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Report Number: AC23144 – 01 – R5

# Buckleys Road Agri-Voltaic Farm

## Assessment of environmental noise effects

*Prepared for:*
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## Document Acceptance

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## 1.0 INTRODUCTION

Acoustic Engineering Services Ltd (AES) has been engaged to undertake an assessment of environmental noise effects relating to the Buckleys Road Agri-Voltaic Farm at 150 and 187 Buckleys Road, Brookside, Selwyn (the site).

Aspects of the construction and operation of a proposed solar array on the site will generate environmental noise. We have therefore undertaken an assessment of environmental noise and vibration effects associated with construction and operation of this source.

Once constructed, the solar array will operate during normal daytime hours being 7:30 am to 8:00 pm, seven days per week. The construction activity will occur from Monday to Saturday, from 7:30 am to 6:00 pm.

The site and location of key operational noise generating aspects (the inverter skid sites, and batteries) is shown in figure 1.1.


Figure 1.1 – Site location

A glossary of acoustics terminology is provided in Appendix A.

## 2.0 ACOUSTIC CRITERIA

The Selwyn District Plan has limits which are relevant for compliance. Other guidance which provides further context about noise effects is also discussed in this section. As above, we have been advised that noise emitting items of the solar array would not operate outside of the hours of 7:30 am to 8:00 pm, seven days per week, and we have therefore limited our assessment of noise from the activity to that time period.

### 2.1 Selwyn District Plan

#### *2.1.1 Operational noise*

According to the Selwyn District Council Operative District Plan (ODP), the site and the surrounding area is zoned Outer Plains (OP). The ODP Rural Volume, Section 9.16 *Activities and noise*, Table C9.3 prescribes the following relevant noise limits for the activity:

- 7:30 am to 8:00 pm – 60 dBA $L_{10}$, and 85 dBA $L_{max}$

Activities of a limited duration required by primary production, for example general use of farm machinery, are not required to comply with these limits but must not generate unreasonable noise in line with Section 16 of the RMA.

The noise limits apply at the notional boundary of any dwelling on a receiving site. Noise must be measured in accordance with the provisions of NZS 6801:1999 *Acoustics – Measurement of environmental sound* and assessed in accordance with NZS 6802:1991 *Acoustics – Environmental noise*.

According to the Selwyn District Council Proposed District Plan (PDP), the site and the surrounding area is zoned General Rural (GRUZ). The PDP Part 2, District Wide Matters, General District Wide Matters, Noise-REQ1 prescribes the following relevant noise limit for the activity:

- 7:00 am to 10:00 pm – 55 dB $L_{Aeq}$

The noise limit applies at the notional boundary of any noise sensitive activity within any site receiving noise. We note that an $L_{max}$ based daytime noise limit has not been added to the PDP. Noise must be measured in accordance with the provisions of NZS 6801:2008 *Acoustics – Measurement of environmental sound* and assessed in accordance with NZS 6802:2008 *Acoustics – Environmental noise*.

Similar to in the ODP, rural production activities using equipment which is mobile or portable during normal use is a permitted activity and not subject to these limits. Because both the ODP and PDP have exclusions for rural production activities such as mobile machinery, it appears that the general limits would be applicable to sources which are fixed in nature, for example a pump, machinery associated with a cowshed, or ventilation fans associated with a poultry farm.

#### *2.1.2 Construction noise*

The ODP does not prescribe any specific noise limits for construction activity. The PDP does contain noise limits which align with the New Zealand Standard NZS 6803:1999 Acoustics – Construction noise (NZS 6803), which is used widely in New Zealand to control the effects of noise from construction activity.

The relevant noise limits are:

- Monday to Saturday - 7:30 am to 6:00 pm - 70 dB $L_{Aeq}$, and 85 dB $L_{Amax}$

The noise limits are intended to be applied at 1 metre from the most exposed wall of the receiving building, in this case residential dwellings in the GRUZ zone.

## 2.2 New Zealand Standard NZS 6802

In the current version of NZS 6802:2008 *Acoustics – Environmental noise* (NZS 6802), the $L_{10}$ noise descriptor for intrusive noise is replaced by $L_{eq}$ to align with both Australian and other international practice. Based on our measurements of similar solar farm equipment, the measured $L_{10}$ noise level is expected to be similar to the measured $L_{eq}$ noise level over the same time period. It would be current best practice to assess noise from the proposed activity in terms of the $L_{eq}$ based noise descriptor prescribed in the current version of NZS 6802.

NZS 6802 suggests a guideline daytime noise limit of 55 dB $L_{Aeq(15\ minute)}$ for "the reasonable protection of health and amenity associated with the use of land for residential purposes".

The Standard also describes how a 3 dB duration adjustment may be applied to sound received for less than 50 % of the daytime period, and a 5 dB adjustment may be applied to sound received for less than 30 % of the daytime period.

NZS 6802 also recommends the application of a penalty for noise containing Special Audible Characteristics (SAC), such as tonality or impulsiveness, as these are distinctive characters which may affect the subjective acceptability of noise. In cases where SAC are confirmed to be present, a penalty of up to 5 dB may be appropriate.

## 2.3 World Health Organisation

*Guidelines for Community Noise*[1], a document produced by the World Health Organisation based on extensive international research recommends a daytime guideline limit of 55 dB $L_{Aeq(16\ hours)}$ to ensure few people are seriously annoyed in residential situations. A daytime guideline limit of 50 dB $L_{Aeq(16\ hours)}$ is recommended to prevent moderate annoyance. A guideline night-time limit of 45 dB $L_{Aeq}$ is recommended to allow occupants to sleep with windows open.

## 2.4 Ambient noise environment

William Reeve of Acoustic Engineering Services deployed noise monitoring equipment at two separate locations on the subject site on the afternoon of the 25th of January 2023. These were collected on the 1st of February 2023. One noise logger was close to the western edge of the subject site near 324 Branch Drain Road, and the second near the eastern extent close to 870 Hanmer Road. The monitoring locations and further details about the monitoring are shown in Appendix C. This equipment recorded six days of data each, although on many days there were extended periods with moderate to high wind speeds.

Attended measurements were also undertaken when deploying and collecting the logging equipment. We observed that the existing noise environment was typical of a rural area distant from major roads. The main contributors to the ambient noise environment when wind speeds were low were insects and birds, livestock, intermittent traffic on nearby roads and irrigator systems. Distant farm machinery was also audible at some locations. At higher windspeeds, wind generated noise in shelterbelts and other vegetation became more apparent. Some low-level electrical noise was observed close to the substation at the northwest extent of the subject site.

The monitoring data was reviewed for days and periods when the wind speeds were relatively low during the proposed operational hours of the solar farm. This confirmed that in these conditions there are extended periods where noise levels are between 38 – 48 dB $L_{Aeq\ (15\ min)}$, often with several louder periods throughout the day. The results from two representative days are presented in figure 2.1 on the next page. At higher windspeeds, there will be more noise induced by vegetation.

[1] *Edited by Berglund, B et al. Guidelines for community noise. World Health Organization 1999*

We would broadly characterise this area as generally being relatively quiet, with higher levels of sound associated with machinery and other rural activities present on a more transient basis.

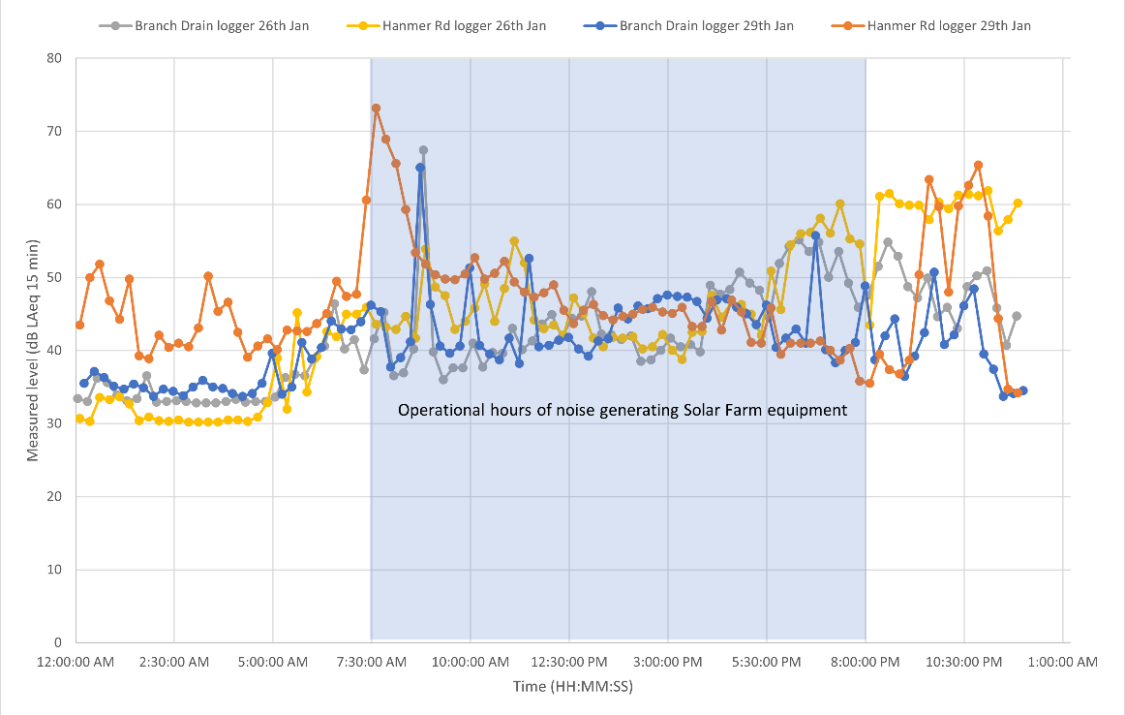


**Figure 2.1 – Measured ambient noise levels for two representative days**

## 2.5 Conclusions regarding appropriate noise levels

The operative Selwyn District Plan daytime noise limits are at the upper end of noise limits that would be considered to provide adequate amenity protection for rural dwellings, being more lenient than many local and international guidelines and higher than existing ambient levels in the vicinity of the site. We consider these numerical limits to be generous compared with other districts in NZ, although not unreasonable based on the explanation in the District Plan that the rural area is considered as a business zone.

The proposed Selwyn District Plan limits are broadly consistent with the upper thresholds for residential amenity provided in NZS 6802:2008 and by the WHO. However, they are also higher than ambient levels typically experienced in the vicinity of the site.

Given that this source is relatively steady state in character, and that existing ambient noise levels are relatively low, we consider that noise limited to the following level (measured and assessed in accordance with NZS 6801:2008 and NZS 6802:2008 respectively), when received at the notional boundary of neighbouring dwellings would be acceptable:

- Daytime (7:30 am to 8:00 pm) - 50 dB $L_{Aeq(15\ minute)}$

The nominated $L_{Aeq}$ based noise limit is more stringent than the District Plan noise limits and adopts the conservative daytime hours outlined in the ODP. It is consistent with the lower WHO threshold for the protection of residential amenity. While this limit would permit levels that are higher than the current background noise levels in the area at times, if predictions are based on a scenario with favourable sound propagation conditions, then given the distance to receivers, noise levels will typically be lower.

We consider that construction noise should be managed in accordance with NZS 6803:1999.

## 2.6 Vibration

We do not expect that operation of the solar array will generate any significant levels of vibration, however some aspects of the construction may generate significant levels of vibration, such as during piling.

The ODP section 9.17 *Activities and blasting and vibration*, Part 9.17.1.2 prescribes that permitted activities which involve vibration from any source comply with New Zealand Standard 2631:1985-89 Parts 1-3. We note that standard is typically used to protect human comfort due to vibration generated by long-term emission sources such as an industrial facility, and it is not an appropriate standard to use when considering the impacts of vibration from construction activity which occur over a much shorter time frame for any one receiver.

The PDP rule NOISE-R14 contains requirements for activities that generate vibration and prescribes vibration limits which align with the guideline values from the German Standard DIN 4150-3:2016 *Vibration in buildings – Part 2: Effects on structures (DIN 4150)*. That standard is widely in New Zealand when assessing the impacts from construction activity.

## 3.0 NOISE ASSESSMENT

Airborne noise modelling was undertaken using SoundPLAN (v8.2) which takes into account the sound power levels for plant items, locations of the activity and receivers, attenuation of noise over distance and local ground conditions. This model implements the calculation standard ISO 9613 which means that predictions are representative of conditions favourable to sound propagation, such as light downwind conditions or ground-based temperature inversions.

The modelling was based on information contained in the following provided documents:

- Technical report titled *Sound Pressure Level in FreeMaq PCSK/FREESUN HEML GEN3 Inverters*, prepared by Power Electronics, dated March 2022.
- Email containing noise emission level for the CAT battery units, dated 22 July 2022.
- V5 site layout and notes provided by Kea Energy on the 18th of July 2023, and V5 battery layout provided on the 19th of July 2023.
- Our observations and measurements at the Kea Energy site in the Wairau Valley.

We understand the receivers at the following addresses have provided written approval of all aspects of the proposed Agri-Voltaic Farm, including around matters of noise and vibration emission:

- 105 Buckleys Road
- 115 Buckleys Road
- 150 Buckleys Road
- 187 Buckleys Road

We have not considered the effects of noise and vibration at these receiver locations.

### 3.1 Operational noise source levels

To assess the expected level of noise from the operating solar array, modelling was undertaken which included the cumulative noise emission from the key fixed plant items operating concurrently.

The solar farm will comprise panel arrays which are connected to inverter / transformer skids distributed beside a roadway. Fourteen batteries will be grouped centrally on the site (seven each side of the road). The “Single Skid” location will have one inverter and one transformer. The six “Twin Skid” locations will have two inverters, and one central transformer, as shown in figure 3.1.

Figure 3.1 –Skid layouts (double & single)

The sound power level for each plant item was taken from data provided by the manufacturer, and the transformer noise levels were based on guidance from the Australian and New Zealand Standard AS/NZS 60076.10:2009 *Power Transformers*. We have applied a +5 dB penalty to the transformer noise levels to address the potential for special audible characteristics from that source. We have not applied penalties for special audible characteristics to the inverter or battery sources as we do not consider it likely the operation of these plant items would result in special audible characteristics during the daytime. This approach was verified by undertaking a site visit to a similar KeaX installation in the Wairau Valley. This installation also has a similar skid arrangement with a single Power Electronics inverter, and a transformer. The inverter model is the previous generation of what is proposed on this site. In that case, the noise from the ventilation fan intake was dominant and not tonal.

The source noise levels used in the modelling are shown in table 3.1.

Table 3.1 – Operational noise source levels

| Plant item | Sound power level (dB $L_{WA}$) |
|---|---|
| Inverter | 98 |
| Battery | 101 |
| Transformer (4.39 MVA for single inverter skid) | 75 |
| Transformer (6.58 MVA for double inverter skid) | 78 |

We understand that a tracking system may be installed at this site. Based on our observations of the tracking system at the Applicants Wairau Valley site, which we understand is of a similar scale to what is proposed here, and predictions for other similar operations, these motors will have a very low sound power level (in the order of 58 dB $L_{WA}$). They also only operate for short periods to re-orient the panels. This source is not expected to contribute appreciably to the cumulative noise levels received at neighbouring dwellings and is not included in the model.

We note that our measurements of the second-generation inverter at Wairau, and the manufacturers data for the third-generation inverter show that this source has some directionality. It is likely that the battery will exhibit similar characteristics. However, all sources have been modelled as dispersing sound uniformly in all directions.

The third-generation inverter also has a variable speed fan, and the manufacturers data indicates that noise levels reduce by in the order of 10 – 12 dB, depending on orientation, when the fan speed is reduced.

The modelling does not account for any local screening provided by the inverters or batteries to each other, or from the panel array itself. Indicative modelling shows that there will likely be a small benefit from panel screening for some dwellings.

The operating solar farm will also include other sources of noise such as operation of the site office and intermittent vehicle movements relating to staff moving to and from the site and undertaking maintenance inspections. We do not expect noise from those sources will be acoustically significant when compared with the noise from the fixed plant items.

We understand there would be no mechanical cleaning of the solar panels, or mechanical grass cutting, on the site.

## 3.2 Expected levels of operational noise

The noise emissions from the operation of the solar array are shown in figure 3.2. These noise levels do not include any duration adjustments.


Figure 3.2 – Predicted operational noise levels

Sites containing dwellings (not identified as providing APA above) that are expected to receive noise levels of more than 40 dB $L_{Aeq}$ are shown in figure 3.2, and the predicted noise levels at the notional boundary of these dwellings are as follows:

| | |
|---|---|
| 324 Branch Drain Road – | 47 dB $L_{Aeq\ (15\ min)}$ |
| 313 Branch Drain Road – | 45 dB $L_{Aeq\ (15\ min)}$ |
| 79 Buckleys Road – | 44 dB $L_{Aeq\ (15\ min)}$ |
| 277 Branch Drain Road – | 42 dB $L_{Aeq\ (15\ min)}$ |
| 56 Buckleys Road – | 42 dB $L_{Aeq\ (15\ min)}$ |
| 15 Stewarts Road – | 42 dB $L_{Aeq\ (15\ min)}$ |
| 29 Irwell Rakaia Road – | 41 dB $L_{Aeq\ (15\ min)}$ |
| 265 Branch Drain Road – | 41 dB $L_{Aeq\ (15\ min)}$ |

At other dwellings, noise levels are predicted to be less than 40 dB $L_{Aeq}$. Dwellings with predicted operational levels of more than 35 dB $L_{Aeq}$ are presented in Appendix B.

Given the expected steady state type operation of this equipment, the $L_{Aeq}$, $L_{A10}$ and $L_{Amax}$ emission levels are likely to be similar. This analysis confirms that the noise levels are expected to comply with the ODP and PDP noise limits (for the daytime) at all the relevant receiver locations. The noise from the operation of the project will be 10 dB or more below the ODP noise limits, and more than 5 dB below the PDP limits.

324 Branch Drain Road will receive the highest noise levels, where the operational noise is expected to be up to 47 dB $L_{Aeq\ (15\ min)}$ on some areas of the property (those close to the northern façade of the house). While this noise level is well below the acceptable level in the zone, there may be periods of days when noise from the solar farm is clearly audible in the areas outside this dwelling, depending on the mode of operation of the fixed plant, weather conditions (affecting sound propagation) and the presence or absence of other sources of environmental noise, such as wind in vegetation, and agricultural activity. The noise levels inside those dwellings would be in the order of 10 to 17 dB lower (with windows open) than the external levels, depending on the aspect of the internal spaces. Overall, we expect even for this property, the noise will not interfere with typical domestic activities and the noise effects will be acceptable.

## 3.3 Construction noise source levels

The construction activities were modelled based on our understanding of the key noise emitting equipment that would make up the team for each construction activity group, shown in table 3.2.

To provide some context to the noise emission from the equipment listed in table 3.2, the sound power levels for the equipment are what could be expected from typical equipment commonly used for roading, construction and demolition projects. The sound power levels were sourced from British Standard BS 5228-1:2009 *Code of practice for noise and vibration control on construction and open sites*, and AES's noise source database.

**Table 3.2 – Modelled construction activities**

| Activity group | Equipment | Sound Power Level dB $L_{WA}$ |
|---|---|---|
| Piling | Piling rig | 117 |
| | Truck | 96 |
| Civil works | Excavator – 20 to 30 tonne | 103 |
| | Grader | 106 |
| | Truck | 96 |
| Panel construction | Telehandler – 4 tonne | 104 |
| | Truck | 96 |
| | Hand tools | 89 |
| Tree clearing | Chainsaw | 117 |
| | Loader | 98 |
| | Truck | 96 |

While the construction activity will move around the site, we have modelled the noise from each activity group at the closest distance to each receiver, to capture a worst-case situation for compliance assessment purposes.

We understand there could be more than one piling rig used on the site concurrently, however the piling teams would be spaced apart and there would not likely be a noticeable increase in the cumulative noise level from piling at any one receiver location. We have adjusted the piling noise source level to reflect an expected 30% on-time during a 15-minute period.

While the noise emission from the planned activity will be reasonably steady state at times, we expect there could be instantaneous maximum noise events that cause levels in the order of 10 to 15 dB higher than those presented in table 3.2.

## 3.4 Expected levels of construction noise

The noise modelling results are shown for each construction activity in Appendix B. It can be seen that the construction noise levels are expected to comply with the noise limit (70 dB $L_{Aeq(15\ min)}$) at all the adjacent receiver locations. The panels have been located so that a 50 metre setback between the piling rig and any nearby dwellings will be achieved.

We expect there could be instantaneous maximum noise events that cause levels in the order of 10 to 15 dB higher than those presented in Appendix B. The noise limit for these transient noise events is 85 dB $L_{Amax}$, and we expect that maximum noise levels from the construction activity will also comply with the $L_{Amax}$ noise limit.

While our analysis confirms that the noise from construction activity can comply with the noise limits, the duration of the construction activity (one year), and the likelihood that noise levels will at times be significantly higher than the background noise levels, means that it is appropriate to be considerate of neighbours to minimise noise effects as far as practicable.

Often this would be addressed by implementing a Noise Management Plan (NMP) for use during the construction phase of the project, and we understand that the Applicant is willing to adopt this measure. This is expected to be a relatively brief document in this case, focussed on community relations management with neighbours – given that construction noise levels are lower than 55 dB $L_{Aeq}$ at all but 324 Branch Drain Road, and 79 Buckleys Road, and the higher levels at these locations are only expected when construction activities occur close to these dwellings.

## 4.0 VIBRATION ASSESSMENT

We expect the piling activity will generate the most significant level of vibration during the construction works. Given the reasonably large (approximately 50 metres) offset distances between the planned works and the adjacent residential buildings outside the project site, we expect that vibration from the piling works can comply with the guideline values from DIN 4150.

## 5.0 CONCLUSION

Acoustic Engineering Services Ltd (AES) has been engaged to undertake an assessment of environmental noise effects relating to the Buckleys Road Agri-Voltaic Farm at 150 and 187 Buckleys Road, Brookside, Selwyn (the site).

Aspects of the construction and operation of a proposed solar array on the site will generate environmental noise. We have undertaken an assessment of environmental noise and vibration effects associated with construction and operation of this source.

Given that this source is relatively steady state in character, and that existing ambient noise levels are relatively low, we consider that noise limited to the following level (measured and assessed in accordance with NZS 6801:2008 and NZS 6802:2008 respectively), when received at the notional boundary of neighbouring dwellings would be acceptable:

- Daytime (7:30 am to 8:00 pm) - 50 dB $L_{Aeq(15\ minute)}$

The nominated $L_{Aeq}$ based noise limit is more stringent than the District Plan noise limits and adopts the conservative daytime hours outlined in the ODP. It is consistent with the lower WHO threshold for the protection of residential amenity. While this limit would permit levels that are higher than the current background noise levels in the area at times, if predictions are based on a scenario with favourable sound propagation conditions, then given the distance to receivers, noise levels will typically be lower.

Our analysis confirms that the operational noise levels are expected to comply with this criterion. The noise from the operation of the project will also be 10 dB or more below the ODP noise limits, and more than 5 dB below the PDP limits. Noise levels of 47 dB $L_{Aeq}$ will be received at the dwelling at 324 Branch Drain Road, and there are another seven that will receive noise levels between 41 – 45 dB $L_{Aeq}$. At all other dwellings (which have not provided APA) noise levels will be 40 dB $L_{Aeq}$ or below.

While this noise level is well below the acceptable level in the zone, there may be periods of days when noise from the solar array is clearly audible in the areas outside these dwellings, depending on the mode of operation of the fixed plant, weather conditions (affecting sound propagation) and the presence or absence of other sources of environmental noise.

Given the long duration of construction works, and the likelihood that noise levels will at times be significantly higher than the background noise levels, the Applicant is willing to adopt a Noise Management Plan for the construction phases of the project. We expect that vibration from the piling activity (most vibration intensive) can comply with the relevant guideline values.

Overall, we expect the effects of noise and vibration emission from the construction and operation of the project will be acceptable.

# Appendix A

## Glossary of acoustics terminology

| | |
|---|---|
| Ambient level | The total noise or vibration level that includes contribution from all sources of noise present in the testing environment. |
| Decibel [dB] | The measured sound pressure level is typically presented in the units of Decibels.<br>Some typical sound pressure levels include:<br>30 dB(A) A quiet library or a quiet outdoor location in the country.<br>45 dB(A) Typical office space or outdoor in a city at night.<br>60 dB(A) Outdoors in a city centre during the daytime.<br>70 dB(A) A car passing by on the street.<br>80 dB(A) Loud music played inside a home.<br>90 dB(A) A truck passing on the street.<br>100 dB(A) A loud music concert.<br>120 dB(A) Very loud noise, possibly causing discomfort. |
| dB(A) | A-weighted decibels.<br>The human ear is more sensitive to mid frequency sounds.<br>Low and high frequency sounds of the same loudness are not perceived as being as loud.<br>A sound level meter measures all frequencies equally but can then aim to replicate the human response of the ear by using an electronic filter which is called an “A” weighting filter.<br>The sound pressure level in dB(A) gives a closer indication of the subjective loudness of a noise. |
| $L_{Amax(T)}$ | The maximum sound pressure level measured over a given period. |
| $L_{Aeq\ (T)}$ | The “equivalent noise level” is the summation of noise events and integrated over a specific period of time (T). Sometimes called the average noise level. |

# Appendix B

## Expected noise levels

| Receivers with predicted operational noise levels >35 dB $L_{Aeq}$ (highest first) | Rating noise level dB $L_{Aeq\ (15\ min)}$ | Construction noise level dB $L_{Aeq\ (15\ min)}$ | | | |
|---|---|---|---|---|---|
| | Operation | Tree clearing | Piling | Panel construction | Civil works |
| 324 Branch Drain Road | 47 | 57 | 69 | 67 | 67 |
| 313 Branch Drain Road | 45 | 51 | 52 | 46 | 45 |
| 79 Buckleys Road | 44 | 58 | 60 | 53 | 52 |
| 277 Branch Drain Road | 42 | 48 | 46 | 39 | 38 |
| 56 Buckleys Road | 42 | 54 | 51 | 44 | 43 |
| 15 Stewarts Road | 42 | 53 | 49 | 43 | 41 |
| 29 Irwell Rakaia Road | 41 | 54 | 50 | 43 | 42 |
| 265 Branch Drain Road | 41 | 52 | 45 | 38 | 37 |
| 23 Buckleys Road | 39 | 50 | 46 | 39 | 38 |
| 821 Hanmer Road | 39 | 48 | 50 | 43 | 42 |
| 43 Dunsandel and Brookside Road | 39 | 48 | 44 | 37 | 36 |
| 71 Stewarts Road | 39 | 46 | 42 | 35 | 34 |
| 883 Hanmer Road | 38 | 48 | 44 | 37 | 36 |
| 233 Branch Drain Road | 38 | 49 | 42 | 35 | 34 |
| 229 Branch Drain Road | 37 | 48 | 41 | 34 | 33 |
| 485 Brookside and Irwell Road | 37 | 45 | 41 | 34 | 33 |
| 932 Hanmer Road | 36 | 45 | 40 | 33 | 32 |
| 254 Smythes Road | 36 | 42 | 38 | 31 | 30 |
| 2 Brookside and Burnham Road | 36 | 43 | 39 | 32 | 31 |
| 7 Brookside and Burnham Road | 36 | 43 | 39 | 32 | 31 |
| 180 Grahams Road | 36 | 47 | 40 | 33 | 32 |
| 253 Smythes Road | 36 | 42 | 37 | 30 | 29 |
| 191 Branch Drain Road | 36 | 46 | 39 | 32 | 31 |

# Appendix C

## Ambient noise monitoring locations

| | |
|---|---|
| **Photos of logger installation** |   |
| **Logger locations** |   North of 324 Branch Drain Rd   West of 870 Hanmer Rd |
| **Equipment** | Convergence Instruments NSRTW Mark 3<br>Serial Number: CnjcDNWS+30XiptwT4jZnD – AES #8<br>Laboratory calibrated: 20th of May 2021<br><br>Convergence Instruments NSRTW Mark 3<br>Serial Number: AnnUJVWQ0Xe3KhlgR4pxtD – AES #9<br>Laboratory calibrated: 5th of May 2021<br><br>*The analysers were field calibrated before measurements, and the calibration checked after measurements. No significant change (+/- 0.1 dB) was noted.* |
| **Logging period** | AES#8 – 25/01/23 1255 until 1105 31/01/23 (retrieved 1/02/23)<br>AES#9 – 25/01/23 1235 until 1850 31/01/23 (retrieved 1/02/23) |