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Frasers Solar Farm

Operational Noise Assessment

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Frasers Solar Farm

Operational Noise Assessment

Client: Frasers Lane Development Pty Ltd

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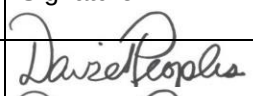
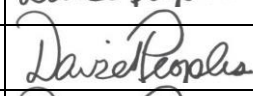
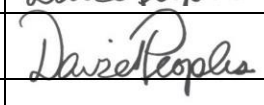
0	05-Dec-2019	Draft for Issue	David Peoples Technical Director	
1	17-Dec-2019	Draft incorporating client comments	David Peoples Technical Director	
2	05-Mar-2020	Revised layout and inverter selection	David Peoples Technical Director	
3	10-Mar-2020	Addition of Battery Storage Inverters	David Peoples Technical Director	
4	12-Mar-2020	Reduced Battery Storage Inverters from 12 to 3	David Peoples Technical Director	

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Executive Summary

AECOM has assessed the potential environmental noise emissions from the operation of the proposed Frasers Solar Farm in relation to applicable environmental noise criteria.

The main sources of noise from the operation of the proposed solar farm will be the inverters comprising the Power Control Units (PCUs).

There are residences located in the vicinity of the site of the proposed solar farm. The Victorian Environment Protection Authority (EPA) Guidelines *Noise from Industry in Regional Victoria* (NIRV) will apply to noise emissions from the proposed solar farm at these nearby residences.

The Recommended Maximum Noise Levels have been determined in accordance with the procedures of NIRV for each period at the nearest and potentially worst noise-affected residential locations.

The inverters are proposed to operate at nominal power and 100% fan speed during the hours 7am to 10pm, which covers the NIRV Day and Evening periods, and operate at a reduced current with 50% fan speed, this emitting less noise, from 10pm to 7am, which is the Night period. The proposed battery storage PCUs could operate at nominal power and 100% fan speed all of the time.

Computer noise modelling was performed to predict the solar farm operational noise levels at the nearest residential locations for the two inverter operating conditions. The noise levels were predicted for neutral weather conditions, and with a moderate breeze assisting noise propagation towards the sensitive receptor locations.

The predicted solar farm Effective Noise Levels are compliant with the Recommended Maximum Noise Levels that apply to the respective operating conditions for both modelled meteorological conditions, at all nearby receptor locations.

For some of the receptor locations the predicted Effective Noise Levels are only just compliant with the Recommended Maximum Noise Levels (i.e. equal to the criterion).

As a result of this, any changes to the proposed layout, or to the proposed plant items, could lead to higher noise levels at the receptor locations thus causing non-compliance with the criteria.

Therefore, the final layout and design of the proposed solar farm should undergo acoustic review with respect to environmental noise emissions during the detailed design phase of the project.

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1.0 Introduction

AECOM Australia Pty Ltd was engaged by Frasers Lane Development Pty Ltd to undertake an assessment of the potential noise emissions from the operation of the proposed Frasers Solar Farm. There are residential premises in the vicinity of the site that may be affected by noise from the inverters and substation at the solar farm, which will be the main sources of noise emission from the site.

The scope of this assessment includes prediction of the inverter and substation noise levels and consideration of the predicted noise levels in relation to applicable noise criteria. The scope does not include measurement of the existing acoustic conditions surrounding the proposed solar farm site.

This report presents noise criteria applicable at the nearby residences with respect to the operational noise emissions, the methodology used to predict the noise emissions, and discussion on the predicted noise levels in relation to the nominated criteria.

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2.0 Site Description

The subject site is on agricultural land on Frasers Lane approximately two kilometres south of the Toongabbie township.

The solar farm is proposed to be constructed on the site indicated in Figure 1.

The nearest residential locations are as follows:

- 40 Chappels Road, approximately 600 metres to the south of the site
- 60 Chappels Road, approximately 600 metres to the south of the site
- 80 Chappels Road, approximately 700 metres to the south of the site
- 110 Chappels Road, approximately 750 metres to the south of the site
- 390 Glengarry North Road, approximately 300 metres to the west of the site
- 415 Glengarry North Road, approximately 500 metres to the west of the site
- 1465 Traralgon-Maffra Road, approximately 400 metres to the north of the site
- 101 Chappels Road East, approximately one kilometre to the south east of the site

The solar farm proposal includes the following items that will generate environmental noise emissions:

- 20 Power Conversion Units (PCUs) across the site, each incorporating three inverters,
- One PCU comprising three inverters, associated with battery storage, to be located near the north-eastern corner of the site.
- A substation which will be located at the north-eastern corner of the site.

The proposed layout of the solar farm is shown in Appendix A.

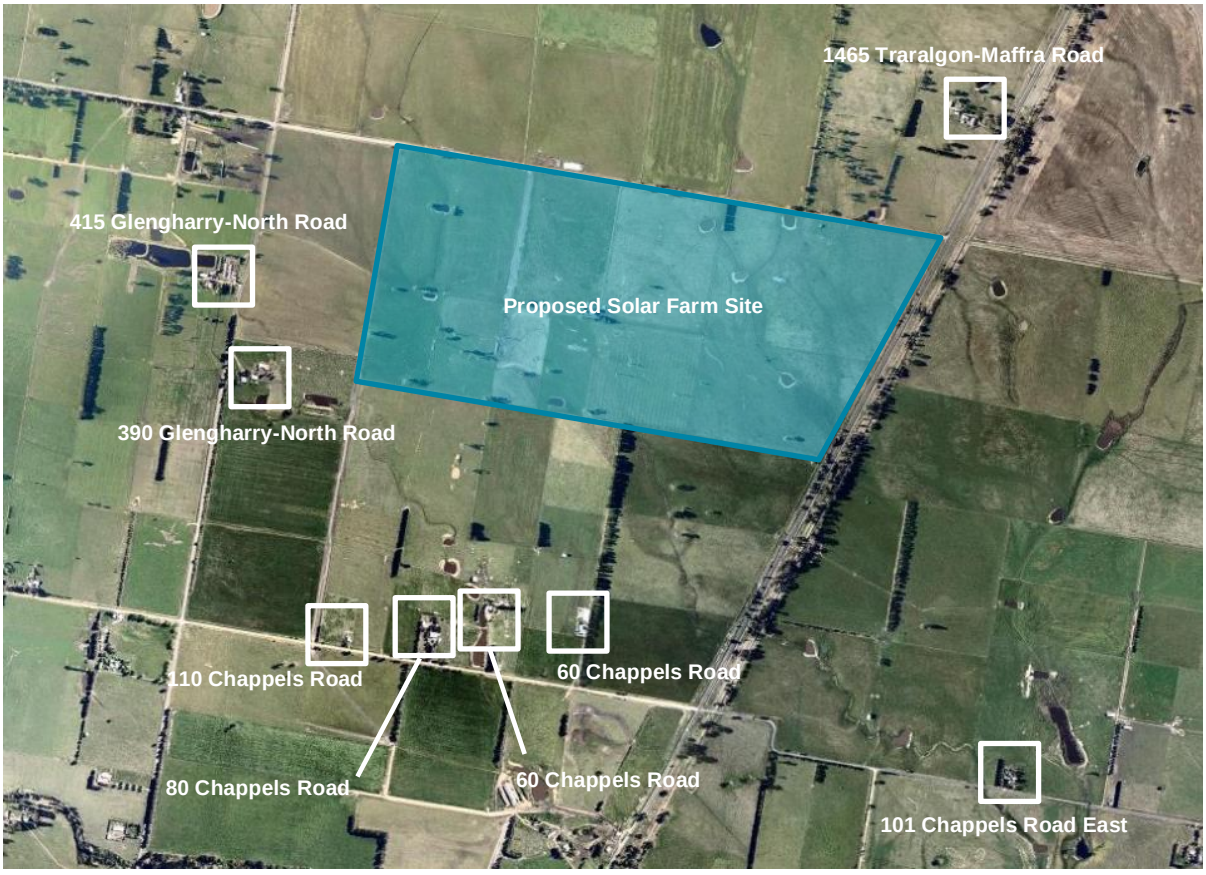

Figure 1 – Proposed Frasers Solar Farm site and surrounds (source Nearmap)

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3.0 Noise Criteria

3.1 Victorian Policies and Guidelines

In rural Victoria, the EPA Guidelines *Noise from Industry in Regional Victoria* (NIRV) applies to noise emissions from industrial premises. NIRV specifies the procedure for establishing noise criteria, and for measuring and assessing industrial noise at noise sensitive locations. NIRV largely refers to *State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No. N-1* (SEPP N-1) for the methodology applicable to the measurement and assessment of noise. SEPP N-1 is the statutory noise Policy that applies to industrial noise in Metropolitan Melbourne.

Unlike SEPP N-1, NIRV is a non-statutory guideline and therefore compliance is only legally binding when applied through statutory instruments such as a planning permit.

Under the NIRV and SEPP N-1 assessment procedures, noise from the source under consideration is measured or predicted to determine its impact over a continuous 30-minute period. Adjustments to the noise level then are applied to account for the effects of duration, tonality, intermittency and impulsiveness. The resultant noise level is called the Effective Noise Level.

3.2 Time Periods

Under NIRV, noise criteria are established for the three periods; Day, Evening and Night. The following time period classifications are defined by NIRV:

Table 1 NIRV Time periods

NIRV Time Period	Time
Day	7am to 6pm Weekdays 7am to 1pm Saturdays
Evening	6pm to 10pm Weekdays 1pm to 10pm Saturdays 7am to 10pm Sundays and Public Holidays
Night	10pm to 7am

3.3 Recommended Maximum Noise Levels

3.3.1 Step 1 – Zone Levels

Noise criteria for the proposed solar farm have been established using the procedures from Part 3 of NIRV; the noise criteria are termed ‘Recommended Maximum Noise Levels’.

Step 1 in determining the Recommended Maximum Noise Levels involves determining ‘Zone Levels’, based on the zoning of the land at the noise sensitive area and at the noise-emitting premises. The Zone Levels are read from Table 1 of NIRV.

Referring to the relevant Planning Scheme, presented in Appendix B, the proposed solar farm site and the nearest receptors are situated on land zoned *Farming Zone* (FZ).

For these land use zonings, i.e. noise-generating zone FZ to receiving zone FZ, from Table 1 of NIRV, the Zone Levels are as follows:

- Day period: 46
- Evening period: 41
- Night period: 36

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3.3.2 Step 2 – Distance-Adjusted Levels

Step 2 in determining the noise criteria is to adjust the Zone Levels based on the distance from the noise sensitive receiver to the boundary of the zone in which the noise-emitting premises is located. The distance adjustment is 1 dB for every 100 metres from the boundary of the zone on which the noise emitter is located, to the noise sensitive receptor.

NIRV prescribes that where the noise-emitting premises and the receptor are in the same continuous zone, the distance adjustment is zero. NIRV also states that:

If there is a zone for a road or a railway line that divides a noise-emitting zone, this road/railway zone would be ignored (i.e., the zone should be treated as one contiguous zone for the receiver distance adjustment).

For all receivers except 101 Chappel Road East, the proposed solar farm site and the nearest receptors are in the same continuous zone, therefore for these receptors the distance adjustment is zero.

The proposed site and 101 Chappel Road East are also in the same zone classification, with an intervening road zone comprising Traralgon-Maffra Road, and running adjacent to the road zone there is a 30-metre wide strip of *Public Conservation and Resource Zone* (PCRZ) zone which contains the Gippsland Plains Rail Trail.

While NIRV stipulates that a road or rail zone that divides the zone between a source and receiver is to be ignored in the evaluation of the distance adjustment, it does not state the same for PCRZ dividing the zones. However, in this instance it is considered that the strip of PCRZ running alongside the road should also be ignored in evaluating whether a distance adjustment applies for 101 Chappels Road East with the result that the distance adjustment will be zero.

The reason for this is that the strip of PCRZ alongside the road serves a similar purpose to road and rail zones in that it accommodates an access trail, and it is not a substantial area of land with a use that contrasts with the surrounding area to warrant an adjustment to the noise limits. Note that if the PCRZ zone accommodating the rail trail was not ignored, such that the distance adjustment is applied, the Zone Levels at 101 Chappels Road East would need to be reduced by 9 dB.

Therefore, the distance adjustment is taken to be zero for all receivers in the vicinity of the proposed solar farm.

3.3.3 Step 3 – Base Noise Level Check

Step 3 in determining the criteria is the base noise level check. For each period, the greater of the distance adjusted noise levels and the NIRV 'base noise levels' are to be adopted. The base noise levels are as follows:

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

Therefore, the Zone Levels determined in Step 1 are to be adopted for each receptor.

3.3.4 Step 4 – Background Noise Level Check and Adjustment

NIRV also prescribes that if the noise sensitive area is determined to be a 'background-relevant area', a background noise assessment including background noise monitoring may be conducted. If the noise sensitive area is not a background-relevant area, the Recommended Maximum Noise Levels are the applicable Zone Levels, adjusted as appropriate from Steps 2 and 3.

Background-relevant area is defined in NIRV as follows:

> *'Background-relevant area' means a noise-sensitive area where background levels may be higher than usual for a rural area. This includes areas where freeway or highway traffic is a significant audible background noise source. It also includes coastal areas, where representative background levels are elevated by surf.*

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For a background relevant area, the noise criteria will be the Day period background level plus 8 dB(A), and the Evening and Night period backgrounds plus 5 dB(A), if these values exceed the applicable recommended levels for the respective periods.

For the area surrounding the proposed solar farm site it is considered that the background noise levels would not be higher than usual for a rural area, and no adjustment for background noise is to be applied.

Therefore, the Recommended Maximum Noise Levels are as presented in Table 2.

Table 2 Recommended Maximum Noise Levels

NIRV Time Period	Time	Recommended Maximum Noise Level [dB(A)]
Day	7am to 6pm Weekdays 7am to 1pm Saturdays	46
Evening	6pm to 10pm Weekdays 1pm to 10pm Saturdays 7am to 10pm Sundays and Public Holidays	41
Night	10pm to 7am	36

The Recommended Maximum Noise Levels presented above apply to the noise emitted from the proposed solar farm, outdoors within 10 metres of the dwellings at the identified nearest receptors.

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4.0 Noise Modelling

This section outlines the methodology that was used to undertake acoustic computer modelling to predict the noise levels at the nearby residential locations due to the operation of the proposed solar farm.

4.1 Noise Modelling Software

The noise levels at the nearby residential locations due to the operation of the solar farm were calculated using 'SoundPLAN' environmental noise modelling software, version 8.0. This software is capable of accurately modelling environmental noise levels and mapping the results. SoundPLAN is used extensively worldwide, and takes a standards-based approach to modelling.

The modelling was undertaken using the CONCAWE[1] prediction method that is widely used in Australia for modelling environmental noise, and is accepted by EPA. The CONCAWE method was originally developed for predicting the long-distance propagation of noise from petrochemical complexes. It is especially suited to predicting noise propagation over large distances because it accounts for a range of atmospheric conditions that can significantly influence the propagation of noise over large distances.

4.2 Noise Modelling Parameters

The following sections outline the assumptions and parameters input into the acoustic model to calculate the noise levels at the nearest noise-sensitive locations.

4.2.1 Topography

The site of the proposed solar farm and the surrounding land is relatively flat, therefore, the site and surrounds extending out to the receivers was modelled as flat ground.

4.2.2 Ground Absorption

All ground in the study area was modelled as being 60% acoustically absorptive, as the terrain in the vicinity of the site is predominantly vegetated and soil-covered fields which will partially absorb noise.

4.2.3 Meteorological Conditions

Meteorological conditions such as the presence of a temperature inversion or light to moderate winds can have a significant effect on sound propagation. Generally, as air pressure increases, relative humidity increases and temperature decreases, noise propagation is enhanced.

Temperature inversions (i.e. when the normal temperature profile of the atmosphere is reversed such that the air temperature increases with increasing height above ground) typically occur at night and tend to assist the propagation of noise. Likewise, a light to moderate wind (i.e. 1 to 3 m/s) from the source to the receiver tends to assist the propagation of noise to the receiver, while the impact of noise for any receivers in the opposite direction would be reduced. For higher wind speeds, the wind becomes too turbulent to effectively assist the propagation of noise, and background noise levels tend to increase, masking any increases in noise level due to wind-assisted propagation.

Noise levels at the noise sensitive receptors were calculated for two meteorological conditions, as follows:

- neutral atmospheric conditions with no wind, and
- a temperature inversion with a 3m/s wind from the site to the residences.

In general, the meteorological conditions in the vicinity of the site will include higher wind speeds than were modelled. As noted above, wind speeds in excess of 3 m/s are not considered to be favourable for noise propagation due to turbulence, and cause increased background noise levels at the receiver locations. Therefore, wind speeds of greater than 3 m/s were not incorporated into the acoustic model.

[1] CONCAWE Report No. 4/81, "The Propagation of Noise from Petroleum and Petrol Chemical Complexes to Neighbouring Communities", Published 1981.

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4.2.4 Noise Sources

The main sources of noise from the operation of the proposed solar farm will be the inverters and the substation transformer.

The inverters were modelled at the locations indicated on the site layout drawing shown in Appendix A. Three inverter units were modelled at each marked location, as per the current design for the solar farm. The inverters are nominally two metres high; therefore, each inverter was modelled as a point source, at a height of two metres above the local ground level.

The substation transformer was modelled within the substation area indicated on the proposed site plan on the southern site boundary, at a height of three metres above the local ground level.

4.2.5 Receivers

Receiver points for the calculation of the noise levels at the residential locations were placed at 1.5 metres above the local ground level. Noise levels were calculated at these locations under 'free-field' conditions, i.e. without influence from any sound-reflecting structures.

4.3 Noise Level Data

Ingeteam model "Ingecon Sun Power B Series" inverters are proposed for installation at the site. Ingeteam supplied Sound Power Level data for the proposed inverter units for a range of operating conditions.

South Energy have advised that the inverters associated with the 20 PCUs dispersed across the site would operate under two conditions, depending on the time of day. The provided noise level data for the two operating conditions, and times of day for which they will operate under those conditions, is presented in Table 3, below.

Table 3 – Inverter Noise Level Data

Time of Day	Operating Condition	Overall Sound Power Level (dBA)
7am to 10pm	Acoustic power with fans at 100% and a nominal power	94.5
10pm to 7am	Acoustic power with fans at 50% and a current of 1130 A	82.8

South Energy advised that the three inverters comprising the battery storage PCU could potentially operate at nominal power all of the time.

Octave band or one-third octave band noise level data was not available for the proposed inverter units, therefore the acoustic frequency distribution, or 'spectrum shape', was assumed based on the one-third octave band data for another inverter, the SMA Solar Technology AG SC 2500 model inverter.

The one-third octave band noise levels were adjusted uniformly across the frequency range to provide overall Sound Power Levels for the two operating conditions tabulated above for use in the modeling.

Noise level data for the substation transformer was not available for use in the modelling. Therefore, the transformer was modelled as having an overall Sound Power Level of 80 dB(A), which is estimated to be within the likely range of sound output for this item. If a transformer with a higher Sound Power Level is selected for installation, details of the proposed transformer should be provided for acoustic review.

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4.4 Noise Modelling Results

The predicted noise levels at the nearby residences due to the operation of the proposed solar farm, for full power operation and 50% power operation, for the two meteorological conditions considered, are presented in Table 4 and Table 5, below.

Table 4 – Predicted Noise Levels due to Operation of Solar Farm – Nominal Power and Full Fan Speed

Receiver	Predicted A-weighted Sound Pressure Level, L_{Aeq} [dB(A)]	
	Neutral Meteorological Conditions	Temperature Inversion + 3m/s Wind
40 Chappels Road	29	35
60 Chappels Road	29	35
80 Chappels Road	27	33
110 Chappels Road	26	32
390 Glengarry North Road	30	36
415 Glengarry North Road	28	34
1465 Traralgon-Maffra Road	30	36
101 Chappels Road East	22	28

Table 5 – Predicted Noise Levels due to Operation of Solar Farm – 50% Power (current of 1130A) and 50% Fan Speed

Receiver	Predicted A-weighted Sound Pressure Level, L_{Aeq} [dB(A)]	
	Neutral Meteorological Conditions	Temperature Inversion + 3m/s Wind
40 Chappels Road	18	24
60 Chappels Road	18	24
80 Chappels Road	16	22
110 Chappels Road	15	21
390 Glengarry North Road	19	25
415 Glengarry North Road	16	22
1465 Traralgon-Maffra Road	26	31
101 Chappels Road East	13	19

The inverter noise emissions are the dominant contributors to the predicted overall noise levels; the substation noise being a relatively minor noise contributor.

In accordance with the EPA requirements, the predicted noise levels with adjustments applied are to be assessed in relation to the Recommended Maximum Noise Levels. This is presented in the following section.

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5.0 Assessment of Compliance

In accordance with SEPP N-1, which prescribes the noise measurement and assessment methodology adopted by NIRV, adjustments are to be applied to the noise level at the receiver to account for the character of the sound. The adjusted noise level is the Effective Noise Level, which is assessed in relation to the Recommended Maximum Noise Levels.

One-third octave band sound level data for the Ingeteam inverters was not supplied for the assessment, however, noise emissions from inverters can exhibit strong tonal character. Therefore, a tonal adjustment needs to be considered for application to the predicted noise levels.

The magnitude of the tonal adjustment is determined based on the prominence of the tonal character of the noise as assessed at the location of the noise sensitive receiver. This will depend on the level and character of the noise in respect of the background noise conditions at the time of the assessment; a noise with strong tonal character in the presence of high background noise levels will exhibit a weaker tonal character than in the presence of low background noise levels.

Where the tonal character of the noise is 'just detectable', the SEPP N-1 prescribes a tonal adjustment of +2 dB; where the tonal character is 'prominent', a +5 dB adjustment is applied.

In this instance, during times of low background noise levels, the solar farm noise could be observed to exhibit prominent tonal character at the locations of the nearest receptors, such that the tonal adjustment would be +5 dB.

The resultant predicted Effective Noise Levels with the +5 dB tonal adjustment applied are presented in the tables below. Table 6 presents the Effective Noise Levels for the hours 7am to 10pm, for nominal power and full fan speed, and the Recommended Maximum Noise Levels that apply for those hours. Table 7 presents the levels for the hours 10pm to 7am, for 50% power and fan operation, and the Recommended Maximum Noise Levels that apply for those hours.

Table 6 – Predicted Effective Noise Levels due to Operation of Solar Farm - Nominal Power and Full Fan Speed

Receiver	Recommended Maximum Noise Level [dB(A)]		Predicted Effective Noise Level [dB(A)]	
	Day	Evening	Neutral Meteorological Conditions	Temperature Inversion + 3m/s Wind
40 Chappels Road	46	41	34	40
60 Chappels Road	46	41	34	40
80 Chappels Road	46	41	32	38
110 Chappels Road	46	41	31	37
390 Glengarry North Road	46	41	35	41
415 Glengarry North Road	46	41	33	39
1465 Traralgon-Maffra Road	46	41	35	41
101 Chappels Road East	46	41	27	33

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Table 7 – Predicted Effective Noise Levels due to Operation of Solar Farm - 50% Power (current of 1130A) and 50% Fan Speed

Receiver	Recommended Maximum Noise Level [dB(A)]	Predicted Effective Noise Level [dB(A)]	
	Night	Neutral Meteorological Conditions	Temperature Inversion + 3m/s Wind
40 Chappels Road	36	23	29
60 Chappels Road	36	23	29
80 Chappels Road	36	21	27
110 Chappels Road	36	20	26
390 Glengarry North Road	36	24	30
415 Glengarry North Road	36	21	27
1465 Traralgon-Maffra Road	36	31	36
101 Chappels Road East	36	18	24

The predicted solar farm Effective Noise Levels are compliant with the noise criteria that apply for all modelled scenarios.

For some of the receptor locations the predicted Effective Noise Levels are only just compliant with the Recommended Maximum Noise Levels (i.e. equal to the criterion).

As a result of this, any changes to the proposed layout, or to the proposed plant items, could lead to higher noise levels at the receptor locations thus causing non-compliance with the criteria.

Therefore, the final layout and design of the proposed solar farm should undergo acoustic review with respect to environmental noise emissions during the detailed design phase of the project.

6.0 Summary

AECOM was commissioned to assess the potential environmental noise emissions from the operation of the proposed Frasers Solar Farm.

Noise modelling was performed to predict the noise levels at nearby residences due to the operation of the solar farm, and the modelling results were considered in relation to the noise criteria prescribed by the Victorian EPA NIRV Guidelines.

The modelling results indicate that the noise emissions from the proposed solar farm will be compliant with the noise criteria at all receiver locations under neutral meteorological conditions, and under the condition of a moderate breeze assisting noise propagation from the solar farm to the nearby receptors.

Appendix A

Appendix B