Viewbank Solar Farm

Noise Impact Assessment

9 September 2020

Project No.: 0493694

ERM

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Signature Page

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Viewbank Solar Farm

Noise Impact Assessment

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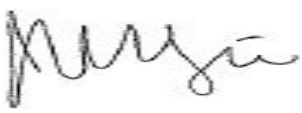

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EXECUTIVE SUMMARY

Environmental Resources Management Australia Pty Ltd (ERM) has been appointed by FRV Services Australia Pty Ltd (FRV) to undertake a Noise Impact Assessment (NIA) for the proposed Viewbank Solar Farm (the Project) located on the land generally known as '85 McCague Road' Cooma and '90 McCague Road' Girgarre East, Victoria.

This report presents the methodology, findings and any recommendations to address potential operational and construction noise impacts so that noise associated with the Project works can be managed and impacts minimised if necessary.

Assessment Overview

The project will consist of a solar energy facility comprising up to 172,368 solar modules. It is expected that the combined solar panels will have an expected capacity to generate approximately 76MW.

A substation is proposed to be located in the south-east corner of the site. This substation will connect the solar farm to the electricity network. A Battery Energy Storage System (BESS) will also be located on site, north of the site substation.

The purpose of this assessment is outlined below:

- *Determine the extent of construction noise impacts (if any) associated with the development of the Project and associated infrastructure.*
- *Determine the extent of operational noise impacts (if any) associated with the operation of the proposed Viewbank Solar Farm and associated infrastructure.*
- *Recommend mitigation measures to be implemented on site (where necessary).*

Assessment Approach

This assessment has been completed with consideration of the applicable policy, guidelines and standards presented in the reference section of this report. The key noise policy and guideline documents adopted to assess potential noise impacts are listed below:

- *State Government of Victoria – EPA Victoria – Noise from Industry in Rural Victoria (NIRV - Publication 1411), October 2011.*
- *State Government of Victoria - Environment Protection Authority (EPA) Victoria – Noise Control Guidelines (Publication 1254), October 2008.*
- *State Government of Victoria - Environment Protection Authority (EPA) Victoria – SEPP N-1 and NIRV Explanatory Notes (Publication 1412), October 2011.*

*Noise sensitive receptors and existing acoustics conditions of the area surrounding the Project were identified, refer **Section 3**. Noise criteria and limits were derived in accordance with Publication 1254 for construction aspects and the NIRV for operational aspects, refer **Section 4**.*

*Brüel & Kjær's Predictor 7810 (Version 12) noise modelling software package was utilised to calculate Project construction and operational noise levels as outlined in **Section 2.2** of this report. Based on the methodology and inputs described in **Section 2** to **Section 4**, $L_{eq,\ 30minute}$ noise levels in dBA associated with the construction and operational assessment scenarios were predicted.*

Assessment Findings

*The predicted construction noise levels identified in **Section 5** highlight that good-practice construction noise management and control techniques will be required to reduce noise levels and minimise impacts. In accordance with the requirements of Publication 1254 suitable recommendations, which can be practically implemented on-site, are provided in **Section 7**. Construction noise levels will be reduced and impacts minimised with the successful implementation of these recommendations. Impacts may not be reduced to negligible levels for all receptors during all construction activities; however, the recommendations are designed to ensure that any residual impacts are minimised as far as is practically achievable.*

*The operational noise assessment identified that the predicted operational noise levels (i.e. effective noise levels) for the Project are below the NIRV recommended maximum noise limits during the daytime, evening and night time assessment periods. As Project noise levels are predicted to comply with the applicable NIRV noise limits, mitigation and management measures to reduce operational noise are not considered necessary. It is important however that noise levels do not increase to be above those considered in this report and suitable recommendations for this design feature are provided in **Section 7** and reproduced below. It is recommended that:*

- *The quantity of noise generating operational equipment incorporated into any future design changes should not increase to be above those specified in **Appendix B** unless it can be demonstrated that the additional items will not increase operational noise levels to be above the NIRV noise limits presented in this report; and*
- *The Sound Power Level (Lw) of operational equipment incorporated into any future design changes should not increase to be above those specified in **Appendix B** unless it can be demonstrated that the increase in Lw will not increase operational noise levels to be above the NIRV noise limits presented in this report (i.e. sum of Lw for all new equipment should be $\leqslant$ 101.7 dBA).*

As compliance is demonstrated, operational noise impacts are considered acceptable at all receptors during all operational activities based on the requirements for assessment defined by the NIRV.

1. INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) has been appointed by FRV Services Australia Pty Ltd (FRV) to undertake a Noise Impact Assessment (NIA) for the proposed Viewbank Solar Farm (the Project) located on the land generally known as '85 McCague Road' Cooma and '90 McCague Road' Girgarre East, Victoria.

The purpose of this assessment is outlined below:

- Determine the extent of construction noise impacts (if any) associated with the development of the Project and associated infrastructure, including a Battery Energy Storage System (BESS).
- Determine the extent of operational noise impacts (if any) associated with the operation of the proposed Viewbank Solar Farm and associated infrastructure.
- Recommend mitigation measures to be implemented on site (where necessary).

1.1 Background

The project will consist of a solar energy facility comprising up to 172,368 solar modules. It is expected that the combined solar panels will have an expected capacity to generate approximately 76MW.

A substation is proposed to be located in the south-east corner of the site (above Midlands Highway). This substation will connect the solar farm to the electricity network, with no additional substation works proposed on-site. A Battery Energy Storage System (BESS) will also be located on site, north of the site substation.

Approximately 6.5 kilometres of gravel access roads will be constructed to provide access around the site and to the solar modules. Notably, internal access tracks will not be located within 30m of the site boundary. It is expected that all external public roads will be able to adequately cater for movements generated by the proposed development, and as such no upgrades or improvements are being contemplated to external roads.

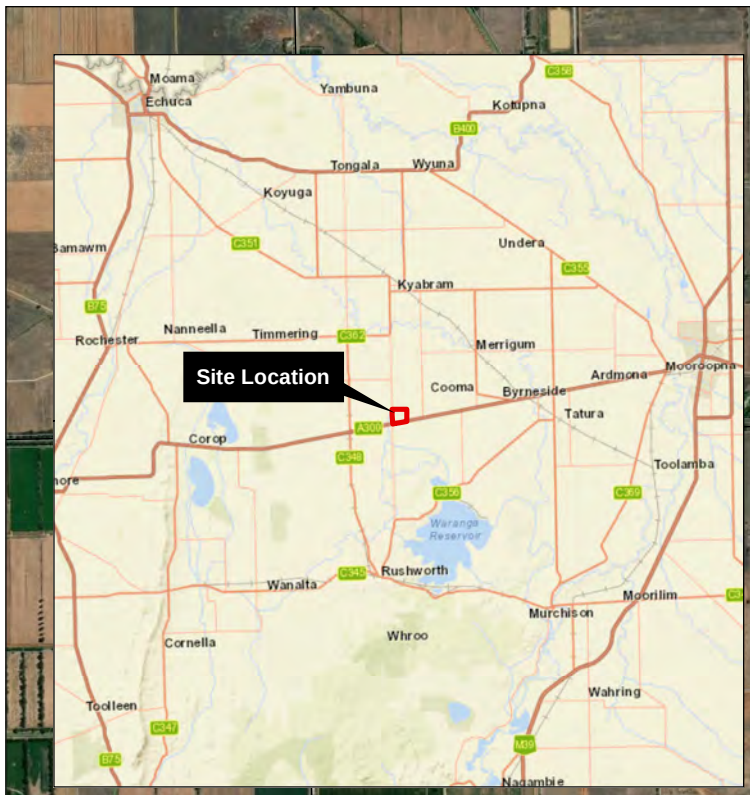
A dedicated car park has been proposed north of the office building with, the ability to use the internal access tracks as required.

1.2 Site Description

The Project site is approximately 5km east of Stanhope and 30km west of Shepparton. In relation to Melbourne, the site is approximately 200km to the north. The site is approximately 217 ha and is farmland that is used for cropping and grazing. The topography of the land is generally flat, with an elevated area to the north of the site. The property then slopes down towards the irrigation areas which also includes a natural drainage channel and swamp that are located to the south west corner. There is an existing dwelling and associated buildings on the site of 85 McCague Road, Cooma to the north of the site.

The site sits within the Greater Shepparton local government area (LGA). All land within the site is designated as Farming Zone – Schedule 1 (FZ1), with no specific planning overlays applicable to this area of land.

The site, surrounding area, land use zoning, sensitive receptors and noise monitoring locations are presented **Figure 1.1** to **Figure 1.3**.



Legend

- Site Boundary
- Cadastre
- Elevation Contour (m AHD)
- Major Road
- Local Road

Source:
GIS Data : DELWP Vicmap
Imagery : ESRI World Imagery (2016)

Locality Map

F 1.1

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Date:	15/06/2020	Drawing Size: A3	
Drawn By:	GR	Reviewed By: AB	Client: FRV Services Australia Pty Ltd

Coordinate System: GDA 1994 MGA Zone 55

0 200 400 600m

N

ERM

BREWER ROAD
MASON ROAD
CRADDOCK ROAD
PEPPERTREE LANE
COOMA
MORRISSEY ROAD
MCCAGUE ROAD
4\PP2661
53\PP2661
5\PP2661
BALDWIN ROAD
50\PP2661
1\TP119726
51\PP2661
MCEWEN ROAD
MIDLAND HIGHWAY
KYABRAM-COOMA ROAD
MIDDLE ROAD
GIRGARRE EAST
GIRGARRE EAST ROAD
POOLE ROAD
MCGRATH ROAD

Legend
- Site Boundary
- Overhead Power Line
- Cadastre
- Major Road
- Local Road
- FZ - Farming Zone
- RDZ1 - Road Zone - Category 1

Source:
GIS Data : DELWP Vicmap
Imagery : ESRI World Imagery (2016)

Zoning Map

F 1.2

Drawing No: 0493694m_NA_G002_R00.mxd		Viewbank Solar Farm Noise Assessment
Date: 15/06/2020	Drawing Size: A3	
Drawn By: GR	Reviewed By: AB	Client: FRV Services Australia Pty Ltd

Coordinate System: GDA 1994 MGA Zone 55

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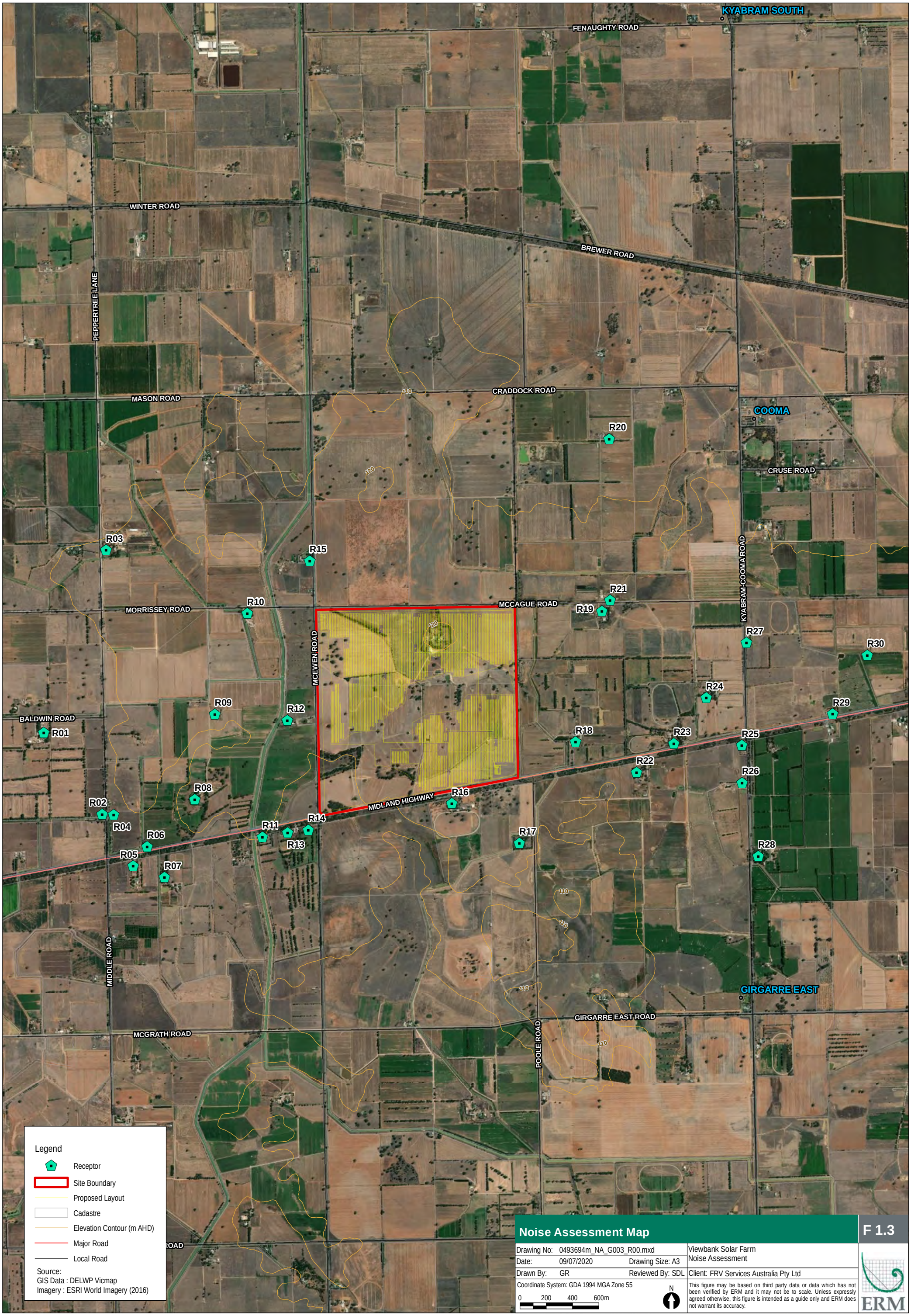
KYABRAM SOUTH
FENAUGHTY ROAD
WINTER ROAD
BREWER ROAD
PEPPERTREE LANE
MASON ROAD
CRADDOCK ROAD
COOMA
R20
CRUSE ROAD
R03
R15
R21
R10
MORRISSEY ROAD
MCCAGUE ROAD
R19
KYABRAM-COOMA ROAD
R27
R30
MCEWEN ROAD
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BALDWIN ROAD
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MIDLAND HIGHWAY
R14
R11
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R06
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R07
MIDDLE ROAD
GIRGARRE EAST
GIRGARRE EAST ROAD
POOLE ROAD
MCGRATH ROAD
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Receptor
Site Boundary
Proposed Layout
Cadastre
Elevation Contour (m AHD)
Major Road
Local Road
Source:
GIS Data : DELWP Vicmap
Imagery : ESRI World Imagery (2016)
Noise Assessment Map
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Date: 09/07/2020
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Drawn By: GR
Reviewed By: SDL
Coordinate System: GDA 1994 MGA Zone 55
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Viewbank Solar Farm
Noise Assessment
Client: FRV Services Australia Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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2. ASSESSMENT METHODOLOGY

To assess project construction and operational noise, the following scope of work has been completed:

- Review the available project and third-party data and information as considered relevant to the assessment.
- Review aerial photography, zoning data, cadastre data and third-party project data to identify potential residential (dwelling) and other sensitive (commercial and industrial) receptors situated within the potential area of influence of the site (refer **Section 3**).
- Identify significant noise generating plant, equipment and machinery that may be in use or activities that will be undertaken as part of the project and their source emission level to develop applicable assessment scenarios (refer **Section 5** and **Section 6**).
- Develop a project-specific noise model to predict project construction, and operational levels for each of the assessment scenarios developed. Following this, predicted levels were compared to project-specific criteria to identify any noise levels that exceed criteria and determine the magnitude and extent of any impacts (refer **Section 5** and **Section 6**).
- Recommend noise reducing mitigation, management measures and/or provisions for monitoring suitable to the predicted levels and anticipated impacts. These measures are designed to reduce project noise emissions to compliant levels and to minimise impacts as far as may be feasible, reasonable and practical to implement (refer **Section 7**).

An acoustics glossary of relevant acoustical concepts and terminology is provided in **Appendix A**.

2.1 Relevant Policy, Guidelines and Standards

This assessment has been completed with consideration of the applicable policy, guidelines and standards presented in the reference section of this report. The key noise policy and guideline documents adopted to assess potential noise impacts are listed below:

- State Government of Victoria – EPA Victoria – *Noise from Industry in Rural Victoria* (Publication 1411), October 2011.
- State Government of Victoria - Environment Protection Authority (EPA) Victoria – *Noise Control Guidelines* (Publication 1254), October 2008.
- State Government of Victoria - Environment Protection Authority (EPA) Victoria – *SEPP N-1 and NIRV Explanatory Notes* (Publication 1412), October 2011.

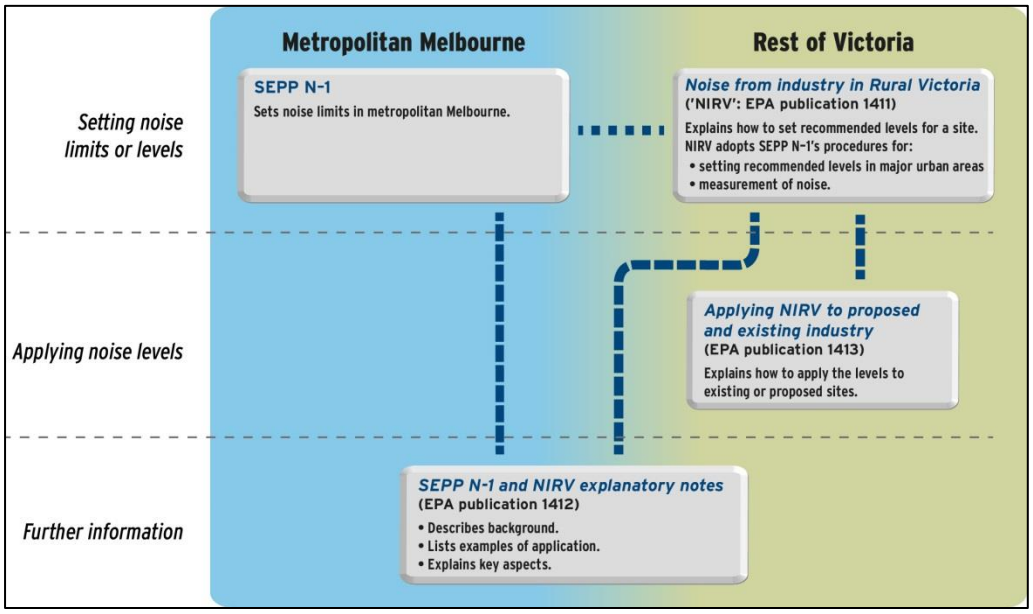
2.1.1 Applying Publication 1411 (Noise from Industry in Rural Victoria - NIRV)

In Victoria, there are two main instruments that set the acceptable levels for industry noise impacting on sensitive areas. The controls for noise depend on where the commercial or industrial premises are located. They are supported by explanatory notes and application guides.

In the Melbourne metropolitan area, SEPP N1 applies. Outside of the Melbourne metropolitan area, Publication 1411 - *Noise from Industry in Rural Victoria* (NIRV) applies. The NIRV provides guidance on protecting community wellbeing and amenity near industrial premises in regional Victoria. The policy is also used as a planning tool. The policy requires new and proposed industries to be designed so as to not exceed the noise limits outlined in the NIRV.

The overall noise assessment process for industrial premises in Victoria is illustrated in **Figure 2.1**. The NIRV has been applied here to assess potential operational noise impacts associated with the Project.

Figure 2.1 – Industrial Noise Assessment Process in Victoria



2.1.2 Applying Publication 1254

Victorian noise guidelines are primarily intended to be used by municipal officers to assist in the resolution of complaints or to avert a possible noise nuisance. However, some state guidelines have been prepared so that they could be incorporated into a permit condition of a development or embodied as a local law. Victorian noise guidelines are designed to be a potential basis of assessment and are not considered the last word.

The Publication 1254 noise control guideline outlines requirements and criteria for construction and demolition site noise applicable to industrial and commercial premises. Publication 1254 affirms the minimum expectation that noise from these sites must not be audible within a habitable room of any residential premises between 10 pm and 7 am. This is considered unreasonable noise under the EP Act. However, provision is made for circumstances of unavoidable works or low-noise or managed-impact works.

Publication 1254 does not limit the general ability of a local government or police officer to assess the unreasonableness of noise at any time. For example, if unavoidable works were done in an unnecessarily noisy way, this may be considered to be unreasonable. General noise at any time during the day might still be considered unreasonable, taking into account the work practices and circumstances of the noise. As specified in s48A (4) of the EP Act, assessment must consider the attributes of the noise and the time, place and circumstances in which it is emitted.

Publication 1254 has been applied here to assess potential construction noise impacts associated with the Project.

2.2 Noise Modelling

The methodology, inputs and assumptions that have informed the construction and operational noise modelling are outlined below:

Table 2-1 Noise Modelling Features, Inputs and Assumptions

ID	Feature	Description
1	Noise modelling software	■ Brüel and Kjær's Predictor 7810 (Version 12) noise modelling software package was utilised to calculate noise levels using the International Organisation for Standardisation (ISO) 9613-2:1996 (ISO9613:2) - *Acoustics - Attenuation of Sound during Propagation Outdoors - Part 2: General Method of Calculation* noise propagation algorithms (international method for general purpose, 1/1 octaves). Meteorological corrections have been calculated via the CONCAWE method (*Report no. 4/18, The propagation of noise from petroleum and petrochemical complexes to neighbouring communities*, Prepared by C.J. Manning, M.Sc., M.I.O.A. Acoustic Technology Limited (Ref.AT 931), CONCAWE, Den Haag May 1981). ■ The Predictor software package allowed 3D elevation data to be combined with ground regions, water, foliage, significant building structures etc. and receptor locations, to create a detailed and accurate representation of the site and surrounding area. The noise model allowed for the quantification of noise levels from multiple sources, based on sound power or pressure levels emitted from each source. ■ Brüel and Kjær's Predictor 7810 (Version 12) software achieves the requirements of ISO 17534, 2015 as applicable to the ISO9613:2, 1996 calculative algorithm.
2	Construction and Operational Noise Level Predictions	■ Sound Power Level (Lw, dBA) data incorporated into the project-specific noise models were provided by the client, obtained from relevant Australian Standards or adapted from a proprietary source term database available at the time of the assessment. This assessment has considered standard good practice mitigation measures via noise modelling by adopting the midpoint values for all sound power levels. ■ 3D 2 metres interval elevation data, zoning data and cadastre (spatial data) was obtained from the VIC Government - Department of Environment, Land, Water and Planning (DELWP). Buildings near the Project were included in the noise model based on this spatial data or manually digitised from aerial photography. ■ Potentially sensitive receptor locations were identified (detailed in **Section 3.2**) to assess construction and operational noise impacts. These locations were selected to ensure the most affected points were assessed. The receptor locations adopted for this assessment were presented in **Figure 1.1** to **Figure 1.3**. ■ Noise levels were calculated at 1.5 metres (m) above ground level for all receptors. ■ A ground factor of 0.7 was adopted for the modelling area (0.0 is hard, 1.0 is soft).

		■ To represent general construction emissions, capturing the size, layout and number of noise generating plant / equipment, “area sources” were utilised to predict $L_{eq,\ 30\ minute}$ noise levels in dBA. A separate area source was placed in the model for each phase of works, stage and activity to represent the distribution of noise across the broader project site. For operational emissions, a combination of “point sources” and “emitting façades” were utilised with separate sources placed in the model for each key noise generating item of equipment. ■ The noise assessment scenarios and modelling data are summarised in **Section 5** and **Section 6** and presented in detail in **Appendix B**.
3	Meteorological Conditions	■ General meteorological conditions for the project-specific noise models included a temperature of 8.6°C (annual mean minimum), and humidity of 72% (annual mean for 9 AM statistics), representative of average conditions for the area. These temperature and humidity values were determined based on annual average weather data publically available from the Bureau of Meteorology (BOM) Weather Station situated at Kyabram: - Site number: 080091 - Locations: Latitude: 36.34° South / Longitude: 145.06° East - Elevations: 105 metres. ■ Both standard meteorological conditions and noise-enhancing meteorological conditions have been considered, for the operational noise modelling, based on the following meteorological parameters: - Standard meteorological conditions: daytime, evening and night Pasquill–Gifford stability Category D conditions and calm winds. - Noise-enhancing meteorological conditions: daytime and evening Pasquill–Gifford stability Category D conditions, light source-to-receiver winds (3 m/s) and a night-time stability Category F temperature inversion condition, light source-to-receiver winds (2 m/s). ■ Construction noise modelling has adopted neutral conditions only (representing conditions commonly experienced during the daytime period, when works would mostly occur) and calm winds for all scenarios.

3. EXISTING ENVIRONMENT

This section presents the noise sensitive receptors (derived with consideration to NIRV) adopted for this assessment and provides a summary of the existing acoustics conditions of the area surrounding the site.

3.1 Existing Noise Environment

A key element in assessing environmental noise impacts is an understanding of the existing noise environment in the vicinity of the closest and/or potentially most affected receptors situated in proximity to the Project site.

The noise environment in the vicinity of the Project receptors is best described as ‘rural’ or an area with an acoustical environment that is dominated by natural sounds, generally characterised by low background noise levels.

3.2 Noise Sensitive Receptors

The closest and/or potential noise sensitive receptors situated in close proximity to and within the potential area of influence of the Project are described in **Table 3.1** and previously shown in **Figure 1.3**.

These locations do not represent all receptors located in the vicinity of the Project but have been adopted here for construction and operational noise level predictions and to assess potential noise impacts. These locations are considered to be representative of locations that will potentially experience the highest impacts associated with the Project, if any.

Table 3.1 Noise Sensitive Receptors

Receptor ID	Description	GPS Co-ordinates (MGA Zone 55 H)		Elevation, ~m AHD[1]	Distance from Project (~m)	Direction from Project
		Easting	Northing			
R01	Residential (dwelling) receptor	321515	5966000	110	2050	west
R02	Residential (dwelling) receptor	321959	5965383	110	1790	west
R03	Residential (dwelling) receptor	321989	5967388	110	1640	north-west
R04	Residential (dwelling) receptor	322046	5965378	110	1600	west
R05	Residential (dwelling) receptor	322194	5964989	110	1460	west
R06	Residential (dwelling) receptor	322302	5965136	110	1335	west
R07	Residential (dwelling) receptor	322433	5964901	110	1280	south-west
R08	Residential (dwelling) receptor	322662	5965495	110	970	west
R09	Residential (dwelling) receptor	322816	5966143	110	800	west
R10	Residential (dwelling) receptor	323061	5966907	110	530	north-west
R11	Residential (dwelling) receptor	323177	5965210	110	515	south-west
R12	Residential (dwelling) receptor	323366	5966096	110	260	west
R13	Residential (dwelling) receptor	323368	5965242	110	320	south-west
R14	Residential (dwelling) receptor	323526	5965264	110	270	south-west
R15	Residential (dwelling) receptor	323535	5967306	113	370	north
R16	Residential (dwelling) receptor	324616	5965463	112	120	south
R17	Residential (dwelling) receptor	325130	5965163	110	504	south
R18	Residential (dwelling) receptor	325557	5965932	112	550	east
R19	Residential (dwelling) receptor	325756	5966924	110	660	east
R20	Residential (dwelling) receptor	325812	5968235	110	1490	north-east
R21	Residential (dwelling) receptor	325818	5967007	110	750	east
R22	Residential (dwelling) receptor	326021	5965700	110	920	east
R23	Residential (dwelling) receptor	326302	5965920	110	1200	east
R24	Residential (dwelling) receptor	326549	5966266	110	1450	east
R25	Residential (dwelling) receptor	326819	5965904	110	1720	east
R26	Residential (dwelling) receptor	326821	5965621	110	1730	east
R27	Residential (dwelling) receptor	326855	5966685	110	1760	east
R28	Residential (dwelling) receptor	326944	5965062	110	1950	south-east
R29	Residential (dwelling) receptor	327511	5966145	110	2400	east
R30	Residential (dwelling) receptor	327773	5966592	110	2680	east

1. AHD = Australian Height Datum. The Project site AHD is approximately 110 m.

4. NOISE LIMITS

This section presents the construction and operational noise limits and criteria derived with due regard to Publication 1254 and the NIRV.

4.1 Construction Noise Limits (Publication 1254)

Publication 1254 does not provide numeric values for noise criteria during normal working hours. Normal working hours for construction as defined in Publication 1254 are:

- 7 am — 6 pm Monday to Friday
- 7 am — 1 pm Saturdays

The construction activities for the proposed Project will be limited to these normal working hours, therefore construction noise limits for this assessment are not considered necessary.

Some noise from construction sites is inevitable, such that Publication 1254 focuses on minimising construction noise impacts, rather than only on achieving numeric noise levels. Predicted $L_{eq,\ 30\ minute}$ (dBA) construction noise levels are presented below in **Section 5**. Recommendations for minimising construction noise impacts are presented in **Section 7.1**.

4.2 Operational Noise Limits (NIRV)

Project-specific operational noise limits (i.e. recommended maximum noise levels) have been derived based on the requirements of NIRV, through establishing zoning levels. These noise limits are presented in **Table 4.1.**

Zone Levels for the assessment have been determined following guidance in the NIRV (Table 1 of Publication 1411) for each assessment periods (i.e. day, evening and night). The land-use zones as identified in **Figure 1.2** are defined as Farming Zone for both the 'generating zone' in which the noise emitter is located and the 'receiving zone' in which the noise-sensitive receptors are located.

The recommended maximum noise levels adopted for the assessment are presented below in **Table 4.1**. These levels have been established from the zoning levels for the Farming Zone. As the noise generator and receiver are covered by the same contiguous zone no adjustments have been made for distance. As the zoning levels are greater than the base noise levels, these zoning levels have been adopted for the project-specific operational noise limits (Publication 1411).

Table 4.1 Operational Noise Limits

Receptor Type	Operational Noise Limits – $L_{eq,\ 30\ minute}$ (dBA)		
	Daytime	Evening	Night
Residential	46	41	36

The assessment periods are defined in SEPP N1, and are as follows:

1. Day: 0700 – 1800 Monday – Friday, 0700 – 1300 Saturdays
2. Evening: 1800 – 2200 all days 1300 – 1800 Saturdays 0700 – 1800 Sundays and public holidays
3. Night: 2200 – 0700

5. CONSTRUCTION NOISE ASSESSMENT

This section presents the predicted construction noise levels ($L_{eq,\ 30\ minutes}$ in dBA) for the proposed Project.

5.1 Construction Phase of the Project

It is understood that the Solar Panel component delivery and erection is to commence reasonably soon after the completion of the initial site access works. A detailed construction timeframe had not been prepared at the time of this assessment, however is likely that the Project will be constructed within 14 months. The main phases of the project are outlined below in **Section 5.2** as assessment scenarios.

As detailed in the *Traffic Impact Assessment: Viewbank Solar Farm* prepared by Cardno dated 3 July 2020, the Viewbank Solar Farm is expected to generate in the order of 354 additional daily traffic movements during the peak construction period. During peak construction 17% of the total daily traffic or 60 vehicle movements are expected to be heavy vehicle traffic; it is noted that the peak construction period will likely only be a small portion of the total construction period.

Given that existing daily traffic volumes on the Midland Highway (A300) in the vicinity of the site are in the order of 2,700 vehicles per day with 18% heavy vehicles, the Project is predicted to increase road traffic noise during peak construction by 1 dBA. Differences in noise levels of less than approximately 2 dBA are generally imperceptible in practice and an increase of 2 dBA is hardly perceivable, if at all. Differences in noise levels are not considered substantial until around 5 dBA. The worst-case predicted noise level for the Project are below this 2 dBA perceptibility threshold.

The Project will therefore not generate a significant increase in vehicles when compared to that of the existing vehicle flows and mixes on the surrounding road network. The introduction of the Project's construction traffic is unlikely to be perceptible, if at all.

5.2 Assessment Scenarios

Based on the noise modelling methodology described in **Section 2** of this report, emissions have been predicted for key project noise generating stages, based on the work elements, equipment and associated activities. These construction emission sources/scenarios are summarised below in **Table 5.1**.

The predicted noise levels and compliance assessment (comparison of predictions to the construction noise limits) is then presented in **Table 5.2** for each scenario. The detailed noise modelling data and assessment scenarios are provided in **Appendix B**.

Table 5.1 Construction Emission Sources & Assessment Scenarios

CON ID	Description	Sound Power Level (Lw) in dBA
01	This noise impact assessment scenario is associated with the potential first stage of works, being **Site Preparation and Establishment.** This covers general site enabling works including clearance of surplus material, ground compaction, establishment of new concrete footings/slabs and delivery of materials (or similar).	Total Lw of 123
02	This noise impact assessment scenario is associated with the **Delivery of Infrastructure**. This scenario includes heavy vehicles, light vehicles, cranes and tools potentially associated with the delivery and loading/unloading of assets.	Total Lw of 114
03	This noise impact assessment scenario is associated with the potential third stage of works, being **General Construction of Infrastructure.** Works for this scenario include construction and installation of new equipment and infrastructure for the Project.	Total Lw of 121

5.3 Predicted Construction Noise Levels

Based on the construction assessment scenarios and associated data presented in **Table 5.1** above, $L_{eq,\ 30\ minute}$ noise levels (in dBA) have been predicted. The resultant values are presented in **Table 5.2** below. These predicted $L_{eq,\ 30\ minute}$ noise levels (in dBA) represent the worst-case noise levels to be experienced at each receptor when the construction fleet is working on the Project site nearest to each receptor.

Table 5.2 Predicted Construction Noise Levels

ID	Predicted Construction Noise levels $L_{eq\ 30\ minute}$ (dBA)		
	CON01	CON02	CON03
R01	40	31	38
R02	42	33	40
R03	41	32	39
R04	43	33	40
R05	42	33	40
R06	43	34	41
R07	43	34	41
R08	47	37	44
R09	49	40	47
R10	51	41	48
R11	50	40	48
R12	56	47	54
R13	52	43	50
R14	55	45	52
R15	52	42	49
R16	60	51	58
R17	52	43	50
R18	53	44	51
R19	49	39	47
R20	42	32	39
R21	48	38	46
R22	48	38	45
R23	46	36	43
R24	44	34	41
R25	42	33	40
R26	42	32	39
R27	42	32	39
R28	40	31	38
R29	39	29	36
R30	37	28	35

5.4 Discussion of Results

The resultant noise levels presented in **Table 5.2** are summarised below:

- The highest predicted ($L_{eq,\ 30\ minute}$) noise level is 60 dBA at R16 associated with the "*Site Preparation and Establishment*" (CON01). R16 is the closest receptor to the south of the site, in close proximity to the proposed Substation and BESS sites.
- The highest ($L_{eq,\ 30\ minute}$) noise levels associated with the "*Site Preparation and Establishment*" (CON01) i.e. >50 dBA are predicted at receptors R10 to R18.
- The highest ($L_{eq,\ 30\ minute}$) noise levels associated with the "*Delivery of Infrastructure*" (CON02) i.e. >50 dBA are predicted at receptor R16.
- The highest ($L_{eq,\ 30\ minute}$) noise levels associated with the "*General Construction of Infrastructure*" (CON03) i.e. >50 dBA are predicted at receptors R12 to R18.

These predicted noise levels are associated with predicted 30 minute noise values calculated via modelling for the purposes of the assessment in accordance with the Publication 1254. These values do not represent a constant noise emission that would be experienced by the community on a daily basis throughout the Project construction schedule. The predicted noise levels will only be experienced for limited periods of time when works are occurring (in close proximity to each receptor); they will not be experienced for full daytime periods. Any impacts associated with these works will be temporary and do not represent a permanent impact on the community and surrounding environment.

Some noise from construction sites is inevitable, such that Publication 1254 focuses on minimising construction noise impacts, rather than only on achieving numeric noise levels. These results identify that good-practice construction noise management and control techniques will be required to reduce noise levels and minimise impacts as far as practically achievable. These will need to be implemented in conjunction with community consultation and a general notification processes.

In accordance with the requirements of Publication 1254 suitable recommendations, which can be practically implemented on-site, are provided in **Section 7**. Construction noise levels will be reduced and impacts minimised with the successful implementation of these recommendations. Impacts may not be reduced to negligible levels for all receptors during all construction activities; however, the recommendations are designed to ensure that any residual impacts are minimised as far as is practically achievable.

6. OPERATIONAL NOISE ASSESSMENT

This section presents the predicted operational noise levels and compares them to the applicable NIRV noise limits.

6.1 Operational Phase of the Project

For the majority of time, solar farms operate with limited maintenance staff and generate minimal traffic movements. Accordingly, apart from the initial construction phase, the proposal is anticipated to have a negligible impact upon traffic on the local road network. Details of likely traffic generation during operation are as follows:

- The Viewbank Solar Farm will generally have a site manager plus two to three additional staff on-site. To conservatively assume four staff on site this would equate to approximately 8 vehicle movements (four per peak hour);
- Routine maintenance and servicing to be carried out by one or two people on an ad hoc basis. It will be assumed that the daily traffic generation will not exceed two to four vehicle movements per day (maintenance/service days only) to the local road network, with all other movements being internal to the site; and
- Occasional engineering maintenance will occur when components of the development need to be replaced, such as replacing solar modules or tracker systems. This is expected to only occur very occasionally, and will have no discernible impact on the external road network.

Operational road traffic noise impacts from the Proposed Project are not anticipated (i.e. from additional vehicles on the public road network). Additional traffic from the Project will be limited to the activities outlined above. For arterial and sub-arterial roads (e.g. Midland Highway) the Project will not generate a significant increase in vehicles when compared to that of the existing vehicle flows and mixes on the surrounding road network. The introduction of the Project's operational traffic is unlikely to be perceptible, if at all.

6.2 Assessment Scenarios

The new noise generating equipment proposed for the Project was modelled to determine additional noise contribution at sensitive receptors. The potential worst-case noise generating situation (all new plant and equipment operating concurrently) was considered, as applicable to the proposed operational activities summarised in **Section 1** of this report. Operational emission sources are summarised in **Table 6.1**. The detailed noise modelling data and assessment scenarios are provided in **Appendix B** of this report.

All predicted operational noise levels consider cumulative adjustments to the L_{Aeq} for noise character, duration and measurement position to determine the effective noise level. The predicted values are have considered the effective noise level, according to the following formula (Publication 1412):

Effective noise level = L_{Aeq} + *Atone* + *Adur* + *Aint* + *Aref* + *Aind* + *Aimp*

Based on the noise source data presented in this assessment (**Appendix B**) and model outputs, the proposed equipment is not anticipated to generate significant tonal or low frequency noise. Therefore no adjustments have been added to the effective noise level. Additionally there are no adjustments anticipated for duration, intermittency, impulsiveness, indoor corrections or reflections.

Table 6.1 Operational Emission Sources & Assessment Scenarios

OPS ID	Description	Sound Power Level (Lw) in dBA
01	This assessment scenario is associated with the **Proposed Operations** of the Viewbank Solar Farm. As described in Section 2.2, standard and noise enhancing meteorological conditions have been modelled in this scenario.	13 x 6.7/3.0 MW Inverters at Lw of 48 1 x Substation Transformer at Lw of 87 1 x BESS at Lw of 101.5 14 x PV sidecars (BESS) at Lw of 48 **Total Lw of 101.7**

6.3 Predicted Operational Noise Levels

Based on the noise modelling methodology described in **Section 2** of this report and the operational assessment scenarios presented in **Table 6.1** above, daytime, evening and night time Leq, 30 minute noise levels (in dBA) have been predicted. The worst-case predicted noise levels (inclusive of the noise enhancing meteorological conditions) and compliance are presented in **Table 6.2** below. A noise contour map for the worst-case (night-time) conditions is presented in **Figure 6.1**.

Table 6.2 Worst-case Predicted Operational Noise Levels and Compliance

ID	Noise Limits Leq 30 minute (dBA)			Predicted Effective Noise levels Leq 30 minute (dBA)			Compliant?
	Day	Evening	Night	Day	Evening	Night	
R01 – R10	46	41	36	<20	<20	<20	Yes
R11 – R12				20	20	20	Yes
R13				21	21	21	Yes
R14				22	22	22	Yes
R15				<20	<20	<20	Yes
R16				35	35	35	Yes
R17 – R18				34	34	34	Yes
R19				21	21	21	Yes
R20				<20	<20	<20	Yes
R21				22	22	22	Yes
R22				28	28	28	Yes
R23				25	25	25	Yes
R24				22	22	22	Yes
R25 – R26				21	21	21	Yes
R27 – R30				<20	<20	<20	Yes

KYABRAM SOUTH
FENAUGHTY ROAD
WINTER ROAD
BREWER ROAD
PEPPERTREE LANE
MASON ROAD
CRADDOCK ROAD
COOMA
CRUSE ROAD
KYABRAM-COOMA ROAD
MCCAGUE ROAD
MORRISSEY ROAD
McEWEN ROAD
BALDWIN ROAD
MIDLAND HIGHWAY
MIDDLE ROAD
GIRGARRE EAST
GIRGARRE EAST ROAD
POOLE ROAD
110
120
R01
R02
R03
R04
R05
R06
R07
R08
R09
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
R26
R27
R28
R29
R30

Legend

Noise Level (dB):

- 45
- 40
- 35
- 30
- 25
- 20
- 15
- Receptor
- Site Boundary
- Proposed Layout
- Cadastre
- Elevation Contour (m AHD)
- Major Road
- Local Road

Source:
GIS Data : DELWP Vicmap
Imagery : ESRI World Imagery (2016)

Operational Noise Contour Map

F 6.1

Drawing No:	0493694m_NA_G004_R01.mxd		Viewbank Solar Farm Noise Assessment
Date:	09/09/2020	Drawing Size: A3	
Drawn By:	KV	Reviewed By: SDL	Client: FRV Services Australia Pty Ltd

Coordinate System: GDA 1994 MGA Zone 55

0 200 400 600m

N

ERM

6.4 Discussion of Results

The results presented in **Table 6.1** and **Figure 6.1** identify the following:

- The highest Predicted $L_{eq,\ 30\ minute}$ (dBA) noise levels for the proposed operations were found at R16. 33 dBA during standard meteorological conditions and 35 dBA during noise enhancing meteorological conditions. R16 is the closest receptor to the south of the site, in close proximity to the proposed Substation and BESS.
- Predicted $L_{eq,\ 30\ minute}$ (dBA) noise levels for proposed operations are below the operational noise limits at all the identified residential receptors and are compliant with the NIRV for the daytime, evening and night-time periods during standard meteorological conditions.
- Predicted $L_{eq,\ 30\ minute}$ (dBA) noise levels for proposed operations are below the operational noise limits at all the identified residential receptors and are compliant with the NIRV for the daytime, evening and night-time periods during noise enhancing meteorological conditions.

6.5 Summary of Findings

The operational noise assessment identified that the predicted operational noise levels (i.e. effective noise levels) are below the Project-specific operational noise limits (i.e. recommended maximum noise levels) during the daytime, evening and night time assessment periods.

It should also be noted that as per typical solar farm operations, there will be minimal load on the inverters/transformers and BESS during the night-time period, resulting in minimal noise impacts. This assessment has conservatively assumed that all operations will remain the same for each assessment period (i.e. daytime, evening and night-time). Despite this approach, predicted $L_{eq,\ 30\ minute}$ (dBA) noise levels are complaint with the NIRV recommended maximum noise levels for the daytime, evening and night time periods.

7. RECOMMENDATIONS

This section presents any recommendations for noise mitigation or management measures that are considered necessary to reduce (or maintain) construction or operational noise. These measures are expected to minimise impacts, though they may not be reduced to negligible levels for all receptors during all construction activities.

7.1 Construction Noise

Based on the findings presented in **Section 5** (construction noise assessment), recommendations for management measures and community consultation (prior to works) are outlined below. These recommendations apply for all construction works associated with the Project. In accordance with Publication 1254 it is recommended that:

- Construction activities associated with the Project should be limited to the Publication 1254 recommended normal working hours for construction (i.e. 7 AM to 6 PM Monday to Friday and 7 AM to 1 PM Saturdays).
- Where it is reasonable to do so the construction methodology should schedule noisy activities for less sensitive times and provide periods of respite from noisier works.
- The weekend (daytime) periods are important for community rest and recreation and respite should be provided when noisy work has been conducted throughout the week. Accordingly, work should not usually be scheduled during these times.
- During the construction design, choose appropriate plant, equipment and/or machinery for each task and adopt efficient work practices to minimise the total construction period and the number of noise sources. During construction works, any equipment or machinery that is identified to be generating elevated noise levels will be stopped and removed from the site if required.
- During the works, avoid unnecessary noise due to idling diesel engines, and fast engine speeds when equipment can be powered down and/or lower speeds are sufficient.
- During the works, instruct drivers to travel directly to the Project and avoid any extended periods of engine idling at or near residential areas, especially at night.
- During the works, ensure all plant, equipment and/or machinery used are in good condition, with particular emphasis on exhaust silencers, covers on engines and transmissions and squeaking or rattling components. Excessively noisy machines should be repaired or removed.
- All vehicular movements to and from the site should only occur during the scheduled normal working hours, unless approval has been granted by the relevant authority.
- All potentially noise-affected neighbours are informed about the nature of construction stages and noise reduction measures (prior to works).
- Give notice as early as possible for periods of noisier works. Describe the activities and how long they are expected to take. Keep affected neighbours informed of progress.
- A principal contact person for community queries should be appointed and 24-hour contact details should be provided through letters and site signage.
- If complaints are received and/or impacts are identified during works, the management measures provided in Publication 1254 for evening and night time works (outside normal hours) should be considered and implemented as far considered feasible and reasonable.

7.2 Operational Noise

The resultant operational noise levels for the Project are below the NIRV noise limits during the day, evening and night time assessment periods. As Project noise levels are predicted to comply with the applicable NIRV noise limits, mitigation and management measures to reduce operational noise are not considered necessary.

It is important however, that noise levels do not increase to be above those considered in this report. It is therefore recommended that:

- The quantity of noise generating operational equipment incorporated into any future design changes should not increase to be above those specified in **Appendix B** unless it can be demonstrated that the additional items will not increase operational noise levels to be above the NIRV noise limits presented in this report; and
- The Sound Power Level (Lw) of operational equipment incorporated into any future design changes should not increase to be above those specified in **Appendix B** unless it can be demonstrated that the increase in Lw will not increase operational noise levels to be above the NIRV noise limits presented in this report (i.e. sum of Lw for all new equipment should be ≤ 101.7 dBA).

8. CONCLUSION

This noise impact assessment was completed on behalf of FRV to assess the potential construction and operational impacts associated the Project (Viewbank Solar Farm) located on the land generally known as '85 McCague Road' Cooma and '90 McCague Road Girgarre East', Victoria.

The existing environment and potentially sensitive noise receptors were established with consideration to NIRV, as documented in **Section 3** of this report. Noise assessment criteria were then developed with consideration of current recognised VIC standards and guidelines applicable to the projects proposed construction and operational activities in **Section 4** of this report.

Applicable construction and operational assessment scenarios were developed based on project information provided by FRV. Noise levels were predicted, and compared to noise limits and criteria to establish compliance and evaluate potential impacts. Based on these impacts potential mitigation/management measures are recommended, where necessary, to reduce levels and minimise impacts. The construction and operational noise assessments are presented in **Section 5** and **Section 6** of this report.

The predicted construction noise levels identified in **Section 5** highlight that good-practice construction noise management and control techniques will be required to reduce noise levels and minimise impacts. In accordance with the requirements of Publication 1254 suitable recommendations, which can be practically implemented on-site, are provided in **Section 7**. Construction noise levels will be reduced and impacts minimised with the successful implementation of these recommendations. Impacts may not be reduced to negligible levels for all receptors during all construction activities; however, the recommendations are designed to ensure that any residual impacts are minimised as far as is practically achievable.

The operational noise assessment identified that the predicted operational noise levels (i.e. effective noise levels) for the Project are below the NIRV recommended maximum noise limits during the daytime, evening and night time assessment periods. As Project noise levels are predicted to comply with the applicable NIRV noise limits, mitigation and management measures to reduce operational noise are not considered necessary. It is important however that noise levels do not increase to be above those considered in this report and suitable recommendations for this design feature are provided in **Section 7**. As compliance is demonstrated, operational noise impacts are considered acceptable at all receptors during all operational activities based on the requirements for assessment defined by the NIRV.

No further noise mitigation or management measures to those provided in this report, or already implemented in the project design, are considered warranted or necessary.

REFERENCES

Cardno Victoria Pty Ltd (Cardno) – **Traffic Impact Assessment: Viewbank Solar Farm**, dated 3 July 2020

International Organisation for Standardisation (ISO) 9613-2:1996 (ISO9613:2) - **Acoustics - Attenuation of Sound during Propagation Outdoors - Part 2: General Method of Calculation**

State Government of Victoria – EPA Victoria – **Noise from Industry in Rural Victoria** (Publication 1411), October 2011.

State Government of Victoria - Environment Protection Authority (EPA) Victoria – **Noise Control Guidelines** (Publication 1254), October 2008

State Government of Victoria - Environment Protection Authority (EPA) Victoria – **SEPP N-1 and NIRV Explanatory Notes** (Publication 1412), October 2011.

State Government of Victoria - Environment Protection Authority (EPA) Victoria – **Applying NIRV to proposed and existing industry guidelines** (Publication 1413), October 2011.

State Government of Victoria - Environment Protection Authority (EPA) Victoria – **Demonstrating Best Practice** (Publication 1517.1), October 2017.

Standards Australia AS 2436–2010™ (AS2436) – **Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites**

APPENDIX A ACOUSTICS GLOSSARY

Glossary – Acoustical Concepts and Terminology

What Is Noise And Vibration?

Noise

Noise is often defined as a sound, especially one that is loud, unpleasant or that causes disturbance or simply as unwanted sound, but technically, noise is the perception of a series of compressions and rarefactions above and below normal atmospheric pressure.

Vibration

Vibration refers to the oscillating movement of any object. In a sense noise is the movement of air particles and is essentially vibration, though in regards to an environmental assessment vibration is typically taken to refer to the oscillation of a solid object(s). The impact of noise on objects can lead to vibration of the object, or vibration can be experienced by direct transmission through the ground, this is known as ground-borne vibration.

Essentially, noise can be described as what a person hears, and vibration as what they feel.

What Factors Contribute To Environmental Noise?

The noise from an activity, like construction works, at any location can be affected by a number of factors, the most significant being:

- How loud the activity is?
- How far away the activity is from the receptor?
- What type of ground is between the activity and the receptor e.g. concrete, grass, water or sand?
- How the ground topography varies between the activity and the receptor, for example, is it flat, hilly, mountainous? Blocking the line of sight to a noise source will generally reduce the level of noise at the receptor.
- Are there any other obstacles that block the line of sight between the source and the receptor e.g. buildings or purpose built noise walls?

How to Measure and Describe Noise?

Noise is measured using a specially designed “sound level meter” which must meet internationally recognised performance standards. Audible sound pressure levels vary across a range of 10^7 Pascals (Pa), from the threshold of hearing at 20μPa to the threshold of pain at 200Pa. Scientists have defined a statistically described logarithmic scale called Decibels (dB) describe noise more manageably.

To demonstrate how this scale works, the following points give an indication of how an average person perceives the noise levels and differences:

- 0 dB - represents the threshold of human hearing (for a young person with ears in good condition).
- 50 dB – represents average conversation.
- 70 dB – represents average street noise, local traffic etc.
- 90 dB – represents the noise inside an industrial premises or factory.
- 140 dB - represents the threshold of pain – the point at which permanent hearing damage may occur.

Unless otherwise stated in this report, all sound pressure levels (predicted or measured noise levels at a location or point) are expressed in decibels (dB, re: 2 x 10^{-5} Pascals, Pa) with the “A-weighting”

curve applied and adopting the relevant acoustical or statistical noise level parameter e.g. $L_{eq,\ 15\ minute}$, $L_{eq,\ 1hour}$ or $L_{90,\ 9\ Hour}$.

All sound power levels (source noise emission values) are expressed in decibels (dB, re: 10^{-12} Watts, W) with the "A-weighting" curve applied (represents human hearing) and adopting the relevant acoustical or statistical noise level parameter.

Human Response to Changes in Noise Levels

The following concepts offer qualitative guidance in respect of the average response to changes in noise levels:

- Differences in noise levels of less than approximately 2 dBA are generally imperceptible in practice, an increase of 2 dBA is hardly perceivable.
- Differences in noise levels of around 5 dBA are considered to be significant.
- Differences in noise levels of around 10 dBA are generally perceived to be a doubling (or halving) of the perceived loudness of the noise. An increase of 10 dBA is perceived as twice as loud. Therefore an increase of 20 dBA is four times as loud and an increase of 30 dBA is eight times as loud etc.
- The addition of two identical noise levels will increase the dBA level by about 3 dBA. For example, if one car is idling at 40 dBA and then another identical car starts idling next to it, the total dB level will be about 43 dBA.
- The addition of a second noise level of similar character which is at least 8 dBA lower than the existing noise level will not add significantly to the overall dBA level.
- A doubling of the distance between a noise source and a receptor results approximately in a 3 dBA decrease for a line source (for example, vehicles travelling on a road) and a 6 dBA decrease for a point source (for example, the idling car discussed above).
- A doubling of traffic volume for a line source results approximately in a 3 dBA increase in noise, halving the traffic volume for a line source results approximately in a 3 dBA decrease in noise.

Terms to Describe the Perception of Noise

The following terms offer quantitative and qualitative guidance in respect of the audibility of a noise source:

- **Inaudible / Not Audible** - the noise source and/or event could not be heard by the operator, masked by extraneous noise sources not associated with the source. If a noise source is 'inaudible' its noise level may be quantified as being less than the measured L_{A90} background noise level, potentially by 10 dB or greater.
- **Barely Audible** – the noise source and/or event are difficult to define by the operator, typically masked by extraneous noise sources not associated with the source. If a source is 'barely audible' its noise level may be quantified as being 5 - 7 dB below the measured L_{A90} or L_{Aeq} noise level, depending on the nature of the source e.g. constant or intermittent.
- **Just Audible** – the noise source and/or event may be defined by the operator. However, there are a number of extraneous noise sources contributing to the measurement. The noise level should be quantified based on instantaneous noise level contributions, noted by the operator.
- **Audible** - the noise source and/or event may be easily defined by the operator. There may be a number of extraneous noise sources contributing to the measurement. The noise level should be quantified based on instantaneous noise level contributions, noted by the operator.

- **Dominant** – the noise source and/or event are noted by the operator to be significantly 'louder' than all other noise sources. The noise level should be quantified based on instantaneous noise level contributions, noted by the operator.

The following terms offer qualitative guidance in respect of acoustic terms used to describe the frequency of occurrence of a noise source during an operator attended environmental noise measurements:

- **Constant** – this indicates that the operator has noted the noise source(s) and/or event to be constantly audible for the duration of the noise measurement e.g. an air-conditioner that runs constantly during the measurement.
- **Intermittent** – this indicates that the operator has noted the noise source(s) and/or event to be audible, stopping and starting intervals for the duration of the noise measurement, e.g. cars passing by.
- **Infrequent** – this indicates that the operator has noted the noise source(s) and/or event to be constantly audible, however; not occurring regularly or at intervals for the duration of the noise measurement e.g. a small number of aircraft are noted during the measurement.

How to Calculate or Model Noise Levels

There are two recognised methods which are commonly adopted to determine the noise at a particular location from a proposed activity. The first is to undertake noise measurements while the activity is in progress and measures the noise, the second is to calculate the noise based on known noise emission data for the activity in question.

The second option is preferred as the first option is largely impractical regarding cost and time constraints, notwithstanding the meteorological factors that may also influence its quantification. Furthermore, it is also generally considered unacceptable to create an environmental impact simply to measure it. In addition, the most effective mitigation measures are determined and implemented during the design phase and often cannot be readily applied during or after the implementation phase of a project.

Because a number of factors can affect how 'loud' a noise is at a certain location, the calculations can be very complex. The influence of other ambient sources and the contribution from a particular source in question can be difficult to ascertain. To avoid these issues, and to quantify the direct noise contribution from a source/site in question, the noise level is often calculated using noise modelling software packages. The noise emission data used in may be obtained from the manufacturer or from ERM's database of measured noise emissions.

Acoustic Terminology & Statistical Noise Descriptors

Environmental noise levels such as noise generated by industry, construction and road traffic are commonly expressed in dBA. The A-weighting scale follows the average human hearing response and enables comparison of the intensity of noise with different frequency characteristics. Time-varying noise sources are often described in terms of statistical noise descriptors. The following descriptors are commonly used when assessing noise and are referred to throughout this acoustic assessment:

- **Ambient noise** – the all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.
- **Background noise** – the underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the L_{A90} descriptor.
- **Cognitive noise** – noise in which the source is recognised as being annoying.

- **Decibel** (dB is the adopted abbreviation for the decibel) – A measure of sound level. The decibel is a logarithmic way of describing a ratio. The ratio may be power, sound pressure, voltage, intensity or other parameters. In the case of sound pressure, it is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure squared to a reference sound pressure squared.
- **dBA** -Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
- **dBC** – unit used to measure 'C-weighted' sound pressure levels. C-weighting is an adjustment made to sound-level measurements which takes account of low-frequency components of noise within the audibility range of humans.
- **dBZ or dBL** – unit used to measure 'Z-weighted' sound pressure levels with no weighting applied, linear.
- **Hertz (Hz)** - the measure of frequency of sound wave oscillations per second. 1 oscillation per second equals 1 hertz.
- **Octave** – a division of the frequency range into bands, the upper frequency limit.
- 1**/3 Octave** – single octave bands divided into three parts.
- **L_{eq}** - this level represents the equivalent or average noise energy during a measurement period. The $L_{eq,\ 15\ min}$ noise descriptor simply refers to the Leq noise level calculated over a 15 minute period. Indeed, any of the below noise descriptors may be defined in this way, with an accompanying time period (e.g. $L_{10,\ 15\ minute}$) as required.
- **$L_{AF90,\ 15\ min}$** - The A-weighted sound pressure level measured using fast time weighting that is exceeded for 90% of the time over a 15-minute assessment period. This is a measure of background noise.
- **$L_{AF90,\ period\ (day/evening/night)}$** – The A-weighted sound pressure level, obtained by using fast time weighting that is equal to or exceeded for 90% of the day, evening and night periods (as defined in this policy) for each 24-hour period.
- **$L_{AF90,\ (shoulder\ period)}$** - The A-weighted sound pressure level measured using fast time weighting that is exceeded for 90% of aggregate sound pressure level data for the equivalent of one week's worth of valid data taken over the shoulder period.
- **$L_{Aeq,\ T}$** - The time-averaged sound pressure level. The value of the A-weighted sound pressure level of a continuous steady sound that, with a measurement time interval T, has the same mean square sound pressure level as a sound under consideration with a level that varies with time (AS1055.1-1997).
- **L_{Amax}** - The maximum sound pressure level of an event measured with a sound level meter satisfying AS IEC 61672.1-2004 set to 'A' frequency weighting and fast time weighting.
- **L_N** - the percentile sound pressure level exceeded for N% of the measurement period calculated by statistical analysis.
- **L_{10}** - the noise level exceeded for 10 per cent of the time and is approximately the average of the maximum noise levels.
- **L_{90}** - the noise level exceeded for 90 per cent of the time and is approximately the average of the minimum noise levels. The L_{90} level is often referred to as the "background" noise level and is commonly used as a basis for determining noise criteria for assessment purposes.
- **Low frequency** - Noise containing major components in the low-frequency range (10 hertz [Hz] to 160 Hz) of the frequency spectrum.

- **Masking** - The phenomenon of one sound interfering with the perception of another sound. For example, the interference of traffic noise with use of a public telephone on a busy street (Bies and Hansen, 1996).
- **Sound Power Level (Lw)** - this is a measure of the total power radiated by a source. The Sound Power of a source is a fundamental property of the source and is independent of the surrounding environment.
- **Sound Pressure Level (LP)** - the level of sound pressure; as measured at a distance by a standard sound level meter with a microphone. This differs from Lw in that this is the received sound as opposed to the sound 'intensity' at the source.
- **Spectral characteristics** - The frequency content of noise.
- **Tonal noise (tonality)**: noise containing a prominent frequency and characterised by a definite pitch.

APPENDIX B DETAILED NOISE ASSESSMENT DATA

TABLE B.1 - DETAILED CONSTRUCTION MODELLING INPUTS

Scenario	Description	Equipment	Quantity	Duty Factor	Base LW Value	Total LW Value	Source	Spectral Data in dBA									
								31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	LW Total, dBA
CON01	Site Preparation and Establishment	Excavator (approx. 20 tonne)	3	75%	105	108.5	Adopted from Australian Standard AS2436, TfNSW CNVS, and ERM Measured Lw Database	66.0	86.7	95.4	98.1	103.3	104.3	99.7	94.3	87.1	108.5
		Concrete agitator truck	2	50%	109	109.0		68.5	84.5	92.7	94.2	101.0	106.4	101.6	94.9	88.4	109.0
		Generator	1	50%	104	101.0		66.9	89.1	93.4	89.4	94.7	93.2	94.2	89.8	80.6	101.0
		Water truck	1	50%	107	104.0		66.8	83.2	84.0	84.4	89.6	103.2	93.2	87.6	78.6	104.0
		Concrete pump truck	2	50%	108	108.0		77.1	85.1	93.2	95.6	100.9	103.6	102.1	96.3	91.0	108.0
		Roller	2	100%	108	111.0		60.4	78.6	93.7	104.2	104.6	105.8	104.0	95.8	89.7	111.0
		Grader	2	75%	110	111.8		64.7	83.9	96.0	104.5	105.9	107.1	103.3	96.1	83.0	111.8
		Jackhammer	1	100%	121	121.0		82.1	96.9	109.6	112.3	113.8	115.7	114.8	107.9	100.2	121.0
		Light Vehicle (idle)	6	50%	103	107.8		76.9	84.9	93.0	95.4	100.7	103.4	101.8	96.1	90.8	107.8
		Heavy Vehicle (idle)	4	50%	107	110.0		65.7	91.1	95.4	101.8	105.1	102.4	104.4	93.4	86.6	110.0
		Light Vehicle (moving)	6	70%	103	109.2		78.4	86.4	94.5	96.8	102.2	104.8	103.3	97.5	92.2	109.2
		Heavy Vehicle (moving)	4	70%	107	111.5		67.2	92.6	96.9	103.3	106.6	103.9	105.9	94.9	88.1	111.5
		Total >>>	34	-	122.6	123.4	-	85.6	100.5	110.8	114.5	116.7	118.3	117.0	109.8	102.6	123.4
CON02	Delivery of Infrastructure	Crane (mobile)	1	75%	104	102.8	Adopted from Australian Standard AS2436, TfNSW CNVS, and ERM Measured Lw Database	65.2	76.3	85.9	88.1	95.8	95.8	91.7	99.1	88.7	102.8
		Generator	1	50%	104	101.0		66.9	89.1	93.4	89.4	94.7	93.2	94.2	89.8	80.6	101.0
		Hand tools (electric)	1	25%	102	96.0		52.7	76.4	81.5	81.2	91.8	91.9	87.2	75.5	65.4	96.0
		Hand tools (pneumatic)	1	25%	116	110.0		71.1	85.9	98.6	101.3	102.8	104.7	103.8	96.9	89.2	110.0
		Light Vehicle (idle)	2	50%	103	103.0		72.1	80.1	88.2	90.6	95.9	98.6	97.1	91.3	86.0	103.0
		Heavy Vehicle (idle)	1	50%	107	104.0		59.7	85.1	89.4	95.8	99.1	96.4	98.4	87.4	80.6	104.0
		Light Vehicle (moving)	2	70%	103	104.5		73.6	81.6	89.7	92.1	97.4	100.1	98.5	92.8	87.5	104.5
		Heavy Vehicle (moving)	1	50%	107	104.0		59.7	85.1	89.4	95.8	99.1	96.4	98.4	87.4	80.6	104.0
		Total >>>	10	-	117.8	113.7	-	77.9	93.4	101.2	104.1	107.2	108.0	107.4	102.6	94.6	113.7
CON03	General Construction of Infrastructure	Bored Piling Rig	6	50%	111	115.8	Adopted from Australian Standard AS2436, TfNSW CNVS, and ERM Measured Lw Database	68.8	83.5	105.3	106.6	107.7	111.3	109.7	100.6	93.8	115.8
		Crane (mobile)	2	75%	104	105.8		68.2	79.3	88.9	91.1	98.8	98.8	94.7	102.1	91.7	105.8
		Generator	1	50%	104	101.0		66.9	89.1	93.4	89.4	94.7	93.2	94.2	89.8	80.6	101.0
		Water truck	1	50%	107	104.0		66.8	83.2	84.0	84.4	89.6	103.2	93.2	87.6	78.6	104.0
		Forklift	2	75%	106	107.8		79.7	85.7	91.7	98.7	100.7	102.7	101.7	95.7	91.7	107.8
		Telehandler	3	75%	105	108.5		74.4	96.6	100.9	96.9	102.2	100.7	101.7	97.3	88.1	108.5
		Hand tools (electric)	4	50%	102	105.0		61.7	85.4	90.5	90.2	100.8	100.9	96.2	84.5	74.4	105.0
		Hand tools (pneumatic)	2	50%	116	116.0		77.1	91.9	104.6	107.3	108.8	110.7	109.8	102.9	95.2	116.0
		Light Vehicle (idle)	6	50%	103	107.8		76.9	84.9	93.0	95.4	100.7	103.4	101.8	96.1	90.8	107.8
		Light Vehicle (moving)	6	70%	103	109.2		78.4	86.4	94.5	96.8	102.2	104.8	103.3	97.5	92.2	109.2
		Total >>>	33	-	118.8	120.6	-	85.0	99.5	109.3	110.9	113.3	115.8	114.3	108.3	100.9	120.6

TABLE B.2 - DETAILED OPERATIONAL MODELLING INPUTS

Description	Equipment	Quantity	Duty Factor	Lp Specification	Base Lw Value	Total Lw Value	Emission Height, m	Source	Individual Noise Source Term Data - Spectral Data, dB(A)									
									31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	LW Total, dB(A)
Operation	6.7 / 3.0 MW Inverter	13	100%	40 dBA at 1m	48.0	59.1	2	Specification provided by FRV	18.9	24.9	41.0	44.4	41.9	35.5	33.4	25.6	13.4	48.0
	Substation Transformer	1	100%	-	87.0	87.0	2	ERM Measured Lw Database	47.9	63.9	80.0	83.4	80.9	74.5	72.4	64.6	52.4	87.0
	Panel Tracking Motors (silent)	-	-	N/A	N/A	-	-	Specification provided by FRV	-	-	-	-	-	-	-	-	-	-
	BESS Tesla Megapack	28	100%	75 dBA at 1 m	-	101.5	-	Specification provided by FRV	-	-	-	-	-	-	-	-	-	-
								Emitting Façade - East	56.4	64.1	65.1	80.1	88.1	86.5	81.2	69.0	64.5	91.3
								Emitting Façade - West	56.4	64.1	65.1	80.1	88.1	86.5	81.2	69.0	64.6	91.3
								Emitting Façade - North	53.7	61.5	62.4	77.4	85.5	83.9	78.6	66.4	61.9	88.6
								Emitting Façade - South	53.7	61.5	62.4	77.4	85.5	83.9	78.6	66.4	61.9	88.6
								Emitting Roof	65.1	72.8	73.8	88.8	96.8	95.2	89.9	77.7	73.3	100.0
	Tesla PV Sidecar (BESS)	14	100%	40 dBA at 1m	48.0	59.4	2	Adopted from Inverters	18.9	24.9	41.0	44.4	41.9	35.5	33.4	25.6	13.4	48.0
Note:	*Emission spectrums (31.5=Hz-8kHz) have been assumed based on measurements of similar equipment by ERM.*																	

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