in good faith with RAPT Consulting's understanding of the client's brief and the generally accepted consulting practice.

2. Existing Environment

2.1 Receptors

The study area and land immediately surrounding, is zoned as primary production (RU1) under the Mid-Western Regional Local Environmental Plan 2012. The area immediately surrounding the study area is therefore sparsely populated with a limited number of residential receptors. No other sensitive land uses (such as schools or places of worship) are located within or surrounding the study area. Several of the dwellings surrounding the study area are participating residences that that have entered into landholder agreements for the life of the project. Receptors within and surrounding the study area assessed in this NVIA are identified in Figure 2 and Table 2-1.

Table 2-1: Receptors and distance to study area

Receiver ID	Address	Distance From Project Area	Association With Project	Easting	Northing
R1	303 Blue Springs Road, Stubbo, NSW 2852	1475m	Associated	745575	6425777
R2	1282 Barneys Reef Road, Stubbo, NSW, 2852	230m	Associated	741140	6429411
R3	The Pinnacle 709 Blue Springs Road, Stubbo, NSW, 2852	Within Study Area	Associated	743597	6430041
R4	Blue Springs 917 Blue Springs Road, Cope, NSW, 2852	1915m	Not Associated	747260	6431376
R5	Blue Springs Cottage" 915 Blue Springs Road, Cope, NSW, 2852	1932m	Not Associated	747293	6431286
R6	1251 Barneys Reef Road, Stubbo, NSW 2852	1635m	Not Associated	739307	6429749

Receiver ID	Address	Distance From Project Area	Association With Project	Easting	Northing
R7	654 Blue Springs Road ,Stubbo, NSW, 2852	1069m	Not Associated	746683	6428817
R8	305 Blue Springs Road, Stubbo, NSW, 2852	1410m	Not Associated	745581	6425844
R9	440 Blue Springs Road, Stubbo, NSW, 2852	680m	Not Associated	746512	6427709
R10	384 Blue Springs Road, Stubbo, NSW, 2852	585m	Not Associated	746141	6426819

2.2 Background and ambient noise

To establish background and ambient noise levels, noise monitoring was undertaken from 17 to 24 August 2020. The monitoring was undertaken at 1278 Barneys Reef Road, Gulgong and 709 Blue Springs Road, Stubbo. These locations were selected as they are indicative of the background and ambient noise environment at the nearest potentially affected receptors for the project. These sites also presented as secure locations whereby minimising the risk of theft or vandalism to the monitoring equipment.

During site visits it was noted that wildlife sources and occasional road noise primarily described the ambient noise environment and is indicative of a rural environment. The monitoring locations are shown in Figure 2 to Figure 4.

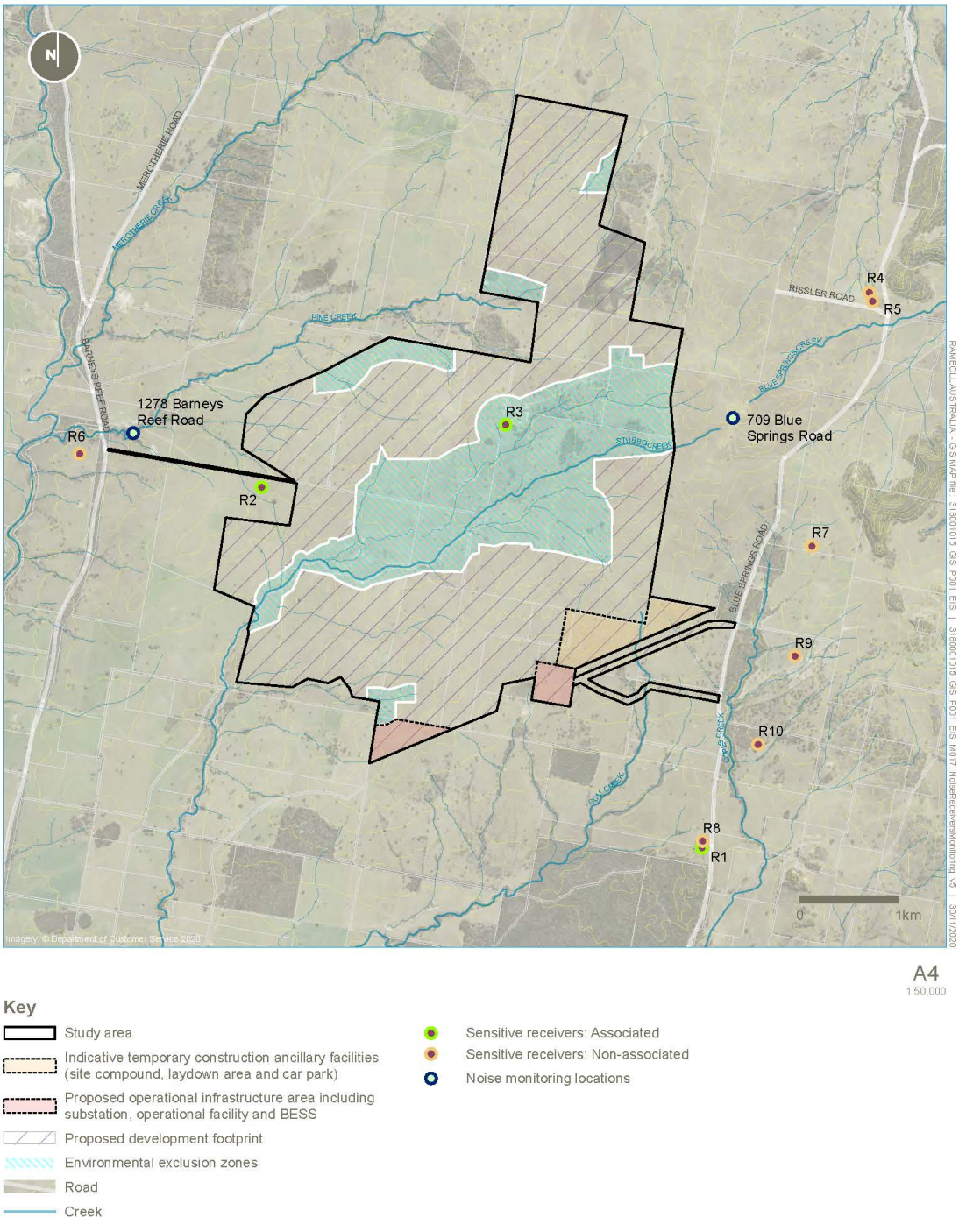


Figure 2 Noise Monitoring Locations and Nearest Receivers

Figure 3 1278 Barneys Reef Road Noise Monitoring Location

Figure 4 709 Blue Springs Road Noise Monitoring Location

Monitoring was undertaken using RION NL-42 noise loggers with Type 2 Precision. Calibration was checked prior to and at the conclusion of the measurements with no significant drift. These loggers are capable of measuring continuous sound pressure levels

and are able to record L_{Amin}, L_{A90}, L_{A10}, L_{Amax} and L_{Aeq} noise descriptors. The instruments were programmed to accumulate environmental noise data continuously over sampling periods of 15 minutes for the entire monitoring period.

The L_{A90} descriptor is used to measure the background noise level. This descriptor represents the noise level that is exceeded for 90 per cent of the time over a relevant period of measurement. In line with the procedures described in the EPA's NPfI, the assessment background level (ABL) is established by determining the lowest tenth-percentile level of the L_{A90} noise data acquired over each period of interest. The background noise level or rating background level (RBL) representing the day, evening and night-time assessment periods is based on the median of individual ABLs determined over the entire monitoring duration. The RBL is representative of the average minimum background sound level, or simply the background level.

The L_{Aeq} is the equivalent continuous noise level which would have the same total acoustic energy over the measurement period as the varying noise actually measured, so it is in effect an energy average.

Logged data was reviewed and filtered to exclude any extraneous data during the monitoring period. Weather information for the unattended noise logging was obtained from the Bureau of Meteorology Mudgee all weather station for the monitoring period and any data adversely affected by rain, wind (more than 5 m/s as per NPfI) were discarded. Noise monitoring graphs are provided in Appendix A.

The RBL and ambient L_{Aeq} levels are provided in Table 2-2 Background and Ambient Noise Monitoring Results below.

Table 2-2 Background and Ambient Noise Monitoring Results

Address	Rating background level, L_{A90}, dB(A)			Ambient noise levels, L_{Aeq} dB(A)		
	Day[1]	Evening[1]	Night[1]	Day[1]	Evening[1]	Night[1]
1278 Barneys Reef Road	35[2] (27)	30[2] (25)	30[2] (23)	43	40	31
709 Blue Springs Road	35[2] (31)	31[3] (33)	30[2] (29)	48	52	44

Note 1 Day: 7:00 to 18:00 Monday to Saturday and 8:00 to 18:00 Sundays & Public Holidays
Evening: 18:00 to 22:00 Monday to Sunday & Public Holidays
Night: 22:00 to 7:00 Monday to Saturday and 22:00 to 8:00 Sundays & Public Holidays

Note 2 Table 2.1 of the NPfI specifies a minimum assumed rating background noise level of 35dB(A) for day and 30 dB(A) for evening and night time. Number in brackets (XX) represents actual measured RBL determined for assessment period.

Note 3 As outlined in the NPfI, the evening and night criteria or management levels are set no louder than that daytime levels. Number in brackets (XX) represents actual measured RBL determined for assessment period.

3. Noise and Vibration Objectives

3.1 Construction Noise

Construction noise is assessed with consideration to DECCW *Interim Construction Noise Guidelines* (ICNG) (July 2009). The ICNG is a non-mandatory guideline that is usually referred to by local councils and other NSW government entities when construction / demolition works require development approval.

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

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

Table 3-1 Construction noise management levels – Residential receivers is reproduced from the ICNG, sets out the noise management levels (NMLs) and how they are to be applied for residential receivers.

Table 3-1 Construction noise management levels – Residential receivers

Time of day	Construction noise management level[4] $L_{Aeq,15min}$	How to apply
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(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq,15\ min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

Time of day	Construction noise management level[4] $L_{Aeq,15min}$	How to apply
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: • Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences • If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB(A)	• A strong justification would typically be required for works outside the recommended standard hours • The proponent should apply all feasible and reasonable work practices to meet the noise affected level • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community • For guidance on negotiating agreements see section 7.2.2 of the ICNG.

Note 4 Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 metres above ground level. If the property boundary is more than 30 metres from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 metres of the residence. Noise levels may be higher at upper floors of the noise affected residence.

3.2 Construction Noise Management Levels

The construction NMLs for this assessment have been conservatively based on the adopted NPfI minimum RBL's of 35 dB(A) for daytime and 30 dB(A) for evening and night time as shown in Table 2-2 and in accordance with the ICNG (DECC 2009) for residential receptors. Construction NMLs are provided in Table 3-2 below.

Table 3-2 Construction Noise Management Levels - Residential Receptors

Period	RBL L_{A90}, dB(A)	Standard hours noise management levels, $L_{Aeq,15min}$, dB(A)	Out-of-hours noise management levels, $L_{Aeq,15min}$, dB(A)
Day[5]	35	45	40
Evening[5]	30	-	35
Night[5]	30	-	35

Note 5 Day: 7:00 to 18:00 Monday to Saturday and 8:00 to 18:00 Sundays & Public Holidays
Evening: 18:00 to 22:00 Monday to Sunday & Public Holidays
Night: 22:00 to 7:00 Monday to Saturday and 22:00 to 8:00 Sundays & Public Holidays

3.3 Construction Sleep Disturbance

The ICNG requires a sleep disturbance assessment to be undertaken where construction works are planned to extend over more than two consecutive nights. The ICNG makes reference to the EPA's NSW Environment Criteria for Road Traffic Noise (ECRTN), now superseded by the NSW RNP, for the assessment of sleep disturbance. The RNP references the recommendations in the ECRTN as providing the most appropriate assessment guidance.

The guidance provided in the RNP for assessing the potential for sleep disturbance recommends that to minimise the risk of sleep disturbance during the night-time period (10pm to 7am), the $L_{A1(1\ min)}$ noise level outside a bedroom window should not exceed the $L_{A90(15\ min)}$ background noise level by more than 15 dB(A). The EPA considers it appropriate to use this metric as a screening criterion to assess the likelihood of sleep disturbance. If this screening criterion is found to be exceeded, then a more detailed analysis must be undertaken that should include the extent that the maximum noise level exceeds the background noise level and the number of times this is likely to happen during the night-time period.

The RNP contains a review of research into sleep disturbance which represents NSW EPA advice on the subject of sleep disturbance due to noise events. It concludes that having considered the results of research to date that, 'Maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions. Therefore, given that an open window provides around 10 dB(A) in noise attenuation from outside to inside, external noise levels of 60-65 dB(A) are unlikely to result in awakening reactions.

Construction is generally expected to take place during standard hours, and therefore sleep disturbance is not expected to be an issue. However, out of hours work and extended construction hours may be required on limited occasions such as for special deliveries or in the case of emergencies. As such an assessment of sleep disturbance has been undertaken and construction sleep disturbance assessment levels are presented in Table 3-3.

Table 3-3 Construction Noise Sleep Disturbance Assessment Levels

Night-time rating background level, dB(A)	Sleep disturbance screening $L_{A1(1min)}$ criteria, dB(A)	Sleep disturbance awakening reaction $L_{A1(1min)}$ criteria, dB(A)
30	45	60

3.4 Construction Road Traffic Nosie

Noise from construction traffic on public roads is not covered by the ICNG. However, the ICNG does refer to the ECRTN, which is now superseded by the RNP, for the assessment of noise relating to construction traffic on public roads.

To assess noise impacts from construction traffic, an initial screening test is undertaken by evaluating whether existing road traffic noise levels would increase by more than 2 dB(A). Where the predicted noise increase is 2 dB(A) or less, then no further assessment is required. However, where the predicted noise level increase is greater than 2 dB(A), and the predicted road traffic noise level exceeds the road category specific criterion then noise mitigation should be considered for those receivers affected. The RNP does not require assessment of noise impact to commercial or industrial receivers.

As the proposed vehicle access to the subject site is much greater during the construction stage than the operational stage, road traffic noise assessment is only considered for the construction stage. Compliance during the construction stage would result in compliance during the operational stage. Therefore, operational traffic will not be considered further from herein.

3.5 Vibration Guidelines

3.5.1 Human Exposure

Vibration goals the were sourced from the DECCW's *Assessing Vibration: a technical guideline*, which is based on guidelines contained in British Standard (BS) 6472–1992, *Evaluation of human exposure to vibration in buildings (1–80 Hz).*

Vibration, at levels high enough, has the potential to cause damage to structures and disrupt human comfort. Vibration and its associated effects are usually classified as continuous, impulsive or intermittent as follows:

- continuous vibration continues uninterrupted for a defined period and includes sources such as machinery and continuous construction activities
- impulsive vibration is a rapid build up to a peak followed by a damped decay. It may consist of several cycles at around the same amplitude, with durations of typically less than two seconds and no more than three occurrences in an assessment period. This may include occasional dropping of heavy equipment or loading activities
- intermittent vibration occurs where there are interrupted periods of continuous vibration, repeated periods of impulsive vibration or continuous vibration that varies significantly in magnitude. This may include intermittent construction activity, impact pile driving, jack hammers.

The preferred and maximum values for continuous and impulsive vibration are defined in Table 2.2 of the guideline and are reproduced in Table 3-4 for the applicable receivers.

Table 3-4 Preferred and Maximum Levels for Human Comfort

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

Note 6 Daytime is 7:00am to 10:00pm and Night-time is 10:00pm to 7:00am

The acceptable vibration dose values (VDV) for intermittent vibration are defined in Table 2.4 of the guideline and are reproduced in Table 3-5 for the applicable receiver type.

Table 3-5 Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

Location	Daytime [6]		Night-time [6]	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas [7]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Note 7 Daytime is 7:00 to 22:00 and night-time is 22:00 to 7:00: and
Note 8 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be needed to assess intermittent values against the continuous or impulsive criteria for critical areas.

3.5.2 Building Damage

Currently, there is no Australian Standard that sets the criteria for the assessment of building damage caused by vibration. Guidance of limiting vibration values is attained from reference to the following International Standards and Guidelines:

- British Standard BS7385.2 - 1993 *Evaluation and Measurement for Vibration in Buildings*, Part 2 - Guide to damage levels from ground borne vibration
- German Standard DIN 4150-3: 1999-02 Structural Vibration – Part 3: *Effects of vibration on structures*.

The recommended Peak Particle Velocity (PPV) guidelines for the possibility of vibration induced building damage are derived from the minimum vibration levels above which any damage may occur are presented in Table 3-6 for DIN 4150-3: 1999-02 and Table 3-7 for BS7385.2 – 1993.

Table 3-6 DIN 4150-3 Guideline values for vibration velocity to be used when evaluating the effects of short-term vibration on structures

Type of Structure	Peak Component Particle Velocity, mm/s			
	Vibration at the foundation at a frequency of			Vibration of horizontal plane of highest floor at all frequencies
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz*	
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20-40	40-50	40
Dwellings and buildings of similar design and/or occupancy	5	5-15	15-20	15
Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 of table 5-7 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

Note 9 At frequencies above 100Hz, the values given in this column may be used as minimum values

Table 3-7 BS7385.2 Transient Vibration Guideline Values for Potential building - Cosmetic Damage

Building Type[9]	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz[8]	15 Hz and above[8]
Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
Unreinforced or light framed structures. Residential or light commercial type buildings.	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Note 10 Values referred to are at the base of the building: and
Note 11 For transient vibration effecting unreinforced or light framed structures at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.

Unlike noise which travels through air, the transmission of vibration is highly dependent on substratum conditions between the source/s and receiver. Also dissimilar to noise travelling through air, vibration levels diminish quickly over distance, thus an adverse impact from vibration on the broader community is not typically expected. Vibration during works is considered an intermittent source associated with two main types of impact: disturbance at receivers and potential architectural/structural damage to buildings. Generally, if disturbance issues are controlled, there is limited potential for structural damage to buildings.

3.6 Operational Noise - NSW Noise Policy for Industry

The NPfI provides guidance on the assessment of operational noise impacts associated with the projects operation. The NPfI assessment procedure has two components:

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

Project Intrusive Noise Levels

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

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

Based on the measured and adopted noise levels outlined in Table 1, The intrusiveness noise levels for residential receivers are provided in Table 3-8.

Table 3-8 Intrusiveness Noise Levels

Period	RBL. L_{A90}, dB(A)	Intrusiveness noise level (RBL + 5), dB(A)
Day[10]	35	40
Evening[10]	30	35
Night[10]	30	35

Note 12 Day 7:00 to 18:00 Monday to Saturday and 8:00 to 18:00 Sundays & Public Holidays
Evening: 18:00 to 22:00 Monday to Sunday & Public Holidays
Night: 22:00 to 7:00 Monday to Saturday and 22:00 to 8:00 Sundays & Public Holidays

Amenity Noise Levels

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

The NPfI recommended amenity noise levels are shown in Table 3-9 below.

Table 3-9 NPfI Recommended Amenity Noise Levels

Type of Receiver	Noise Amenity Area	Time of Day[11, 12]	Recommended amenity noise level, LAeq, dB(A)[13, 14]
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	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[15]
Hospital ward	All		
- Internal		Noisiest 1-hour	35
- External		Noisiest 1-hour	50
Place of worship (internal)	All	When in use	40
Passive recreation (e.g. national park)	All	When in use	50
Active recreation (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	When in use	Add 5 dB(A) to recommended noise amenity area

Note 13 Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am.

Note 14 On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.

Note 15 The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

Note 16 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

Note 17 In the case where existing schools are affected by noise from existing industrial noise sources, the acceptable LAeq noise level may be increased to 40 dB LAeq(1hr)

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

Project amenity noise level = Recommended amenity noise level (Table 3-9) – 5dB(A)

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

LAeq,15minute = LAeq(period) + 3dB(A)

The project amenity noise levels ($L_{Aeq,15min}$) for rural residences and other receptors applied for this project are shown in Table 3-10.

Table 3-10 Project Amenity Noise Levels

Type of Receiver	Noise Amenity Area	Time of Day	Recommended Noise Level, dB(A)	
			LAeq, Period	LAeq, 15min
Residence	Rural	Day	50 – 5 = 45	45 + 3 = **48**
		Evening	45 – 5 = 40	40 + 3 = **43**
		Night	40 – 5 = 35	35 + 3 = **38**
School classroom (internal)	All	Noisiest 1-hour period when in use	35 – 5 = 30	30 + 3 = **33**
Place of worship (internal)	All	When in use	40 - 5 = 35	35 + 3 = **38**
Hospital ward	All	Noisiest 1-hour	50 – 5 = 45	45 + 3 = **48**
Active recreation area (school playground)	All	When in use	55 – 5 = 50	50 + 3 = **53**
Commercial Premises	All	When in use	65 – 5 = 60	60 + 3 = **63**
Industrial premises	All	When in use	70 – 5 = 65	65 + 3 = **68**

Project Noise Trigger Levels

The project noise trigger level is the lower of the intrusiveness and the amenity noise levels. Provided in Table 12 are the established project noise trigger levels for the assessment locations within the study area. Table 3-11 presents the project noise trigger levels for the day, evening and night-time periods.

Table 3-11 Project Noise Trigger Levels

Type of receiver	Assessment period	Intrusive noise levels, $L_{Aeq,15min}$, dB(A)	Amenity noise levels, $L_{Aeq,15min}$, dB(A)	Project noise trigger levels, $L_{Aeq,15min}$, dB(A)
Residential Rural	Day	40	48	40
	Evening	35	43	35
	Night	35	38	35
School classroom - internal	Noisiest 1-hour period when in use	-	33	33
School playground	When in use	-	53	53
Area specifically reserved for passive recreation (e.g. national park)	When in use	-	48	48
Commercial premises	When in use	-	63	63

Maximum Noise Level Assessment

The NPfI requires the potential for sleep disturbance to be assessed by considering maximum noise levels events during the night-time period.

Where the subject development/premises night-time noise levels at a residential location exceed the following screening levels a detailed maximum noise level event assessment should be undertaken:

- LAeq,15min 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or
- LAFmax 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater.

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

Based on the adopted background noise levels during the night, the sleep disturbance criteria for the nearest noise sensitive residential receivers are provided in Table 3-12.

Table 3-12 Night-Time Sleep Disturbance Screening Levels

Receiver type	Assessment Level $L_{Aeq,15min}$, dB(A)	Assessment Level L_{AFmax}, dB(A)
Residential	40	52

- *Maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep*
- *One or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.*

The above references identify that internal noise levels of 50 to 55 dB(A), are unlikely to cause awakenings. On the assumption that there is a 10 dB(A) outside-to-inside noise loss through an open window (see Section 2.6 of the NPfI, p15), this indicates that external noise levels of LAmax 60 to 65 dB(A) are unlikely to cause awakening reactions.

4. Assessment of Potential Impacts

4.1 Construction

Location and timing of construction activities can exacerbate noise levels and their effects on sensitive land uses such as residences. Construction noise by its nature is temporary, may not be amenable to purpose-built noise control measures applied to industrial processes, and may move as construction progresses. With these constraints in mind, the ICNG was developed to focus on applying a range of work practices most suited to minimise construction noise impacts, rather than focusing only on achieving numeric noise levels. While some noise from construction sites is inevitable, the aim of the Guideline is to increase protection of residences and other sensitive land uses from noise pollution most of the time.

4.1.1 Construction Activities

Construction within the array areas will comprise the installation of PV modules and associated infrastructure. Site preparation will be the starting phase of the construction works. The need for heavy civil works such as grading/levelling and compaction will be minimised as the flattest land areas within the three array areas, which are already mostly cleared of vegetation, have been selected.

Some heavier earth moving will likely be required for certain project infrastructure (e.g. substations and BESSs) in those instances where a level pad is necessary. In addition, grading around lower order streams and drainage channels within the three array areas may also be required in order to manage erosion during construction.

Site establishment works and preparation for construction may include:

- the establishment of a temporary construction site compound in a fenced-off area within the development footprint including:
    - A site office
    - Containers for storage
    - Parking areas
    - Temporary laydown areas.
- construction of access tracks and installation of boundary fencing
- site survey to confirm infrastructure positioning and placement
- geotechnical investigations to confirm the ground condition.

Upon completion of the site establishment and pre-construction activities described above, construction will typically be as follows:

- drive or screw piles

- install mounting structures and tracker tubes
- secure PV modules to tracker tubes
- installation of medium voltage and high voltage cables
- installation of PCUs
- complete substation augmentation
- establishment of the BESS compound
- test and commission project infrastructure.

4.1.2 Construction Hours and Duration

The proposed work would be undertaken during standard work hours:

- Monday to Friday, 7am to 6pm
- Saturday, 8am to 1pm
- No works on public holidays.

While not expected, out of hours work and extended construction hours may be required on limited occasions such as for special deliveries to minimise disruption or in the case of emergencies. . Where low intensity construction activities are required to be undertaken outside standard construction hours, such as cabling, minor assembly, use of hand tools etc, they will be managed such that they are not audible at any residential receivers

4.1.3 Noise Generating Equipment

Plant and equipment needed for the project would be determined during the construction planning phase. Likely equipment including typical sound levels are summarised in Table 14. Noise level data has been obtained from the RMS Construction Noise Estimator, Australian Standard AS2436- 2010, “Guide to noise and vibration control on construction, demolition and maintenance sites”, the UK Department for Environment, Food and Rural Affairs “Update of noise database for prediction of noise on construction and open sites” noise database as well as RAPT Consulting internal database. Other equipment may be used however it is anticipated that they would produce similar noise emissions.

Table 4-1 Typical Construction Item Sound Power Levels

Activity	Plant and equipment items	Indicative quantity per 15 minutes	SWLdB(A)[18]	Estimated Usage % during 15-minute period
Site preparation works	Dump truck	2	108	50
	Grader	1	108	50
	Roller	1	116	50
	Compactor	1	112	50
	Crane	1	106	50
	Forklift	1	106	50
	Water truck	1	96	50
	Generator	2	98	100
Pile driving and foundations for substations, BESS(s)	Piling rig	1	115	50
	Road truck (deliveries)	1	103	50
	Crane	1	106	50
	Excavator	1	104	50
	Concrete truck (idling/driving)	1	105	50
	Concrete truck (slumping)	1	113	50
	Light vehicle	2	76	50
Underground cabling	Road truck (deliveries)	1	103	50
	Cable trenching and laying equipment	1	100	50
	Light vehicle	2	76	50
PV modules full installation	Powered hand tools	1	97	50
	Compressor	1	108	50
	Pneumatic wrench	2	104	50
	Generator	1	98	50
	Crane	1	106	50
	Road truck (deliveries)	1	103	50
	Light vehicle	2	76	50
Installation of O&M buildings	Crane	1	106	50
	Forklift	1	106	50
	Light vehicle	2	76	50
	Road truck	1	103	50
	Generator	1	98	100

Activity	Plant and equipment items	Indicative quantity per 15 minutes	SWLdB(A)[18]	Estimated Usage % during 15-minute period
Removal of temporary site compound	Crane	1	106	50
	Forklift	1	106	50
	Light vehicle	2	76	50
	Road truck (deliveries)	1	103	50

Note 18 The sound power levels for the individual plant items are worst-case levels representative of the equipment operating at maximum capacity. In practice, not all plant items would operate at maximum capacity at the same time and therefore the estimated usage has been adjusted to reflect this. This adjustment is consistent with RAPT Consulting experience on similar projects.

4.1.4 Construction Assessment

Acoustic modelling was undertaken using Bruel and Kjaer's "Predictor" to predict the effects of construction noise. Predictor is a computer program for the calculation, assessment and prognosis of noise propagation. Predictor calculates environmental noise propagation according to ISO 9613-2, "Acoustics – Attenuation of sound during propagation outdoors". Terrain topography, ground absorption, atmospheric absorption and relevant shielding objects are taken into account in the calculations.

Construction noise levels have been predicted based on the potential construction noise levels provided in Table 4-1. The different scenarios will occur from site preparation to finishing works. These noise levels represent different equipment noise levels and give an idea how noise levels may change across the study area with different activities being undertaken.

The magnitude of off-site noise impact associated with construction would be dependent upon several factors:

- The intensity of construction activities
- The location of construction activities
- The type of equipment used
- Intervening terrain
- The prevailing weather conditions.

In addition, construction machinery would likely move about the development footprint, variously altering the directivity of the noise source with respect to individual receivers. During any given period, the machinery items to be used in the study area would operate at maximum sound power levels for only brief stages. At other times, the machinery may produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all construction equipment would be operating at their maximum sound power levels at any one time. Finally, certain types of construction machinery would be present in

the development footprint for only brief periods during construction. Therefore, the modelled construction noise results are considered to represent a worst-case scenario as maximum sound power levels and conservative usage periods have been included within the modelled assumptions as outlined in Table 4-1.

The site preparation works and pile driving and foundations for substations, BESS(s) have the most potential for noise impacts given the number of plant to be used, their cumulative emission levels, duration and locations of other construction activities, and therefore are the focus for the assessment. Noise from other construction activities would result in off-site noise levels that are below those from these works. Therefore, site preparation works have been assessed.

As site preparation works and construction of the substations and BESS have the highest potential for generation of noise impacts, construction works at both potential locations were assessed and included within the noise model.

Meteorological conditions

Both standard and noise enhancing meteorological conditions were considered with consideration to the NPfI, with the following parameters:

Daytime/evening

- Standard meteorological conditions – Pasquill stability class D with wind speed up to 0.5 m/s at 10 metres
- Noise enhancing meteorological conditions – Pasquill stability class D with wind speed up to 3 m/s at 10 metres.

Night-time

- Standard meteorological conditions – Pasquill stability class D with wind speed up to 0.5 m/s at 10 metres
- Noise enhancing meteorological conditions – Pasquill stability class D with wind speed up to 3 m/s at 10 metres, and/or stability category F with winds up to 2 m/s at 10 metres.

To simulate a worst case scenario noise enhancing conditions Pasquill stability class D with wind speed up to 3 m/s at 10 metres have been adopted for daytime/evening and stability category F with winds up to 2 m/s at 10 metres for night-time.

Construction noise impact assessment results

Noise levels were predicted to each assessed receptor assuming receiver heights of 1.5m above ground level for typical construction activities. Table 4-2 summarises the maximum predicted noise level from each of the construction scenarios at identified residential receptors and comply with the NMLs at all residential receptors for day period. While not expected, out of hours work and extended construction hours may be required on limited occasions such as for special deliveries to minimise disruption or in the case of emergencies. If necessary, these activities will generate much lower noise levels that what are predicted

below and will comply with out of hours work NML's. The only out of hours work exceedance predicted is while the above-mentioned daytime activities are taking place at R2 which is associated with the project.

Table 4-2 Predicted Construction Noise Levels (North) dB(A) LAeq,15min

Receiver	Day	Evening	Night-Time	Standard Daytime NML	Out of Hours Daytime NML	Evening and Night-Time Out of Hours NML	Highly Affected Noise Level
R1	<35	<35	<35	45	40	35	75
R2	41	41	41	45	40	35	75
R3	<35	<35	<35	45	40	35	75
R4	<35	<35	<35	45	40	35	75
R5	<35	<35	<35	45	40	35	75
R6	<35	<35	<35	45	40	35	75
R7	<35	<35	<35	45	40	35	75
R8	<35	<35	<35	45	40	35	75
R9	<35	<35	<35	45	40	35	75
R10	<35	<35	<35	45	40	35	75

4.2 Construction Road Traffic

Information regarding the project suggests, it would generate 230 light vehicles and 60 heavy vehicles daily during the peak construction period on the cumulative road network. In order to increase noise levels by 2 dB(A) an increase in traffic volume of 60% would be required.

Table 4-3 Future daily traffic assessment for construction traffic

Daily traffic volume category for future year base	Applicable roads	Future year base daily traffic volume (2023)	Construction daily traffic volume (2023)	Total daily traffic volume (2023)	Percentage increase	Upgrade needed (Y/N?)
1-150 vehicles	Beela Rd/ Stubbo Rd	41	30	71	42%	N
150-500 vehicles	Black Lead Lane	128	30	158	19%	N
	Blue Springs Rd	174	465	639	73%	N
	Barneys Reef Rd	390	145	535	27%	N
500-1,000 vehicles	N/A	N/A	N/A	N/A	N/A	N/A
1,000-3,000 vehicles	Cope Rd	1,288	120	1,408	9%	N
	Main St	1,531	120	1,651	7%	N
>3,000 vehicles	Ulan Rd	5,576	120	5,696	2%	N

Table 4-8 shows construction vehicles are not expected to increase overall traffic volumes by 60%, with the exception of Blue Springs Road which is predicted to increase traffic volumes by 73%. This would equate to an increase of 2.3 dB(A). It is widely recognized that differences of up to 2 dB(A) are indiscernible to the human ear and consequently a potential 0.3 dB(A) exceedance at this location is considered negligible and should comply with construction traffic noise management levels. However, it is recommended that construction traffic noise monitoring be undertaken on Blue Springs Road at the nearest potentially affected residence to assess and confirm compliance. Construction road traffic noise at all other locations is expected to be complied with.

4.3 Construction Vibration

The relationship between vibration and the probability of causing human annoyance or damage to structures is complex. This complexity is mostly due to the magnitude of the vibration source, the particular ground conditions between the source and receiver, the

foundation-to-footing interaction and the large range of structures that exist in terms of design (e.g. dimensions, materials, type and quality of construction and footing conditions). The intensity, duration, frequency content and number of occurrences of vibration, are all important aspects in both the annoyances caused and the strains induced in structures.

Energy from construction equipment is transmitted into the ground and transformed into vibrations, which attenuates with distance. The magnitude and attenuation of ground vibration is dependent on the following:

- The efficiency of the energy transfer mechanism of the equipment (i.e. impulsive; reciprocating, rolling or rotating equipment)
- The Frequency contents
- The impact medium stiffness
- The type of wave (surface or body)
- The ground type and topography.

Due to the above factors, there is inherent variability in ground vibration predictions without site-specific measurement data.

Based on distances from the project to nearest receivers which are greater than 100 metres away and items of plant to be used, vibration goals are expected to be met.

Ground Vibration – Minimum Working Distances from Sensitive Receivers

The Transport for NSW *Construction Noise and Vibration Strategy* (CNVS) provides guidance for minimum working distances. As a guide, minimum working distances from sensitive receivers for typical items of vibration intensive plant are listed in Table 4-4. The minimum distances are quoted for both “cosmetic” damage (refer BS 7385) and human comfort (refer Department of Environment and Conservation (DEC) Assessing Vibration - a technical guideline). DIN 4150 has criteria of particular reference for heritage structures. The minimum working distances are indicative and will vary depending on the particular item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions.

Table 4-4 Recommended Minimum Safe Working Distances for Vibration Intensive Plant from Sensitive Receiver

Plant Item	Rating / Description	Minimum Distance Cosmetic Damage		Minimum Distance Human Response (NSW EPA Guideline)
		Residential and Light Commercial (BS 7385)	Heritage Items (DIN 4150, Group 3)	
Vibratory Roller	<50 kN (1-2 tonne)	5m	11m	15m to 20m
	<100 kN (2-4 tonne)	6m	13m	20m
	<200 kN (4-6 tonne)	12m	15m	40m
	<300kN (7-13 tonne)	15m	31m	100m
	>300kN (13-18 tonne)	20m	40m	100m
	>300kN (>18 tonne)	25m	50m	100m
Small Hydraulic Hammer	300kg (5 to 12 t excavator)	2m	5m	7m
Medium Hydraulic Hammer	900kg (12 to 18 t excavator)	7m	15m	23m
Large Hydraulic Hammer	1600kg (18 to 34 t excavator)	22m	44m	73m
Vibratory Pile Driver	Sheet Piles	2m to 20m	5m to 40m	20m
Pile Boring	≤ 800mm	2m (nominal)	5m	4m
Jack Hammer	Handheld	1m (nominal)	3m	2m

Given the nearest residential receptors are further than 100 metres, there are no known Aboriginal or non-Aboriginal heritage items at risk of vibration impacts (for example a grinding groove site at risk of cracking) and the nature of the works indicates the risk is low, no construction vibration impacts associated with the project are expected. Regardless, it is recommended that a construction noise management plan be implemented as part of a project CEMP (Construction Environmental Management Plan).

4.4 Operational Assessment

Acoustic modelling was also undertaken using Bruel and Kjaer's "Predictor" to predict the effects of operational noise.

As part of the detailed design process, the final locations for potential noise-generating infrastructure, in particular the substations and BESS facilities, will consider the distance between this type of infrastructure and nearby non-project related residences, so as to minimise operational noise impacts, where practicable.

Noise sources considered during the operational phase of the project include inverters with integrated transformers, tracker motors (PV modules), substation transformers, BESS components and light vehicles. It is noted that noise from the inverters with integrated transformers can be tonal in nature and therefore a 5 dB penalty has been applied to the predicted noise contributions from this source in accordance with Table C.1 of the NPfI (EPA 2017). Operational noise sources are shown in Table 4-5.

Table 4-5 Operational Noise Source Sound Power Levels

Noise source	L_{Aeq} sound power level per unit, dB
Tracker motor (NEXtracker or similar)	58
Inverters	99[19]
BESS	101
Light vehicle	76
LV-MV transformer	68
MV-HV transformer (50 MVA)	90
MV-HV transformer (100 MVA)	94
MV-HV transformer (200 MVA)	98
Grid transformer (450 MVA)	103

Note 19 This includes a 5 dB adjustment for tonal characteristics as per the NSW NPfI

The results of the assessment are included in Table 4-6.

Table 4-6 Predicted Operational Noise Levels Leq(15min) dB(A)

Receiver	Day	Evening	Night-Time	Daytime Project Noise Trigger Level	Evening Project Noise Trigger Level	Night-Time Project Noise Trigger Level
R1	<35	<35	<35	40	35	35
R2	<35	<35	<35	40	35	35
R3	<35	<35	<35	40	35	35
R4	<35	<35	<35	40	35	35
R5	<35	<35	<35	40	35	35
R6	<35	<35	<35	40	35	35
R7	<35	<35	<35	40	35	35
R8	<35	<35	<35	40	35	35
R9	<35	<35	<35	40	35	35
R10	<35	<35	<35	40	35	35

The results of the operational assessment indicated all project noise trigger levels can be met for day, evening and night-time situations. As all items were modelled at their nominated maximum sound power levels, the results also conclude the maximum noise level assessment is also complied with for sleep disturbance. While compliance with all operational noise trigger levels is expected, it is recommended the project implement an

operations noise management plan to further minimise the risk of any unexpected noise issues.

4.5 Decommissioning

Physically decommissioning a solar array is essentially doing an installation in reverse. In practice, it's not intensive from a noise generating perspective. No piling or other noise intensive activities are involved. Light vehicles, fork lifts, hand tools, Noise emanating from decommissioning is therefore expected to be far less than construction activities modelled and therefore will comply with NML's.

4.1 Cumulative

The proposed Dunedoo Solar Farm is located approximately 30 km north-west of the study area. Construction of the solar farm is scheduled to commence in 2021 and be undertaken over a 12-month period. Cumulative noise and vibration impacts from the concurrent construction of the Dunedoo Solar Farm would be minimal given the distance from the development footprint of the project. These impacts would be dependent on the final timing and duration of construction activities associated with the proposed development and the project.

The Beryl Solar Power Plant is located 14 km south-west of the study area and began operations in June 2019. As noise emissions during operational activities associated with the Beryl Solar Power Plant are minimal, there are no cumulative noise and vibration impacts expected to occur as a result of the project.

There are three open cut coal mines located within the vicinity of the study area: Ulan Mine, located 10 km east of the study area; Moolarben Mine, located 14 km east of the study area; and Wilpinjong Mine, located 24 km south-east of the study area. Noise and vibration emissions from operation of the mines include blasting and operation of heavy machinery. Cumulative noise and vibration impacts with the neighbouring mining operations would be limited to the construction phase of the project and are anticipated to be minimal due to the distance between the operations and the project.

5. Mitigation Measures

It is noted that construction noise emissions are anticipated to satisfy relevant NMLs, however, the project is committed to managing noise emissions within the community and will adopt the following procedures where feasible. Recommendations for consideration during construction activities to reduce emissions to the surrounding community for this project may include:

- Regularly train workers and contractors (such as at toolbox talks) to use equipment in ways to minimise noise.
- Ensure site managers periodically check the site and nearby residences and other sensitive land uses for noise problems so that solutions can be quickly applied.
- 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).
- Maintain good communication between the community and project staff.
- Appoint a community liaison officer where required.
- Provide a readily accessible contact point, for example, through a 24 hour toll-free information and complaints line.
- Regularly inspect and maintain equipment to ensure it is in good working order. Also check the condition of mufflers.
- Place as much distance as possible between the plant or equipment and residences and other sensitive land uses.
- Locate site vehicle entrances away from residences and other sensitive land uses.
- Avoid use of reversing alarms by designing site layout to avoid reversing, such as by including drive through for parking and deliveries.
- Install where feasible and reasonable less annoying alternatives to the typical ‘beeper’ alarms taking into account the requirements of the Occupational Health and Safety legislation; examples are smart alarms that adjust their volume depending on the ambient level of noise and multifrequency alarms that emit noise over a wide range of frequencies.

6. Conclusion

This Noise and Vibration Impact Assessment (NVIA) assessed the potential impacts of the Construction and Operation of the Stubbo Solar Farm. UPC Renewables Australia Pty Ltd proposes to develop the Stubbo Solar Farm, a grid-connected photovoltaic (PV) solar farm of up to 400 megawatts in the New South Wales Central Tablelands region (the project). The project is located approximately 90 kilometres east of Dubbo, New South Wales in the Mid-Western Regional Council Local Government Area.

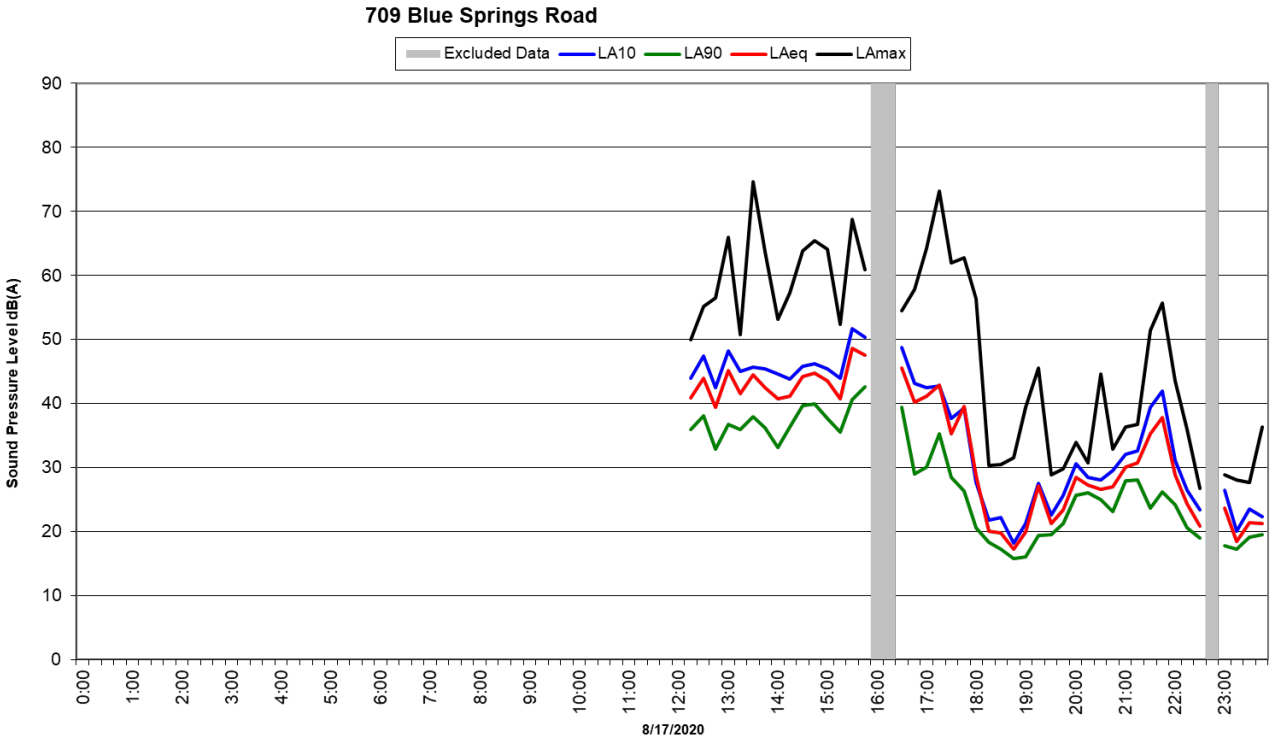
Given the distance to nearest receivers, the assumptions made in the assessment and the nature of the construction works, it is expected that construction noise and vibration will comply with adopted noise and vibration goals. In-principle recommendations are provided in section 5 to deal with the unlikely event of any construction noise issues.

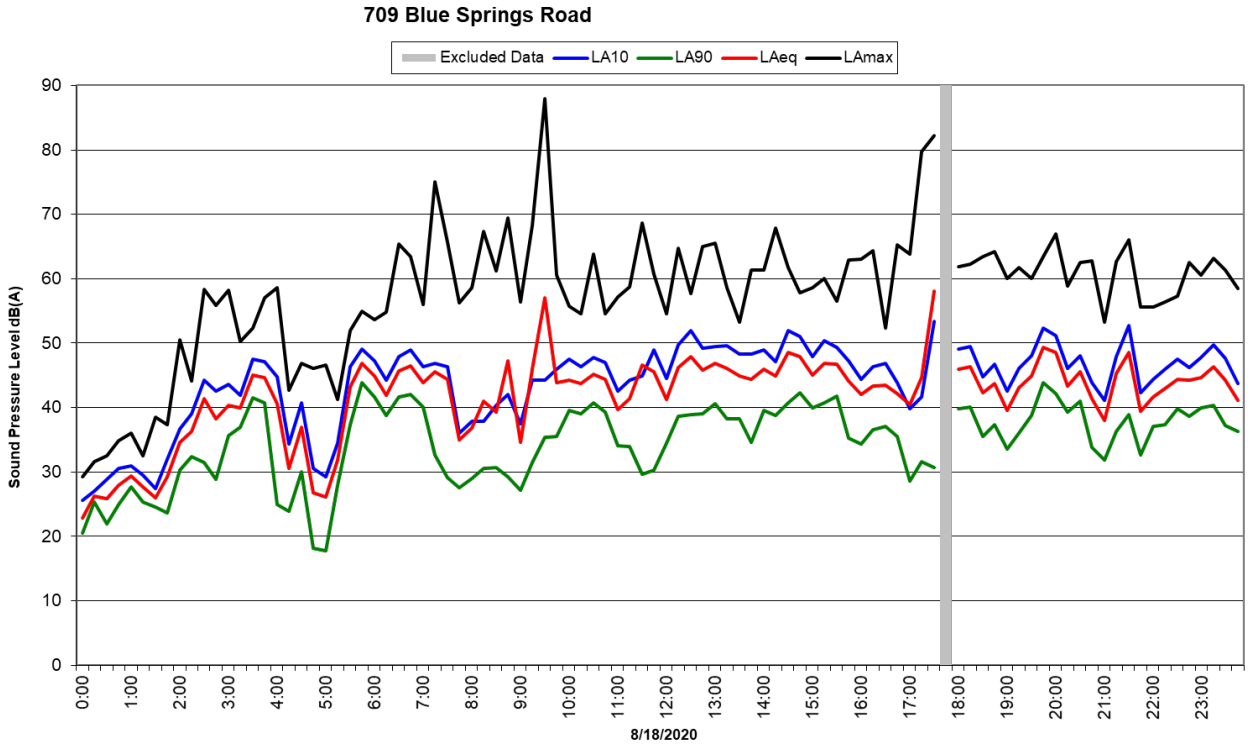
The results of the assessment indicate the operation of the project is predicted to meet with all operational noise trigger levels.

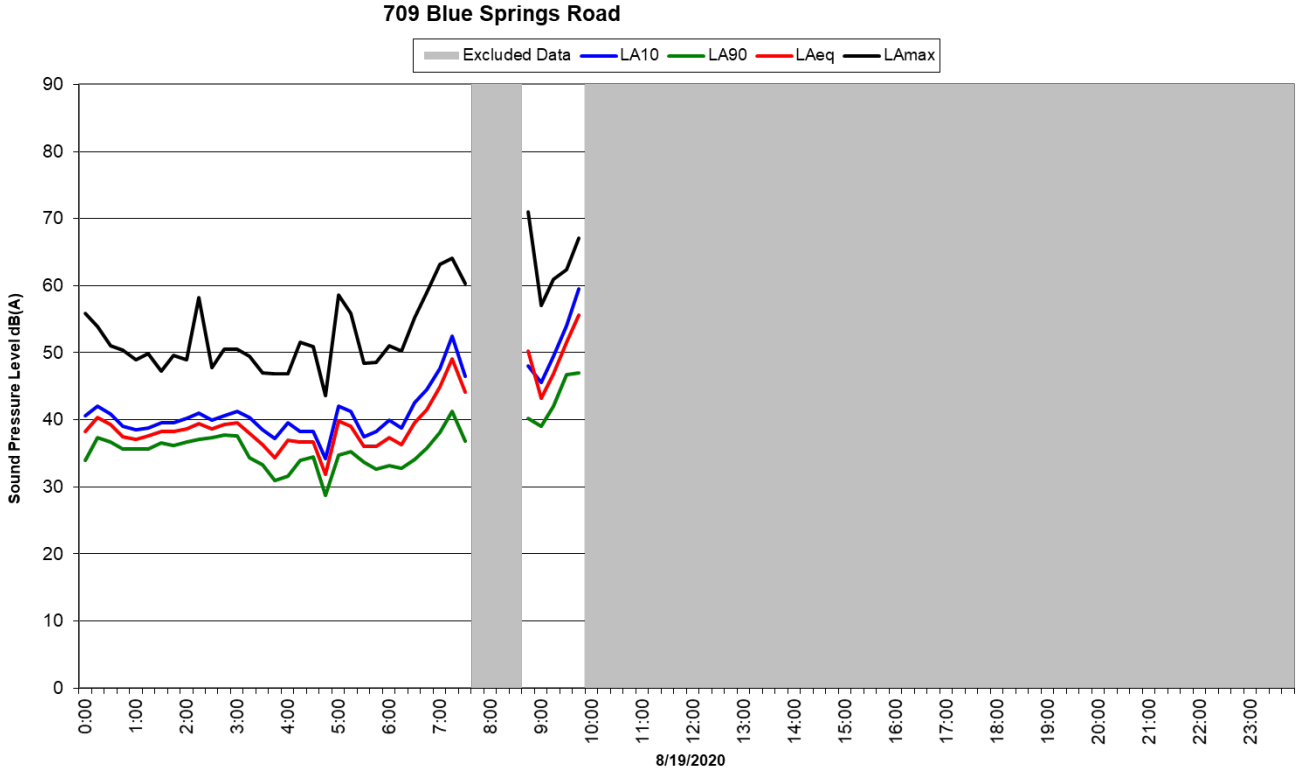
Noise emanating from decommissioning activities is expected to be far less than construction activities modelled and therefore will comply with NML's.

Cumulative noise and vibration impacts with the construction of neighbouring renewable energy projects and mining operations would be limited to the construction phase of the project and are anticipated to be minimal due to the distance between the other projects/operations and the project.

Appendix A Noise Monitoring Graphs



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LA90
LAeq
LAmax
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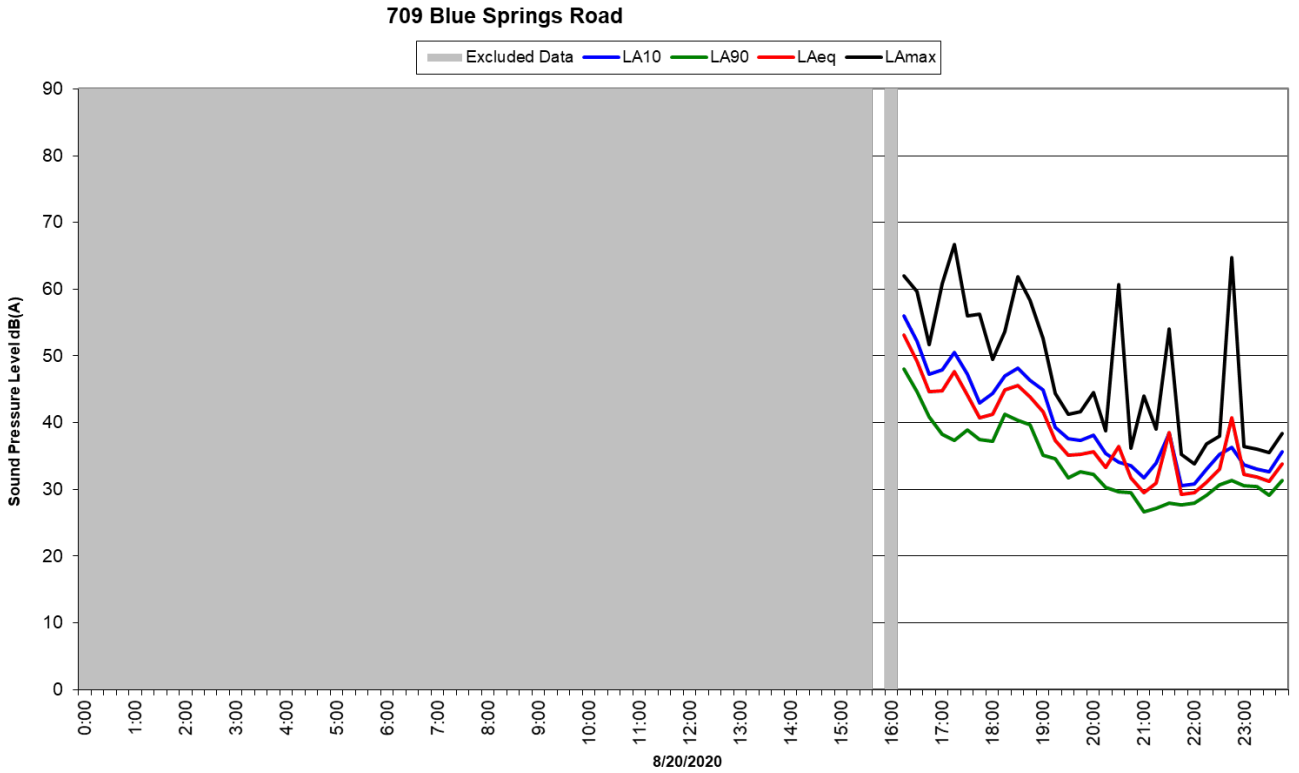
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LAeq
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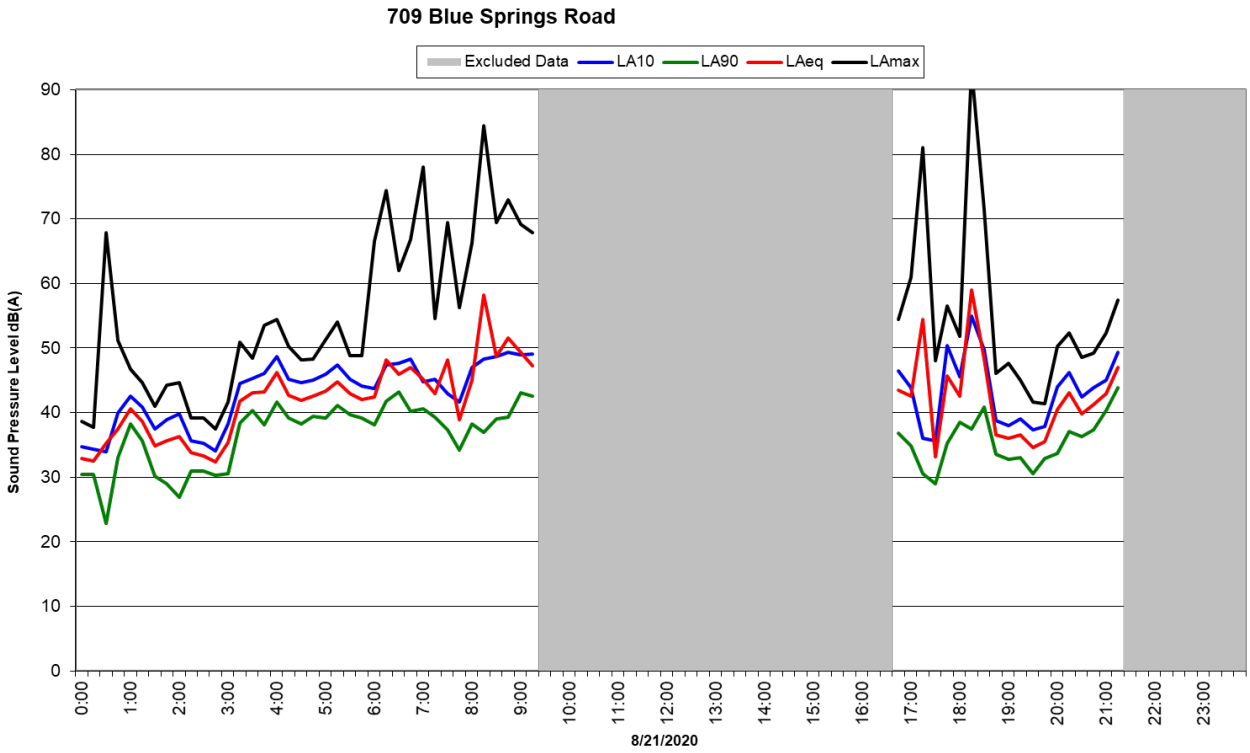
709 Blue Springs Road
Excluded Data
LA10
LA90
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Sound Pressure Level dB(A)
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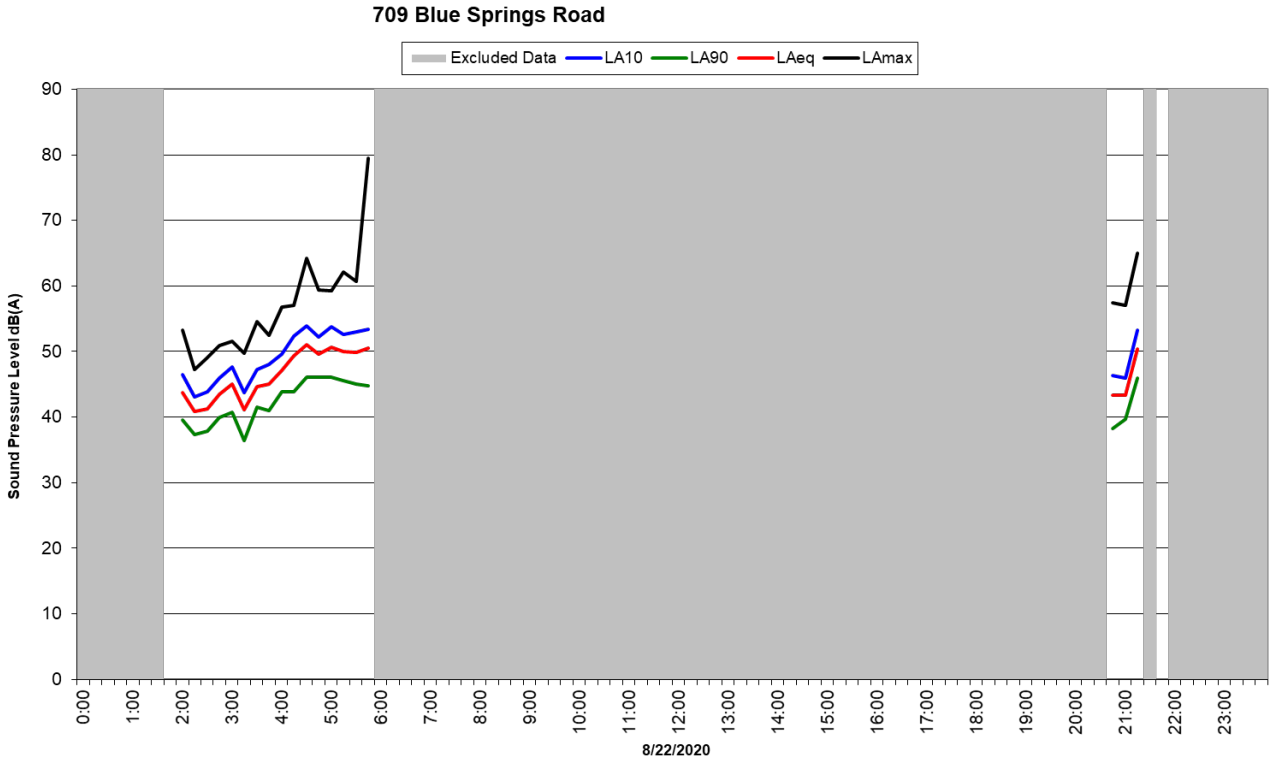
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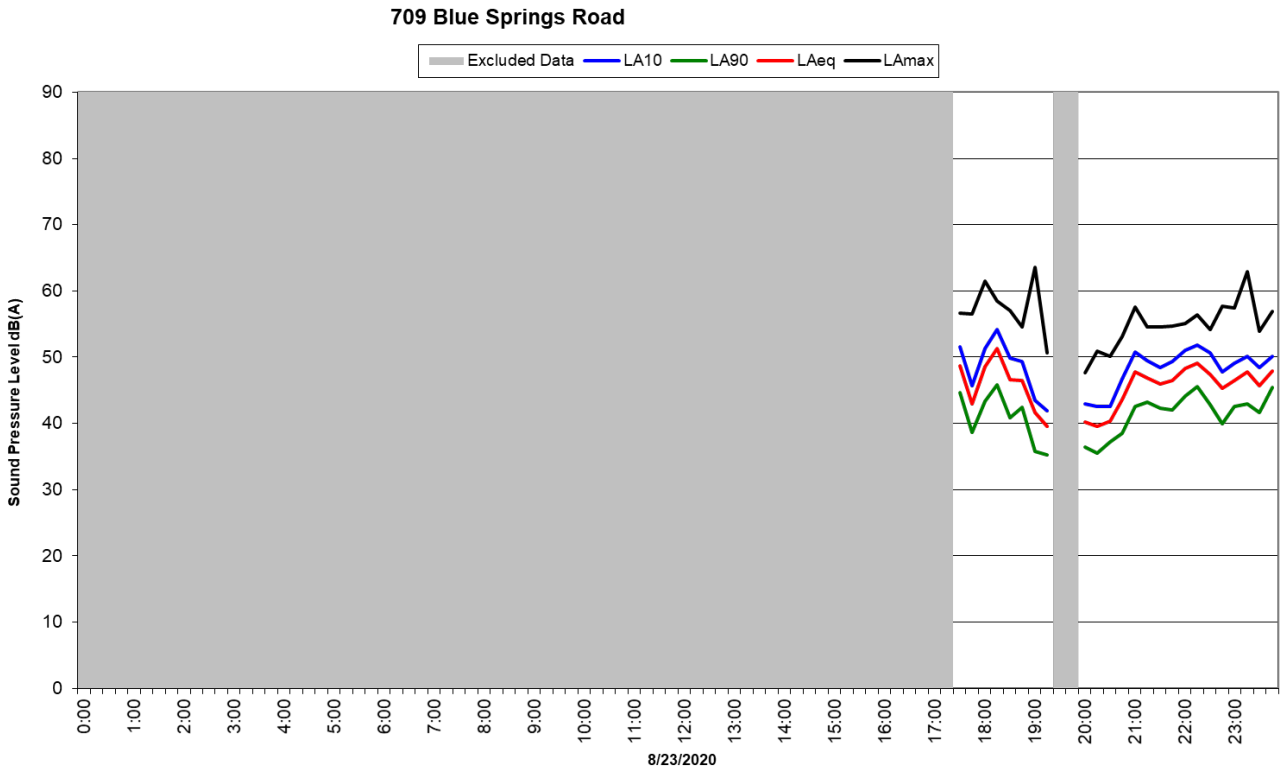
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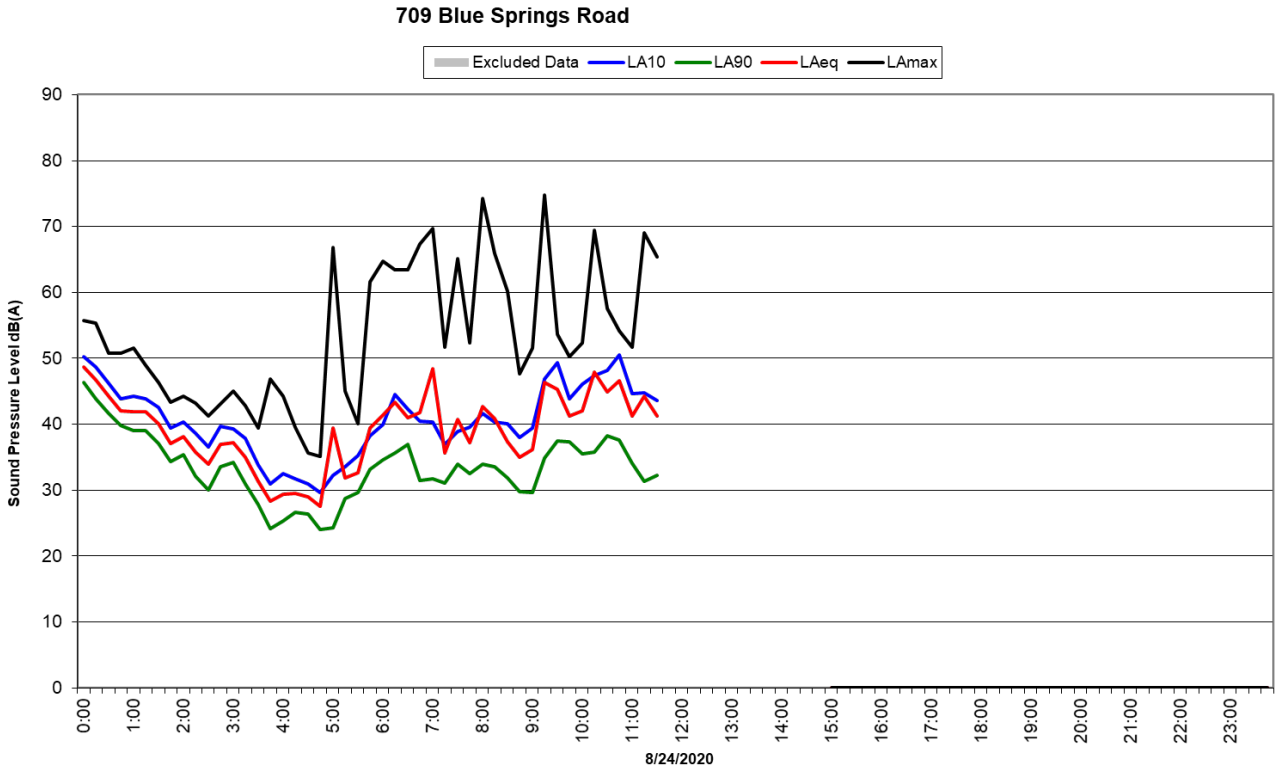
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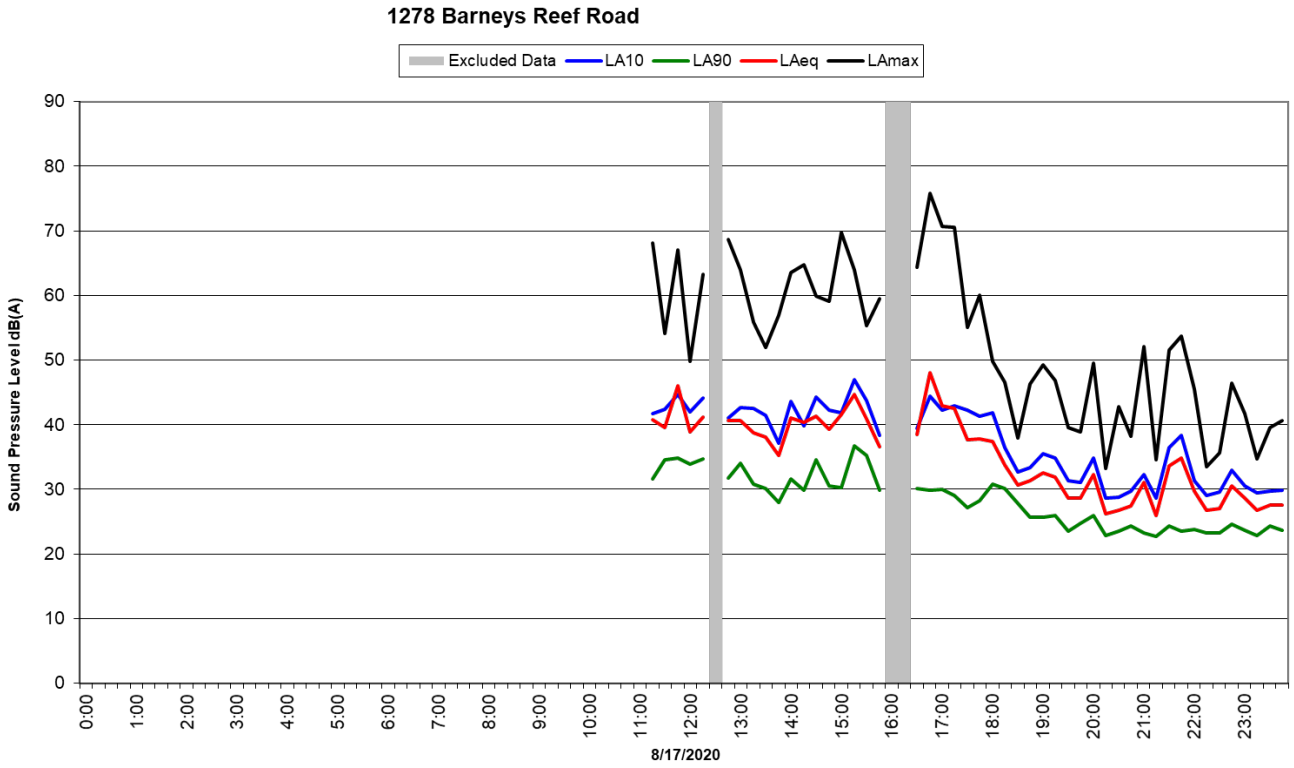
1278 Barneys Reef Road
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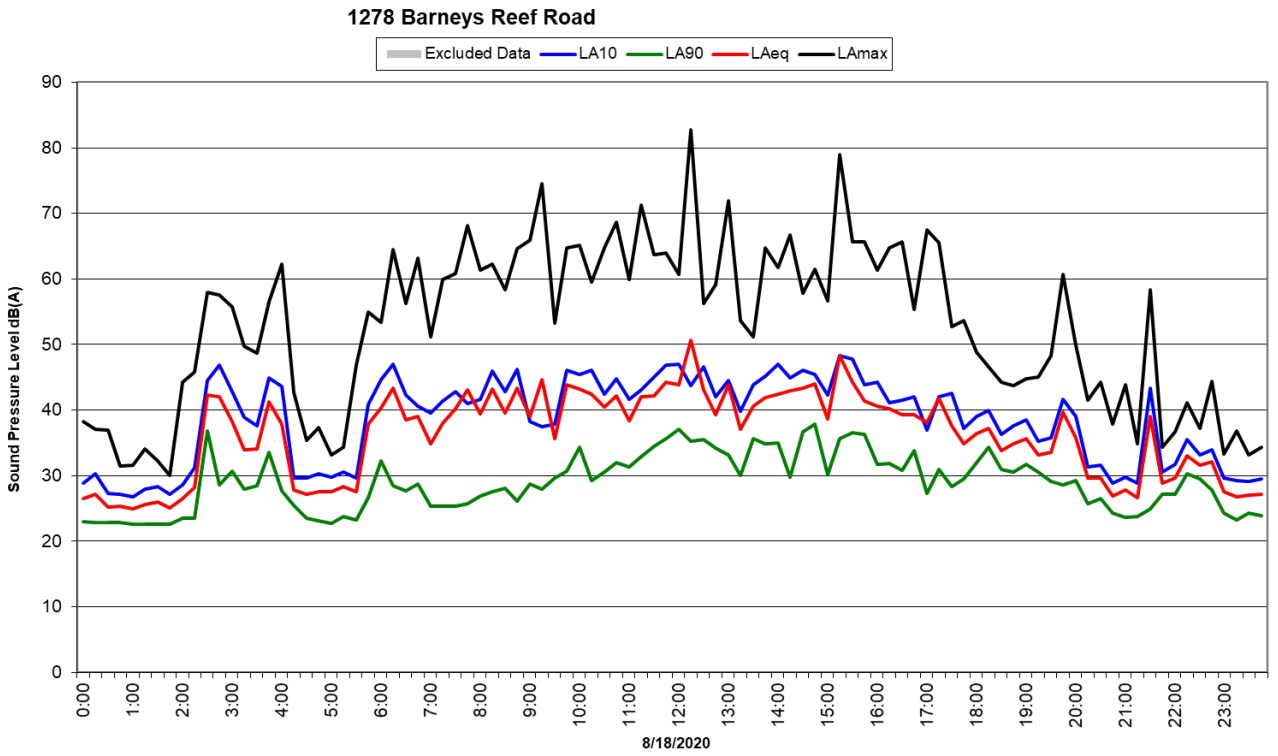
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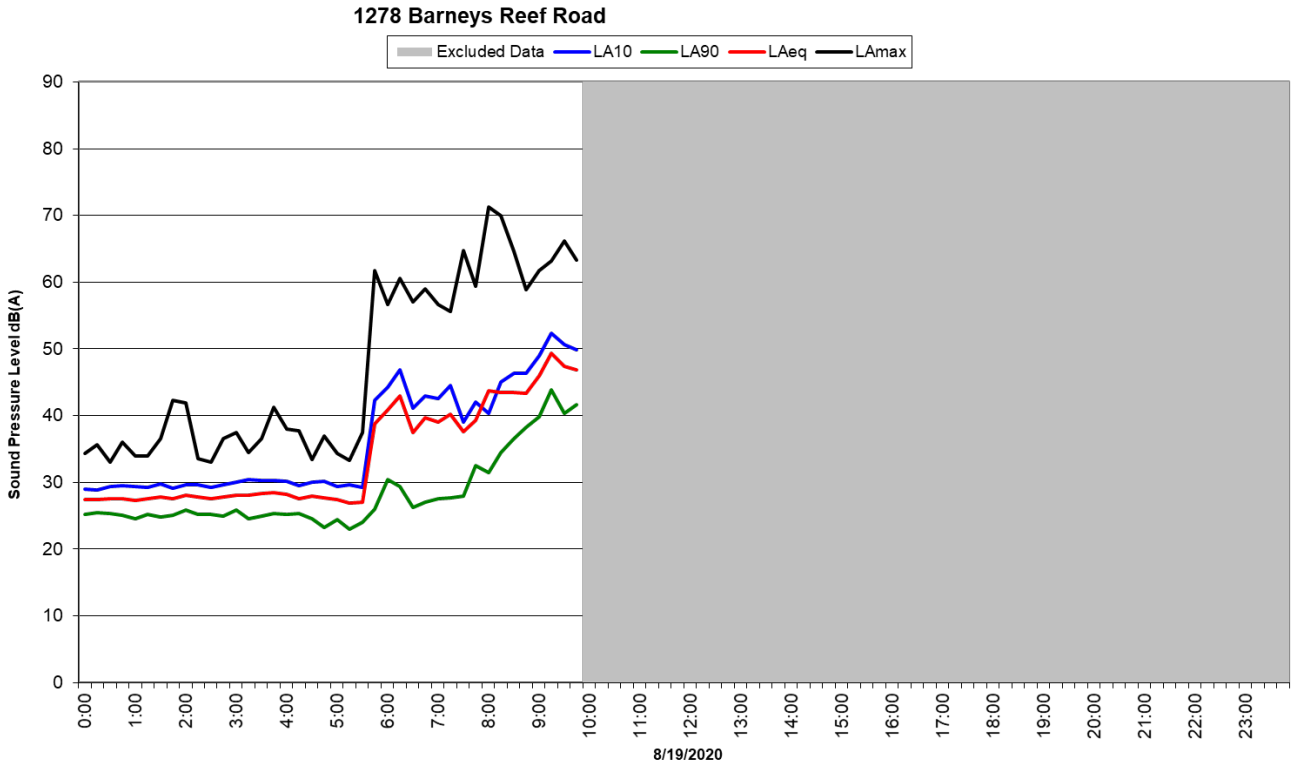
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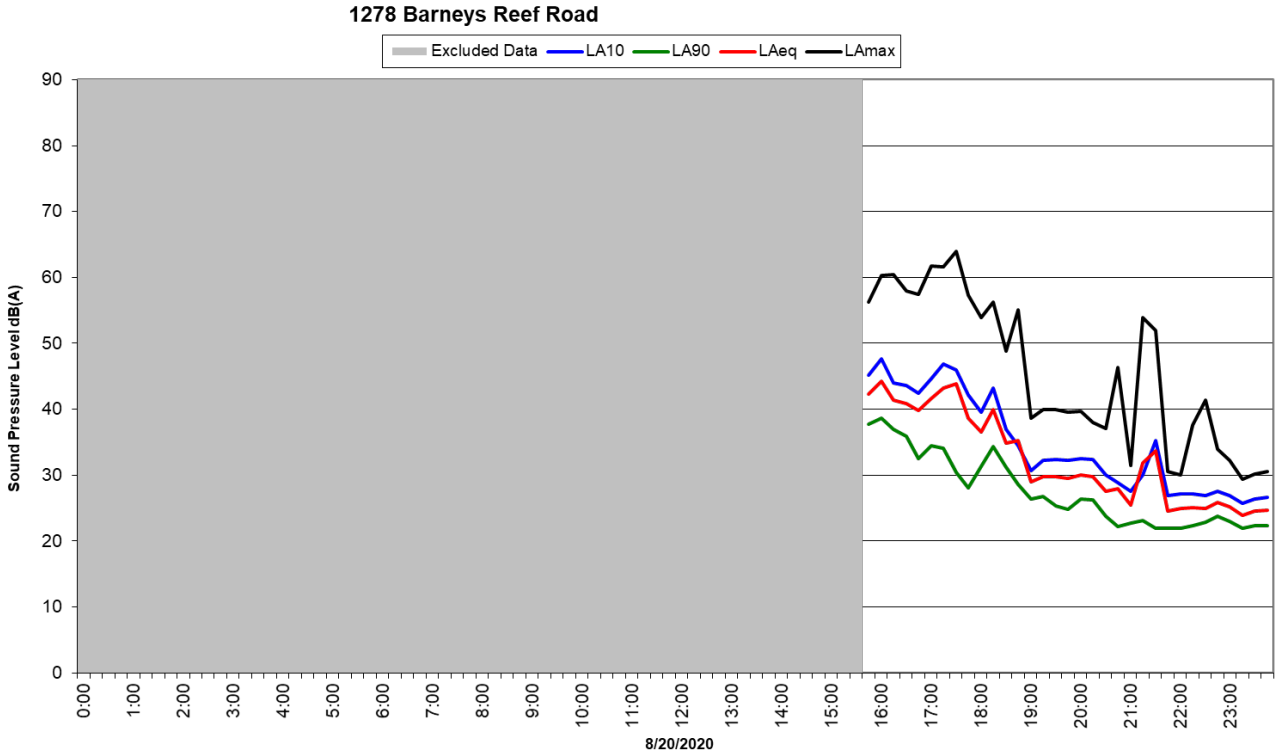
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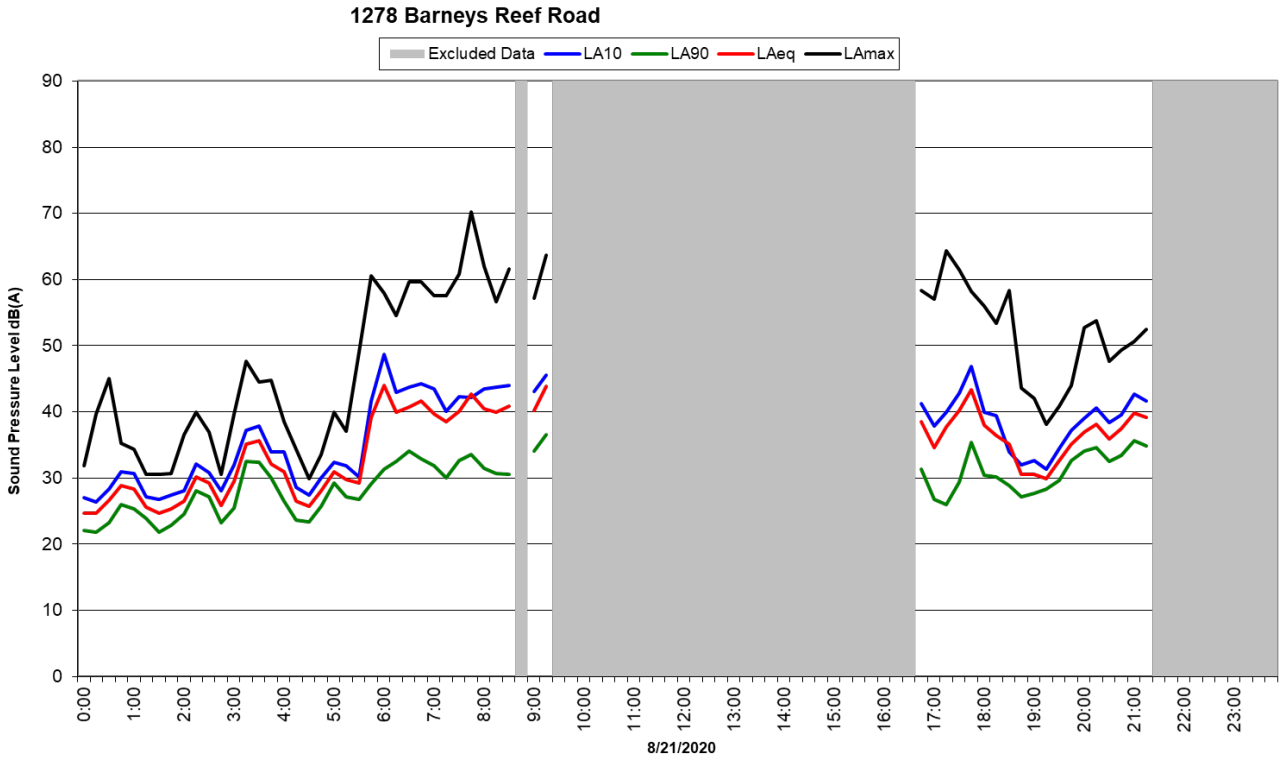
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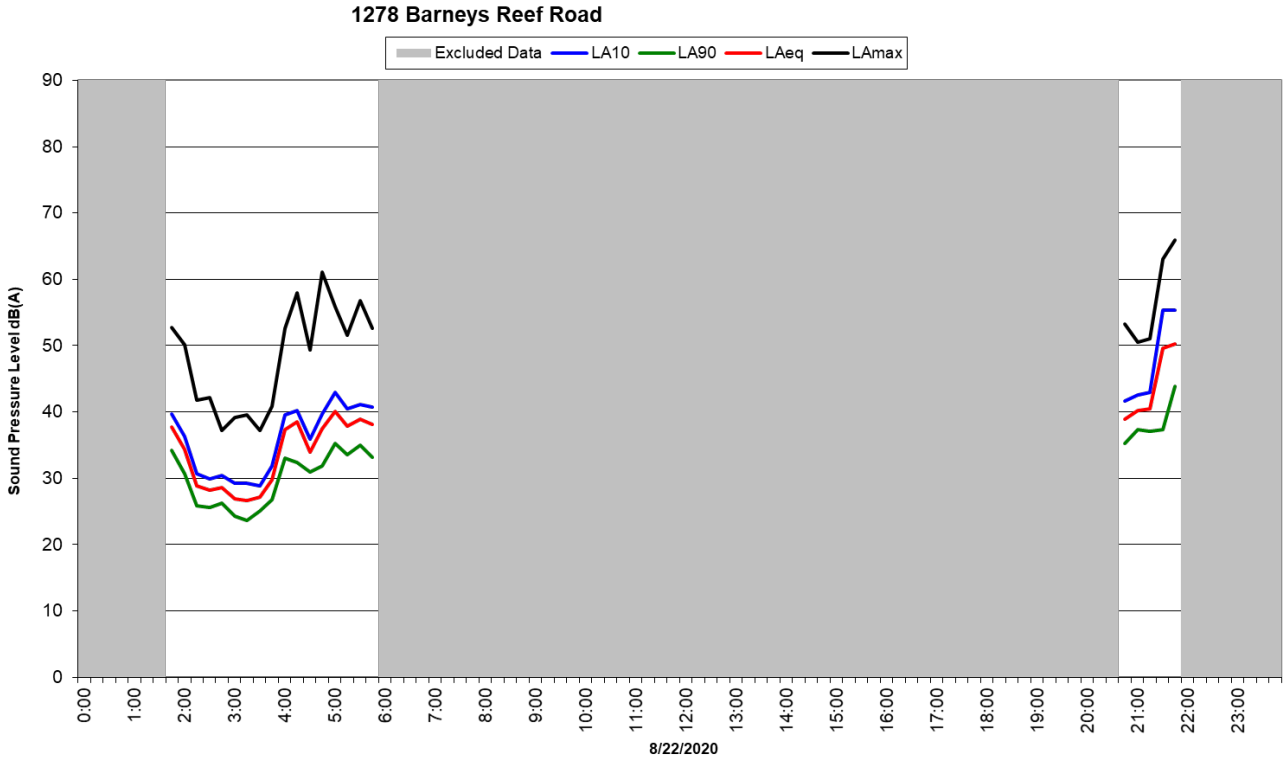
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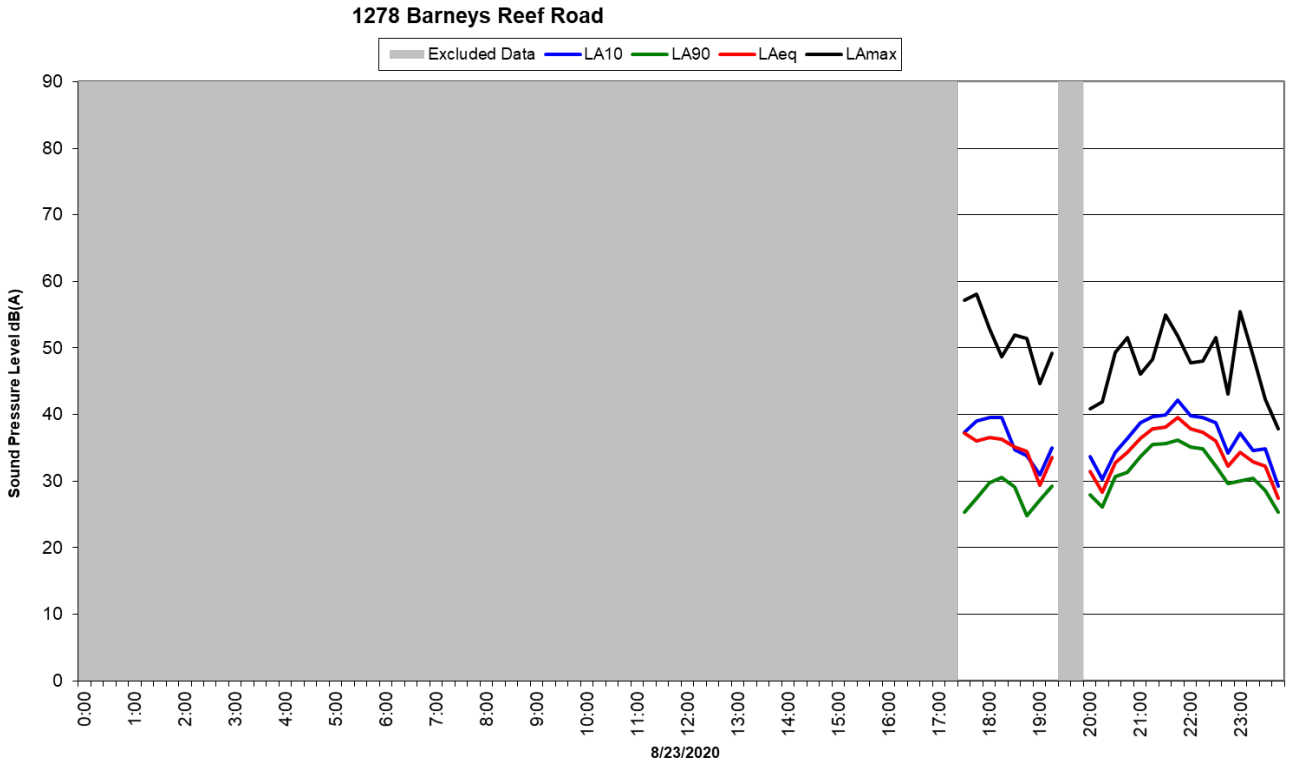
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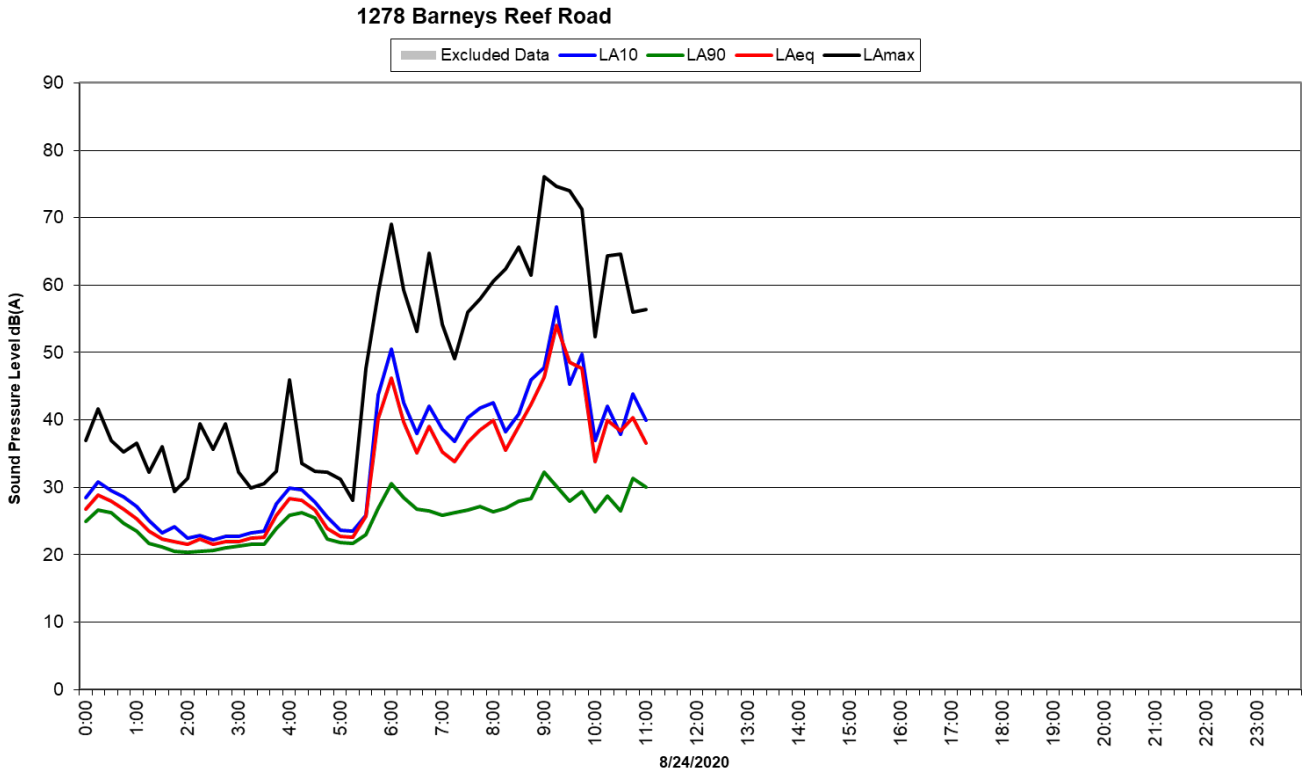
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