297 Te Puna Station Road

Proposed Industrial Development

Te Puna, Tauranga

ONVA

Operational Noise and Vibration Assessment

Date: 24 January 2023

Prepared for: Te Puna Industrial Limited

Prepared by: Earcon Acoustics Limited

Reference: J005252.OP

Application: RC13360L

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Document Control

Operational Noise and Vibration Assessment
297 Te Puna Station Road, Te Puna, Tauranga
Proposed Industrial Development
J005252.OP

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1 Preamble

This report has been prepared to assess potential noise effects from the proposed development at the subject site 297 Te Puna Station Road, for industrial facilities including a container storage and refurbishment operation.

We note that the details of the proposed facilities and operations within the subject development are not fully defined as at the date of this assessment. This is not unusual for similar developments. Furthermore, most industrial facilities change the nature of their operations over time with changing occupancies.

As such, this report should not (and does not) result in a statement or conclusion regarding compliance or non-compliance of the proposed facilities or operations, since the detailed nature of these operations and facilities is not known. It is instead intended to demonstrate if, and how, compliance with the applicable standards can be achieved with practicable mitigation measures.

It is our opinion that the facilities, each separately and as a development collectively, should be governed by Noise Management Plans (**NMP**s) covering, inter alia, operational restrictions, mitigation measures and compliance criteria.

Each NMP must be submitted to, approved and certified by the relevant authority (in this case the District Council) prior to any operation commencing. Any future updates or changes to an NMP (e.g. change in occupancy or operation) would also need to be approved and certified by the relevant authority, and all operations must adhere to the requirements of their latest approved NMP.

NMPs are highly effective tools to facilitate both the rigour of detailed operational controls and the flexibility required for operations to manage changes that can (and in most cases do) occur over time.

As such, this report includes recommended considerations to be taken into account in the design of the facilities (e.g. site layout and building locations) and to be taken into account in the preparation of NMPs for the proposed facilities once the details of the operations are established.

2 Introduction

This report has been prepared to assess potential noise effects from the proposed development at the subject site 297 Te Puna Station Road, for industrial facilities including a container storage and refurbishment operation.

The site for the proposed development is across three lots on the southern side of Te Puna Station Road in Tauranga. The site currently includes a light industrial operation at the south-western end of the site, and general industrial storage facilities both accessible through a gravel road from the northern boundary.

The proposed industrial operations include a container storage and refurbishment facility at the eastern end of the site, with the western end designated for other industrial activities. The proposed development also includes an internal road from the middle of the northern boundary with Te Puna Station Road, to the centre of the site heading east. The exact nature and layout of the operations is not known at this stage.

This report is intended as an acoustic assessment of potential activities within the proposed development against the applicable standards for the subject site, including the Western Bay of Plenty (WBOP) Operative District Plan. This report:

- Identifies noise and vibration generating and receiving activities both within the development and for the surrounding environment in terms of regulatory zoning, and applicable noise and vibrations regulations
- Describes the acoustic environment associated with the subject site, including traffic, rail, and zone noise and vibration levels.
- Details relevant regulatory criteria and recommended guidelines pertaining to both compliance and amenity of the facility.
- Proposes strategies and potential mitigation measures to be taken into account in Noise Management Plans (NMP) for each operation to control effects on surrounding receivers.

This report is based on information provided by:

- Site Plan by Momentum Planning and Design
- Landscape Concept Plan by Momentum Planning and Design
- S92 Request for Information by Western Bay of Plenty District Council dated 10/03/2022
- Email correspondence with Momentum Planning and Design

3 Site

3.1 Identification

The proposed development site is located within three lots on the southern side of Te Puna Station Road, in Te Puna, Tauranga. For ease of reference in this report, directional boundaries are noted in the figure below. For context, the subject site is circa 450m along the boundary with Te Puna Station Road.

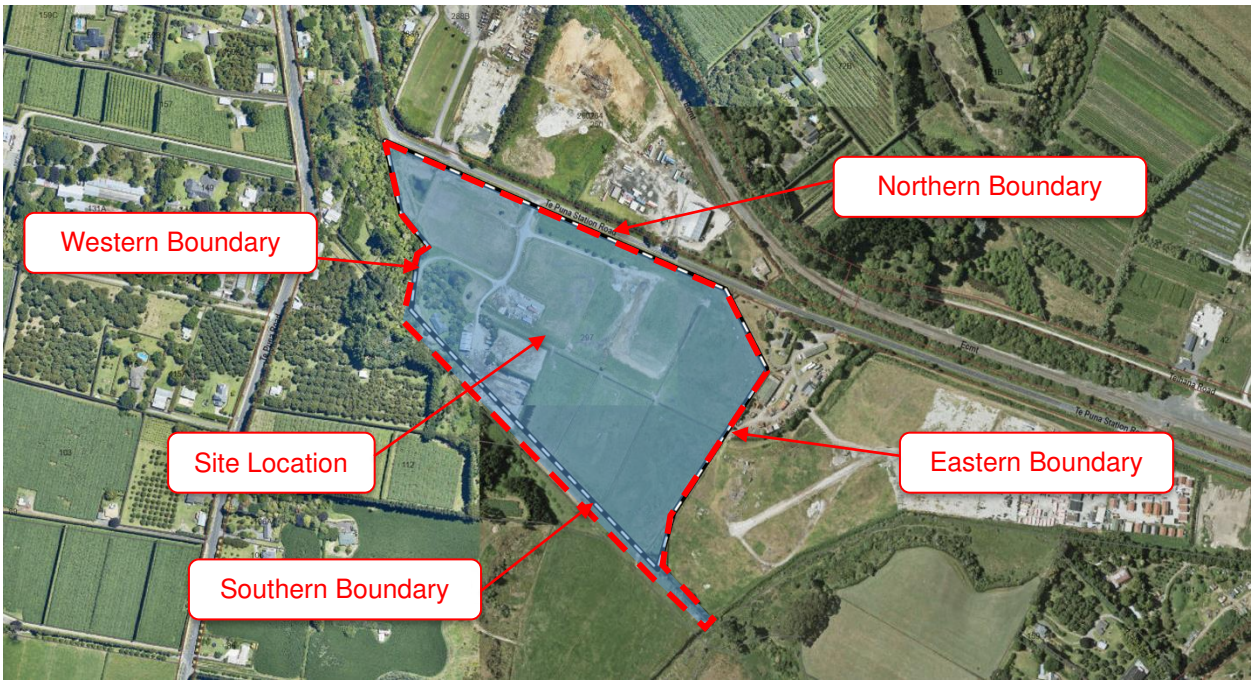


Figure 1 - Site Location – [WBOP Maps]

The proposed development is within the following land parcels, as shown in the figure below:

Figure 2 - Site Boundaries – [LINZ]

Part Lot 3 DP 22158
Section 3 SO 61751
Section 2 SO 61751

3.2 Zoning

In accordance with the WBOP Operative District Plan, the subject site to the North and the adjacent sites to the East are zoned *industrial*. Sites to the West and South are zoned *Rural.*

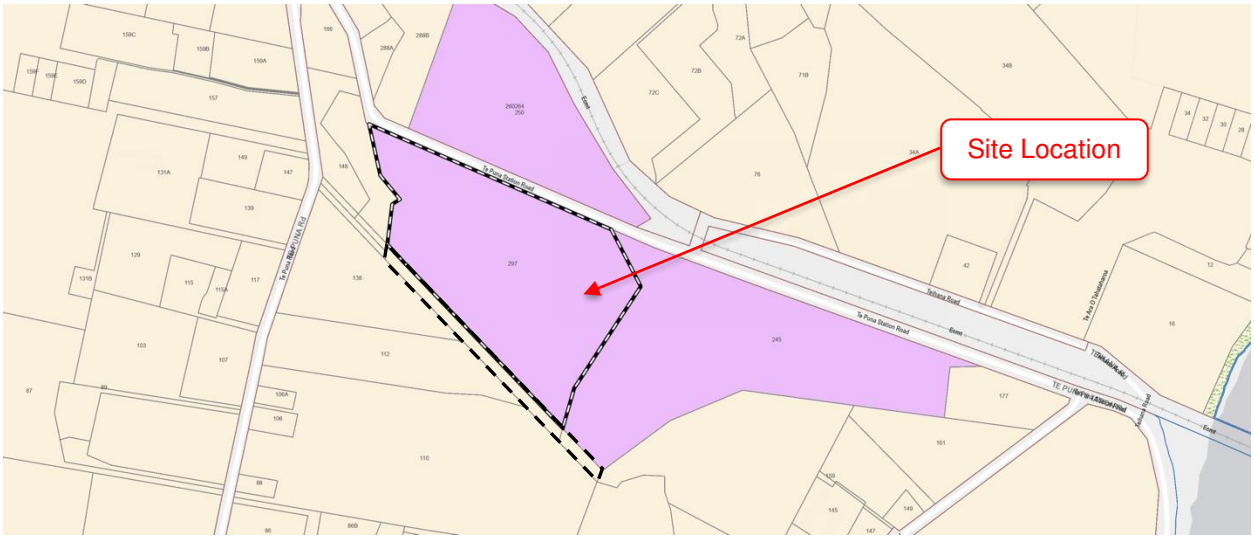


Figure 3 - Site Zoning – [WBOP Maps]

3.3 Vicinity

The neighbouring area adjacent to the subject site to the east, and across Te Puna Station Road to the North are predominantly industrial. Sites further to the east, and to the south and west are rural, and most include dwellings. In context of noise and vibrations, the following receiver sites are in the vicinity of the proposed development:

3.3.1 Industrial

- **North – 288B Te Puna Station Road:** Open yard of a heavy equipment hire operation with boundary at circa 25m from the northern boundary of the subject site.
- **North – 250-264 Te Puna Station Road:** industrial facility including outdoor and indoor operations across Te Puna Road at circa 25m from the boundary of the subject site.
- **East – 245 Te Puna Station Road:** Industrial facility with buildings and outdoor operations at the eastern boundary of the subject site.
- **East – 205 Te Puna Station Road:** Industrial facility with buildings and outdoor operations at circa 75m from the boundary of the subject site across the 245 Te Puna Station Operations.

3.3.2 Rural / Dwellings

The following approximate distances to closest buildings, understood to be habitable (dwellings,) pertain to noise assessment whereby measurements are for the closest distance between a dwelling and the subject site and in the direction of that closest measurement. The list is not intended to be inclusive of all receivers (noise modelling figures, as detailed further in this report, cover the wider surrounding area.)

The distances are noted here for context only. Calculations and modelling are based on LINZ data exports, and take into account topography and locations of noise sources.

Direction	Address	Approximate Distances (Closest to Subject Site)	
		Site Boundary To Subject Site Boundary	Site Boundary to Closest Dwelling
N	288, 288A Te Puna Station Road	40m	95m
N	328 Te Puna Station Road	150m	25m
NNW	166 Te Puna Road	120m	34m
NW	163 Te Puna Road	185m	25m
NW	159A Te Puna Road	135m	12m
NW	158 Te Puna Road	70m	40m
W	159A Te Puna Road	145m	15m
W	157 Te Puna Road	115m	50m
W	147 Te Puna Road	120m	52m
W	139 Te Puna Road	155m	5m
W	148 Te Puna Road	35m	35m
W	138 Te Puna Road	≈85-115m	≈2-5m
W	118 Te Puna Road	20m	165m
W	117 Te Puna Road	240m	15m
W	112 Te Puna Road	125m	100m
W	107 Te Puna Rad	318m	≈5m
SW	110 Te Puna Road	165m	55m
SW	106 Te Puna Road	290m	≈5m
SW	106A Te Puna Road	290m	≈5m
SW	88 Te Puna Road	410m	≈5m
SW	86B Te Puna Road	370m	≈5m
SW	88A Te Puna Road	380m	55m
SSW	56D Te Puna Road	285m	100m
S	56E Te Puna Road	250m	125m
S	97B Clarke Road	480m	85m
S	97A Clarke Road	580m	25m

Table 1 - Rural Receivers – Representative Distances to boundaries

Direction	Address	Approximate Distances (Closest to Subject Site)	
		Site Boundary To Subject Site Boundary	Site Boundary to Closest Dwelling
SE	116 Clarke Road	650m	60m
E	128 Clarke Road	650m	18m
E	134 Clarke Road	630m	10m
E	139 Clarke Road	435m	72m
E	145 Clarke Road	430m	55m
E	147 Clarke Road	525m	≈5m
E	159 Clarke Road	425m	15m
E	149 Clarke Road	565m	≈2m
E	161 Clarke Road	417m	65m
E	177 Te Puna Station Road	550m	85m
NE	76 Teihana Road	125m	105m
N	72C Teihana Road	120m	90m

Table 2 - Rural Receivers – Representative Distances to boundaries (Continued)

3.3.3 Transport

- Te Puna Station Road: Primary Collector Road (Waka Kotahi / NZTA One Network Road Classification) at the northern boundary of the subject site, comprising two lanes, one east-bound and another west-bound.
- Te Puna Road: Primary Collector Road (Waka Kotahi / NZTA One Network Road Classification) to the west of the subject site, comprising two lanes, one north-bound and another south-bound at circa 100m from the boundary of the subject site.
- Railway – ECMT 51: Railway tracks of the KiwiRail East Coast Main Truck and Te Puna Loop, with dual tracks at the eastern end, passing closer to the site (Te Puna Loop at circa 75m), and single track curving to the north (East Coast Main Trunk) away from the site to a distance of circa 300m at the western end.

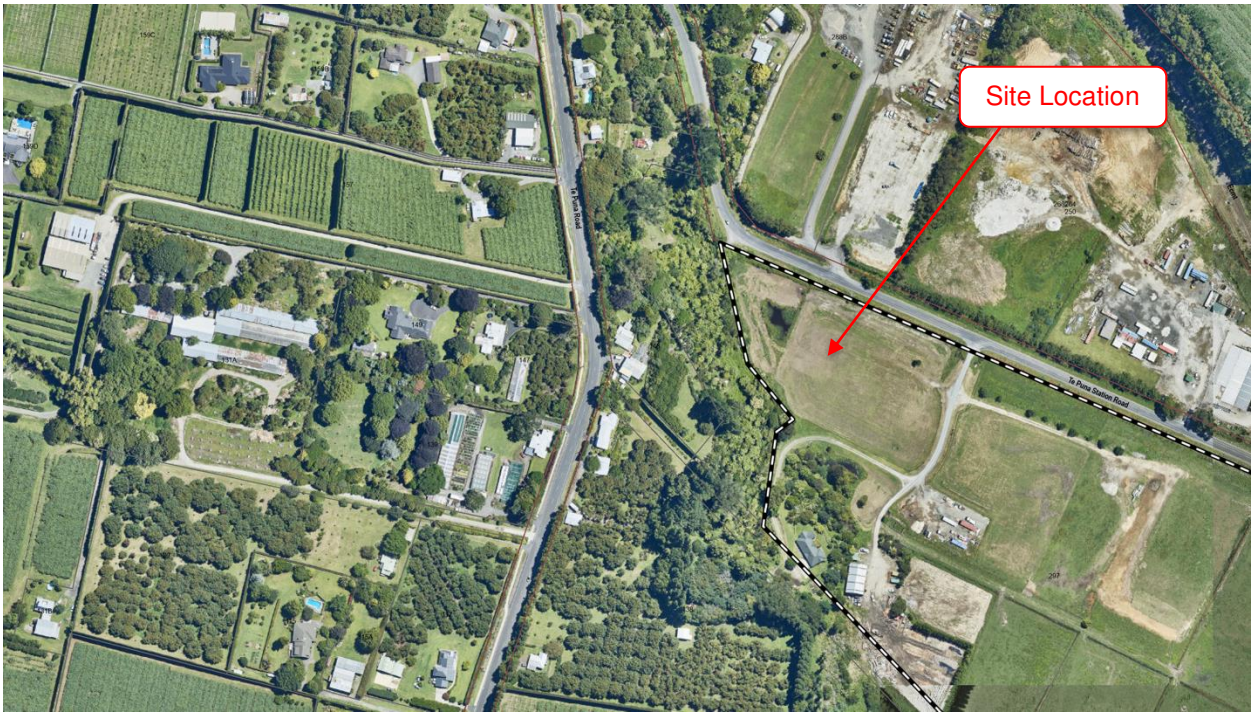


Figure 4 - Site Vicinity Western End – Aerials – WBOP Maps

Figure 5 - Site Vicinity Eastern End – Aerials – WBOP Maps

4 Ambient Environment

We undertook two surveys of the site, on 5/11/2022 and on 12/11/2022, to assess the ambient environment including noise sources and ambient levels at the perimeter of the site and within it. The following considerations were taken into account:

- **Manned noise measurements** were undertaken on Saturdays to assess the operation of the industrial facilities against the lower ambient noise levels, as a conservative measure in context of amenity of receivers. In addition the manned noise monitoring results are used to verify the accuracy of the noise propagation models.
- **Automated noise measurements** were undertaken at a representative location to establish changes in ambient noise levels between weekdays and weekends, and variability across different hours of day and night. The location was selected to include the effects of major existing noise sources (roads, rail, other operations, etc.) without any being overly dominant. This is used to verify the accuracy of noise propagation models.

Noise monitoring, manned and automated was conducted in accordance with the requirements of NZS6801:2008 “Acoustics - Measurement of Environmental Sound” and assessed in accordance with NZS6802:2008 “Acoustics - Environmental Noise.”

In accordance with NZ standards NZS6801, NZS6802, and NZS6803, the following metrics are used to quantify noise and vibrations:

- **L_{WA} [dB]**: A-Frequency Weighted sound power level. This metric is primarily used to describe the power output from a sound source for the purposes of modelling.
- **LA_{eq} [dB] or L_{eq} [dBA]:** A-Frequency Weighted time average sound level. This metric represents the full audio range weighted against the response of the human ear. This is the primary descriptor of noise for receivers.
- **LA_{max} [dB] or L_{max} [dBA]:** Maximum sound pressure level.

4.1 Automated Noise Logging

Automated monitoring was undertaken from the 05/11/2022 to 09/11/2022 using an ARL Ngara, Type 1 integrating sound level meter mounted atop a 1.5m integrated pole with wind shield attached, configured for 1/3 octave readings at 100ms intervals.

The monitor was placed at the western end of the site, at circa 65m horizontally from the edge of Te Puna Station Road:

Figure 6 - Location of Automated Monitoring - [WBOP Maps]

4.1.1 Weather Conditions – Automated Noise Logging

Weather conditions during the automated monitoring period were generally conducive to environmental monitoring, with temperatures around Lo:12 and Hi:22°C. Winds for the majority of the period were at circa 5-10kts, increasing on 9/11/2022 to circa 13kts, with skies clear to partially. Light rains developed in the evening of 8/11/2022 increasing to rain on 9/11/2022 The following is representative of the weather conditions during the monitored period:

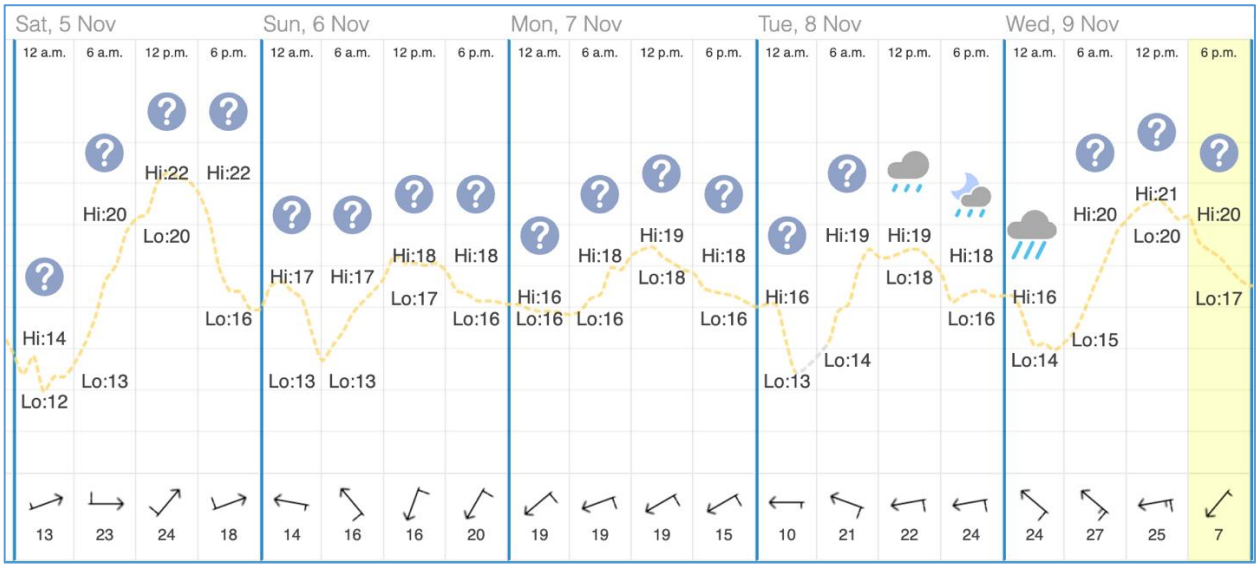


*Figure 7 - Weather Conditions - Tauranga – **Wind reported in km/h** - [timeanddate.com]*

4.1.2 Noise Levels – Automated Logging

The following is general description of the ambient noise levels at the monitoring location as per the graphs below (also presented in detail in Appendix II.)

- Noise Levels during **daytime Weekdays** is generally in the order of **LA_{eq} 50dB - 55dB**
- Noise Levels during **daytime Saturday** is generally in the order of **LA_{eq} 47dB - 52dB**
- Noise Levels during **night time** is generally in the order of **LA_{eq} 35dB - 47dB**

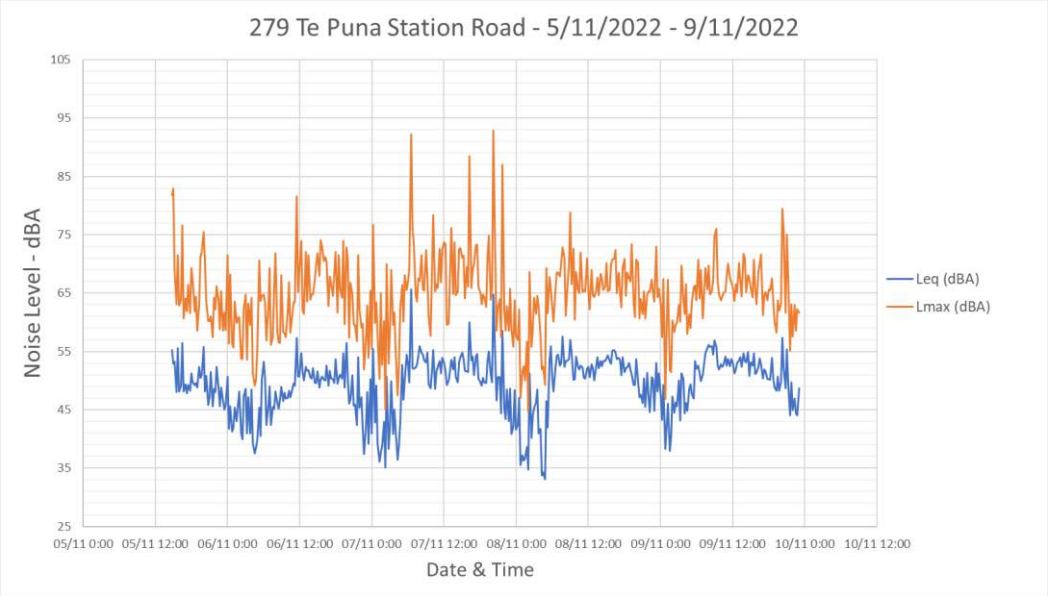


Figure 8 - Ambient Noise Levels – Logged – Full Period

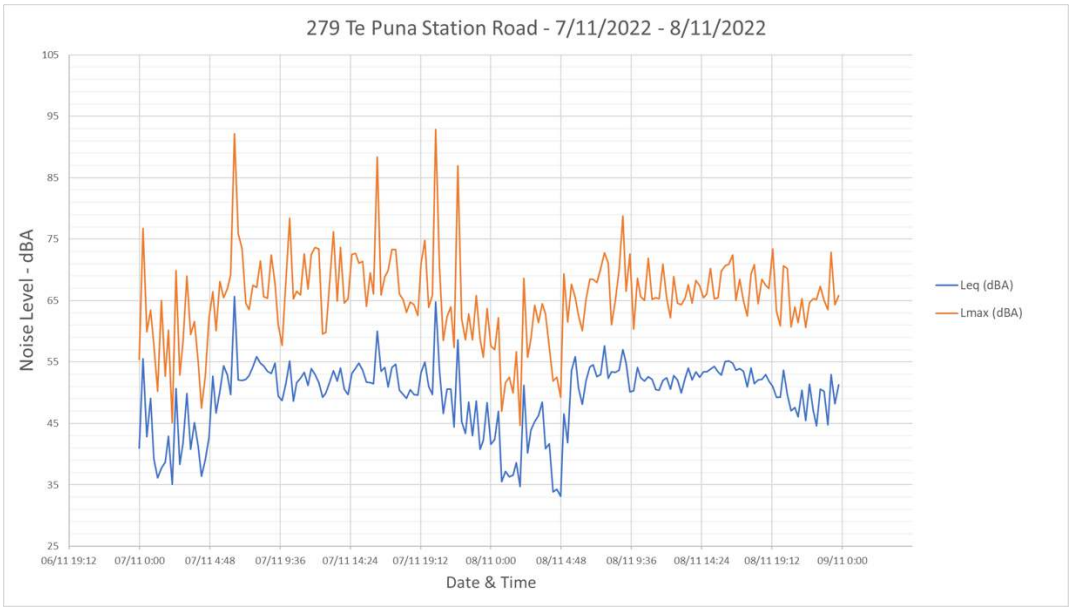


Figure 9 - Logged Noise Levels - Weekdays - Monday-Tuesday

4.2 Manned Noise Monitoring

Manned (Manual) monitoring was undertaken on 05/11/2022 and on 12/11/2022 between 12:00pm and 3:00pm (on both occasions) using a calibrated Type 1 B&K 2270 integrating sound level meter setup for 1/3 octave readings with a wind shield installed, mounted on a tripod at 1.5m above ground level at the following locations, as shown on the figure below:

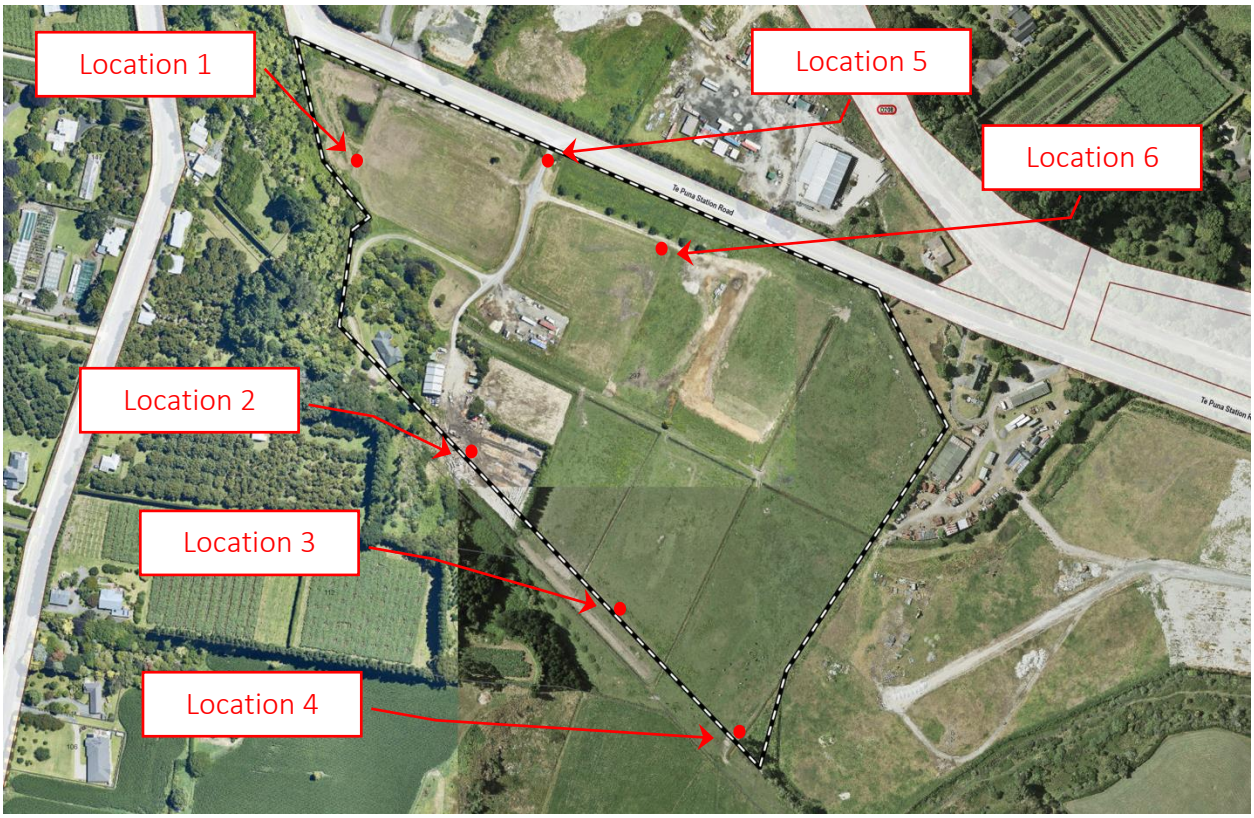


Figure 10 - Manned Monitoring Locations

4.2.1 Weather Conditions – Manned Monitoring

Weather conditions during the manned monitoring period were conducive to environmental monitoring, with temperatures around 15-20°C. Winds for the majority of the period were at circa 5-10kts, with clear skies.

4.2.2 Noise Levels – Manned Monitoring (Saturday)

The following are the ambient noise levels at the monitoring locations as per the figure above:

Location	Measured Noise Levels	
	$L_{eq\ (15min)}$	LF_{max}
Location 1	47 dBA	70 dBA
Location 2	45 dBA	58 dBA
Location 3	43 dBA	54 dBA
Location 4	43 dBA	55 dBA
Location 5	57 dBA	75 dBA
Location 6	53 dBA	71 dBA

We note that none of the noise measurements exhibited special audible characteristics (i.e. sounds were not impulsive or tonal.) As such, audible characteristics corrections are not required for ambient noise.

4.3 Observations

The following was noted from the site surveys, collated with logged and measured noise levels:

- Saturday noise levels were generally noted to be circa 3-4dBA less than weekdays.
- The industrial operations on the northern side of Te Puna Station generated noise levels measured at 53dBA@60m (equivalent to 70dBA@10m) and included forklift operations and movement of steel materials. These noise levels are generally in-line with expected noise levels from similar industrial yard operations.
- Three events of single-engine aircraft traversals were noted overhead during the manned monitoring period. Noise levels were measured at circa LA_{eq} 57dBA during the traversal.
- The main sources of noise at the south-eastern end of the site were noted to be general rural noises associated with birds, animals and rustling of trees.

5 Proposed Development

The proposed development includes establishment of an industrial yard at the western end of the development, planned to include industrial operations, undefined at this stage. At the eastern end of the site, a container storage and refurbishment facility is proposed. Locations of buildings and facilities is not defined as at the date this report, albeit building locations and constructions are likely to be influenced by the recommendations in this report.

The proposed development includes the establishment of an internal road from the general middle of the northern boundary, leading south to the centre of the site, and to the east to the proposed container facility. It is our understanding the container refurbishment and storage facility is planned to operate during daytime hours Monday to Saturday 7am to 6pm.

The overall site plan also includes establishing stormwater ponds, batters along the eastern b boundary, and an acoustic bund along the eastern end of the southern boundary. The following figure is representative of the general site plan, including landscape elements:

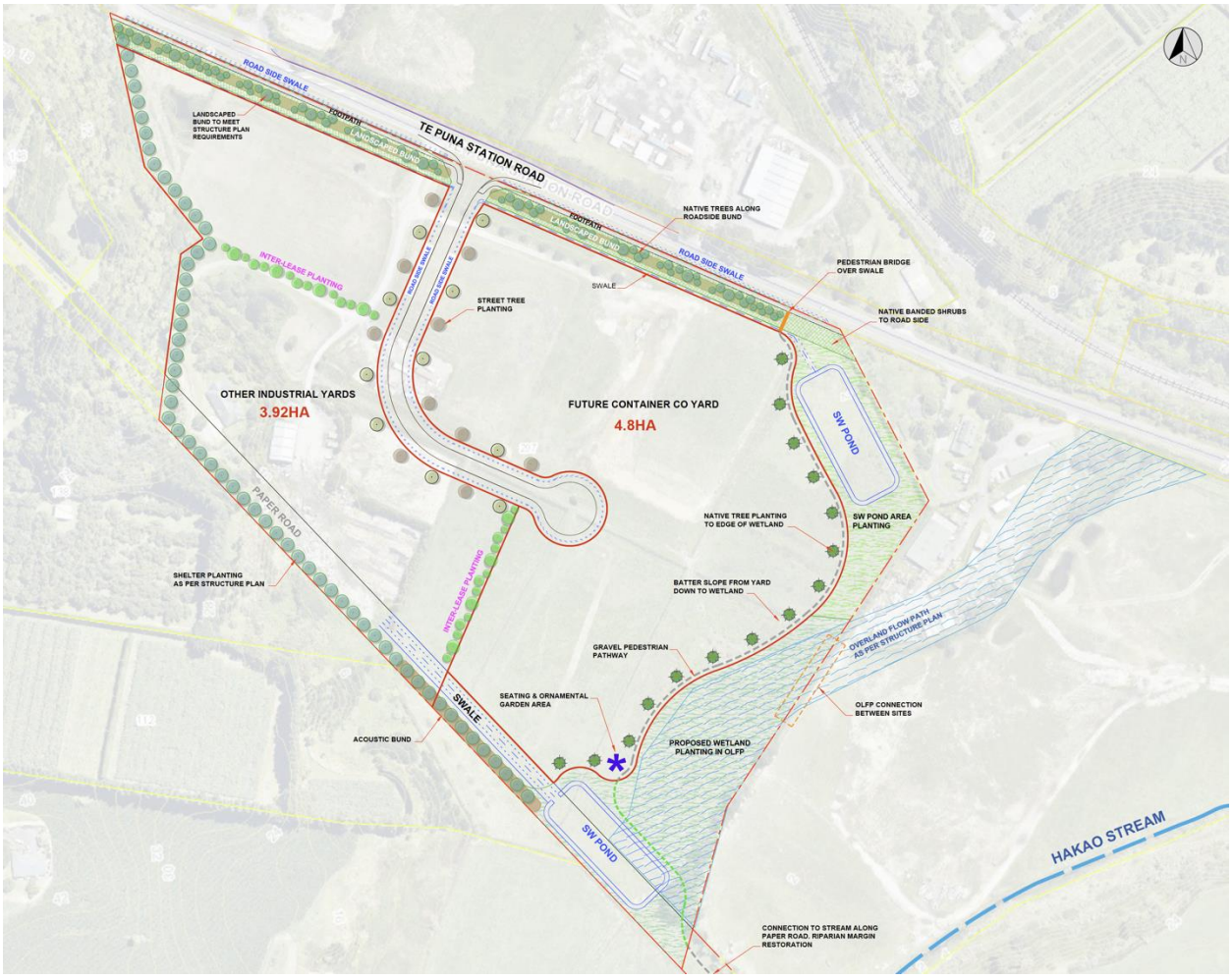


Figure 11 - Proposed Site and Landscape Plan

6 Regulatory Standards

6.1 Noise Levels – Industrial Zone to Industrial Zone

In accordance with the Western Bay of Plenty Operative District Plan – 4C.1.3.2(b)(ii) the following applies for noise generated in an industrial zoned site as received in another industrial zone:

> *4C.1.3.2(b)(ii): All activities located within Industrial Zones (excluding emergency service sirens) shall be so conducted as to ensure that noise from the site shall not exceed the following noise limits within the stated timeframes at any point within the boundary of any other property within an Industrial Zone:*

Time Period	Sound Level Not to be Exceeded	
	LAeq	***LAmax***
Daytime 7am-10pm	65dB	N/A
Night time 10pm-7am	65dB	85dB

Figure 12 - WBOP Noise Limits - Industrial to Industrial Zones

6.2 Noise Levels – Industrial Zone to Industrial Zone

In accordance with the Western Bay of Plenty Operative District Plan – 4C.1.3.2(b)(i) the following applies for noise generated in an industrial zoned site as received in a Rural zone:

> *4C.1.3.2(b)(i): All activities located within Industrial and Commercial Zones shall be so conducted as to ensure that noise from the site shall not exceed the following noise limits within the stated timeframes at any point within the notional boundary of any dwelling in a Rural Zone or Rural Residential Zone, nor at any point within the boundary of any property within a Residential or Future Urban Zone:*

Time Period		Sound Level Not to be Exceeded	
Day	**Hours**	***LAeq***	***LAmax***
Monday to Saturday	6am to 10pm	55dB	N/A
Sunday and Public Holidays	9am to 6pm	55dB	N/A
At all other times		45dB	70dB

Figure 13 - WBOP Noise Limits - Industrial to Rural Zones

6.3 Noise from Public Roads - Exemption

In accordance with the Western Bay of Plenty Operative District Plan – 4C.1.3.3(e) the following applies for noise generated by traffic on public roads:

> *Noise from traffic on public roads that are legally formed and maintained is exempt from the zone rules of the District Plan.*

6.4 Noise Measurement and Assessment

In accordance with the Western Bay of Plenty Operative District Plan – 4C.1.3.4 the following applies to measurement and assessment of noise:

> *a. For the purposes of Rule 4C.1.3.2, subject to the express provisions of these rules, sound levels should be measured in accordance with the requirements of NZS6801:2008 Measurement of Environmental Sound, and assessed in accordance with the requirements of NZS6802:2008 Assessment of Environmental Sound;*
>
> *b. The noise shall be measured with a sound level meter complying with the International Standard IEC 651 (1979): Sound Level Meters, Type 1.*

6.5 Audible Characteristics

In accordance with Standard NZS 6802:2008, consideration shall be given to special audible characteristics of noise (impulsiveness, tonality, etc.) as follows:

> *"Where the sound being assessed has a distinctive character which may affect its subjective acceptability (for example it is noticeably impulsive or tonal) the representative sound level shall be adjusted to take this into account. The adjustment shall be determined in accordance with the provisions of Appendix B"*

Based on the above, and where tonality is observed in noise sources as per the relevant standards, a penalty shall be incurred (arithmetically added) to any noise predictions or measurements as detailed in NZS 6802:2008 Appendix B, as follows:

- *B4.5 Where special* ***audible characteristics are confirmed, the value of the adjustment shall be 5 dB***

6.6 Notional Boundary

As per the New Zealand Standard NZS 6801:2008 Measurement of Sound, a notional boundary is defined as "*a line 20m from any side of a dwelling, or the legal boundary of the property on which the dwelling is located, whichever point is closer to the dwelling.*"

7 Noise modelling

7.1 Noise Propagation Modelling Software

To predict noise propagation at the subject site from the movements of traffic, an environmental model was constructed for the extension using the CadnaA computer modelling program. The following applies to the modelling software CadnaA:

- CadnaA is an internationally recognised software package designed for the prediction of noise propagation. CadnaA implements numerous national and international standards and guidelines, including the CoRTN standard of the United Kingdom Department of Transport and Welsh Office for the Calculation of Road Traffic Noise.
- The modelling method for noise propagation over distance is based on the international standard ISO 9613: "Acoustics – Attenuation of sound during propagation outdoors" methodology.
- The model allows importing digital ground elevation contours and data to define the topography and data for each of the noise sources, and the locations, geometry and elevations of the noise receivers. The program then calculates the dB levels as the metric for noise at receivers for the purposes of assessment.

7.2 Noise Propagation Modelling Parameters

The following parameters were incorporated into the noise propagation models:

Parameter	Value
	Internal Road
Standards	Great Britain - ISO9613 – CRTN (Road), CRN (Railroad)
Ground Attenuation	Open Space: G=1 Roads, Pavements, G=0, Other: G=0.5
Atmospherics	Temperature: 20˚C, Rel. Humidity: 70%
Topography	Imported from LINZ GIS
Receiver Heights	Relative AGL – Representative of 1.5 above ground level
Road Gradient	As per topography
Traffic Flow	Steady
Road Type	Normal

8 Noise Analysis

Noise modelling (as shown in the appendix) was done for the separate and the cumulative effects of traffic, zone and industrial operations. The assessment below shows the assumptions for each component

8.1 Existing Noise Sources

We note that road noise as it stands, is assessed as part of the current ambient environment in context of compliance. Additional traffic associated with the development is considered in context of amenity, as it is exempt from compliance requirements as per 4C.1.3.3(e) of the WBOP Operative District Plan.

8.1.1 Te Puna Station Road Traffic

Assessment is based on published traffic count data for Te Puna Station Road in proximity to the subject site: AADT 2,500 Vehicles per day, with 12% Heavy Vehicles.

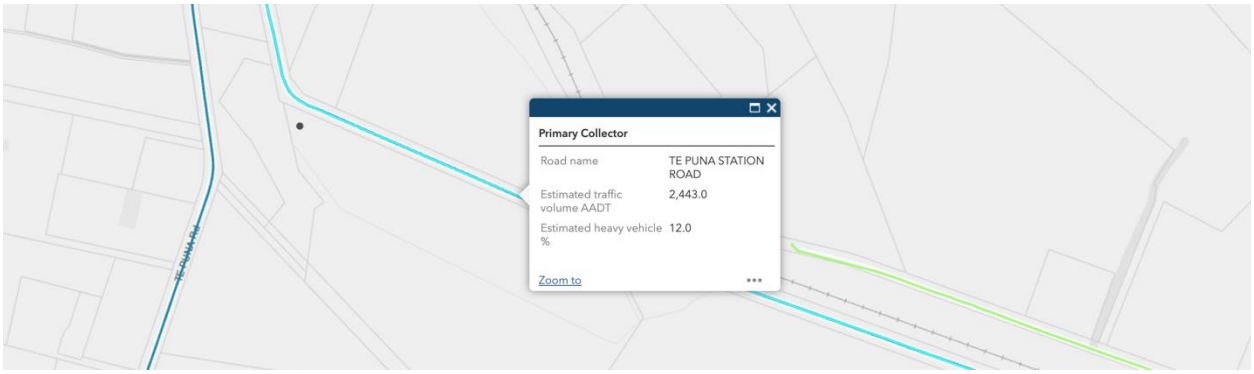


Figure 14 - Published AADT for Te Puna Station Road in proximity - [Waka Kotahi]

8.1.2 Te Puna Road Traffic

Assessment is based on published traffic count data for Te Puna Road in proximity to the subject site: AADT 1,200 Vehicles per day with 3% Heavy Vehicles.

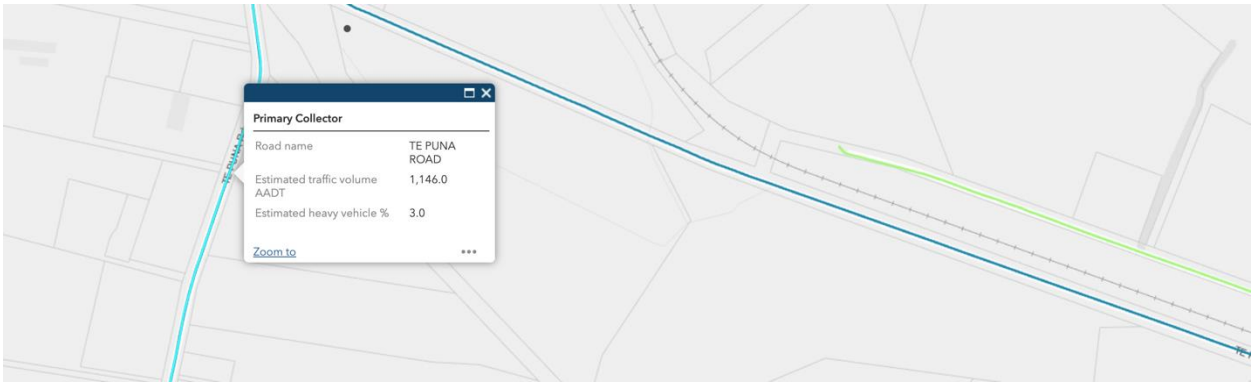


Figure 15 - Published AADT for Te Puna Station Road in proximity - [Waka Kotahi]

8.1.3 Railway – ECMT 51

Taking into account a noise assessment period of 30 minutes is assumed for analysis of noise effects, and collating with observed railway movements during the monitoring period, we assume 3 railway movements in any hour during daytime hours. Locomotives are assumed to be diesel driven.

8.2 Proposed Development Noise Sources

8.2.1 Container Refurbishment and Storage Facility - Daytime

A number of operations and plant are proposed for the container facility, these include:

- Loading and unloading of containers from trucks using forklifts, largest expected to be in the order of 45 Tonnes (45T)
- Stacking of containers in yard storage areas.
- Overnight holding of up to 100 powered refrigerated containers (reefers)
- Refurbishment of containers within a stacked container workshop enclosure (with fabric roofing) are per image below. Refurbishment activities include use of hand-held tools for:
    - Steel cutting, grinding, and drilling
    - Steel welding
    - Jet washing
- Location and orientation of the enclosure is not confirmed, albeit recommendations are made in this regard further in this report and assumed in the predictive models.

Figure 16 – Example Refurbishment Enclosure

The following are noise levels representative of the proposed operations as per measurements at similar sites:

Activity	Equipment	Sound Pressure $LA_{eq(15min)}$ at 10m [dB]
Truck	Truck – 25 Tonne Idling	58
	Loading Container on Chassis	70*
Forklift	Idling	68
	Operating (10km/hr movement)**	78
Stacking	Stacking containers***	75*
Jet Washing	10kW @ 50MPa	80*
Refurbishment	Cutting / Grinding / Drilling	85*
Refrigeration	Powered-on Refrigerated container (per container)	61*

** W/Tonal Correction – Included in modelling*

*** Using Broadband reversing buzzer, not tonal beeper.*

**** Short duration impulsive noise*

We note here that noise from most works that involve steel impact warrant correction for special audible characteristics in context of environmental noise. As such, measured and predicted noise levels from steel works, and operations within the container company are correction by adding 5dBA. Modelling assumes simultaneous operation of relevant activities:

- Refurbishment including jet-washing within enclosure
- Loading/ Unloading and Stacking
- Powered Reefers

8.2.2 Internal Road

It is our understanding that the proposed internal road for this development will be fully sealed and is permitted to carry daily traffic volumes in the order of 774 vehicle movements per day, with circa 17% assumed to be heavy vehicles (*as per advice in email dated 25/11/2022 – Momentum Planning referencing Traffic Assessment.)* It is also our understanding that the Container operation at the eastern end of the site would involve circa 60 daily vehicle movements, of which 24 (40%) would be heavy vehicles. Noise assessment in this report pertains to the full operation of the site, and as such, traffic volumes are modelled as

- 774 movements per day with 17% heavy vehicles, all traversing the length of the proposed internal road from the northern boundary.

8.2.3 Refrigerated Containers (Reefers) - Night-time

It is our understanding (*advice by email dated 02/03/2022 – Momentum Planning*) that the container facility would include holding of up to 100 powered-on refrigerated containers overnight, each noted to have noise levels in the order of 67-72dBA at 1m from the refrigeration unit.

We note that reefers can have a range of noise levels depending on model, loading, ambient temperature etc. Independent measurements and published data[1] indicates reefers can generate higher noise levels in the order of 76dBA at 1m when powered by their own generators. We take the conservative view of assuming the higher published measurements as the reference in this assessment. We also note that the tonal nature of this noise warrants a special audible characteristic correction of +5dBA.

As such, each reefer is assumed in this assessment to generate noise levels in the order of **81dBA at 1m** (≃61dBA at 10m) taking into account the tonal nature of the noise. In addition, we assume that reefers are stacked two-high, whereby noise from the top unit would be at an elevation of circa 5m above ground level.

We note for reference here the cumulative noise from multiple reefers running simultaneously warrants special consideration of mitigation measures and restrictions especially when operating during night hours. The main mitigation measures in this context are the allowed numbers, locations and orientations of reefers, taking into account the less sensitive adjacent industrial zones to the north.

[1] www.dgmr.nl, Database: SourceDB, freely available as a part of the HARMONOISE and IMAGINE research projects.

8.2.4 Other Industrial Facilities

The nature of the other industrial operations at the western end of the site is not known at this stage. As per the recommendations section further in this report, we note these are proposed to be controlled through Noise Management Plans.

Noise levels proposed to be allowed from these operations, (each and cumulatively in Noise Management Plans) shall be based on the allowed additional noise, cumulatively adding to the container operation noise and ambient noise levels. In addition a safety margin is taken into account in consideration of currently unknown nature of the other operations.

9 Predicted Noise Levels

All predictive models are shown in detail in Appendix I of this report.

9.1 Ambient Noise Levels

The following is a noise prediction model for the current ambient environment. This is based on traffic volumes and rail movements and collated with measured and logged noise levels. Where predicted noise levels are within 2dBA of the measured levels, the model is assumed representative of the environment.

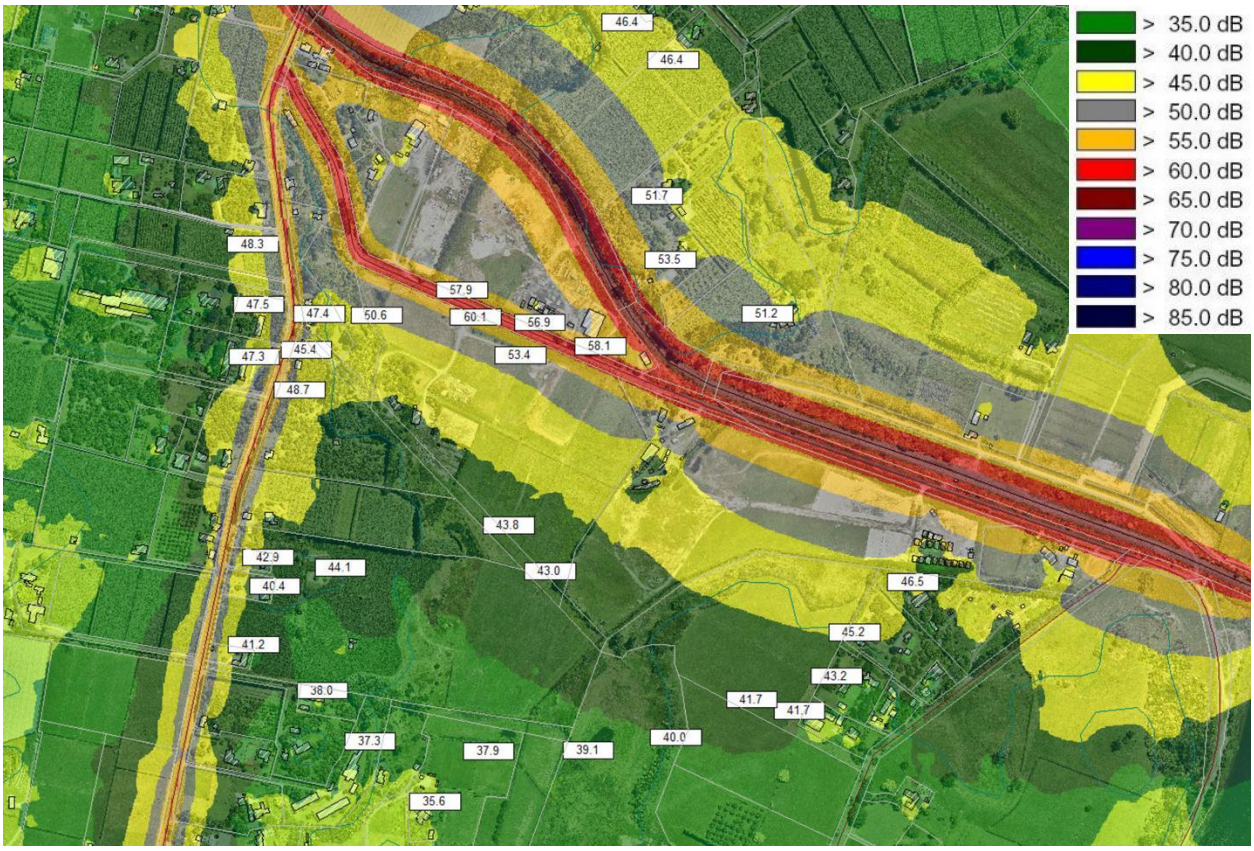


Figure 17 - Ambient Noise Levels

As per the figure above, predicted noise levels for ambient conditions are representative of the environment when collated with measured levels at the relevant locations.

9.2 Predicted Noise Levels – Daytime Compliance Assessment

Modelling of Noise generated by the container operation is shown in the figure below, including all relevant operational activities underway. For the purposes of compliance assessment, noise levels from public roads are assumed in the noise modelling as it stands with the current ambient levels. Internal traffic within the site is however included in the model. We note that while the current traffic noise is assumed part of the ambient environment, the additional traffic generated on public roads by the operation of the site is exempt from compliance assessment (Section 6.3 above.) This additional traffic is however assessed in context of amenity (rather than compliance) in Section 9.4 further in this report.

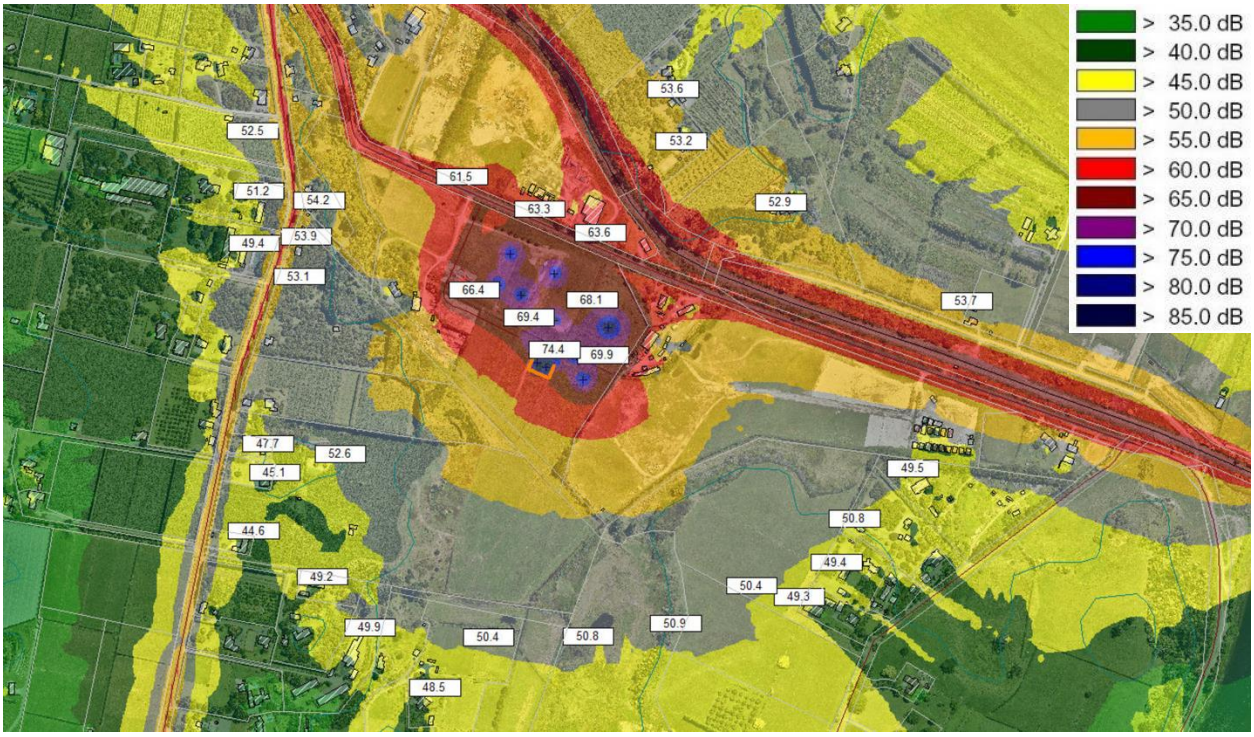


Figure 18 - Predicted Noise Levels – Daytime Compliance

As per the predictive model in the figure above, noise from activities within the container operation, taken cumulatively with the current ambient noise levels, can be managed within compliance with the noise limits at all receivers. Noise levels within the operation itself would be in the order of L_{eq} 70dBA across the yard, which is in-line with what would be expected for similar operations. The highest noise levels at another industrial site would be circa 64dBA to the North across Te Puna Station Rd. The highest noise levels at a rural site would be at the receivers to the west along Te Puna Road in the order of L_{eq} 54dBA.

Noise levels to the north of the facility (north of the railway tracks) are mainly attributed to noise from the railway. Noise from the facility can be managed within compliance with the noise limits at these receivers independent of the railway.

9.2.1 Alternative Refurbishment Facility Location

As an alternative to the refurbishment facility location modelled above (at the S-E corner of the site) an alternative location is considered for operational purposes at the NW corner of the area adjacent the internal driveway. Based on the models below, noise levels from the operation of the refurbishment facility would be compliant at all receivers provided:

- The facility is located:
  - No closer than 250m from the receiver to the West (148 Te Puna Rd)
  - No closer than 250m from the eastern boundary with the adjacent industrial facility
  - No closer than 40m from the northern boundary with Te Puna Station Rd
- The 2xStacked containers of the facility should be supplemented by a second row of 3x stacked containers:
  - West (behind the facility) to shield the residential neighbours at elevation) and
  - North extending at least 1x40ft container length to the east parallel Te Puna Station Road (to shield the industrial facilities and residential receivers across Te Puna Station Road.)

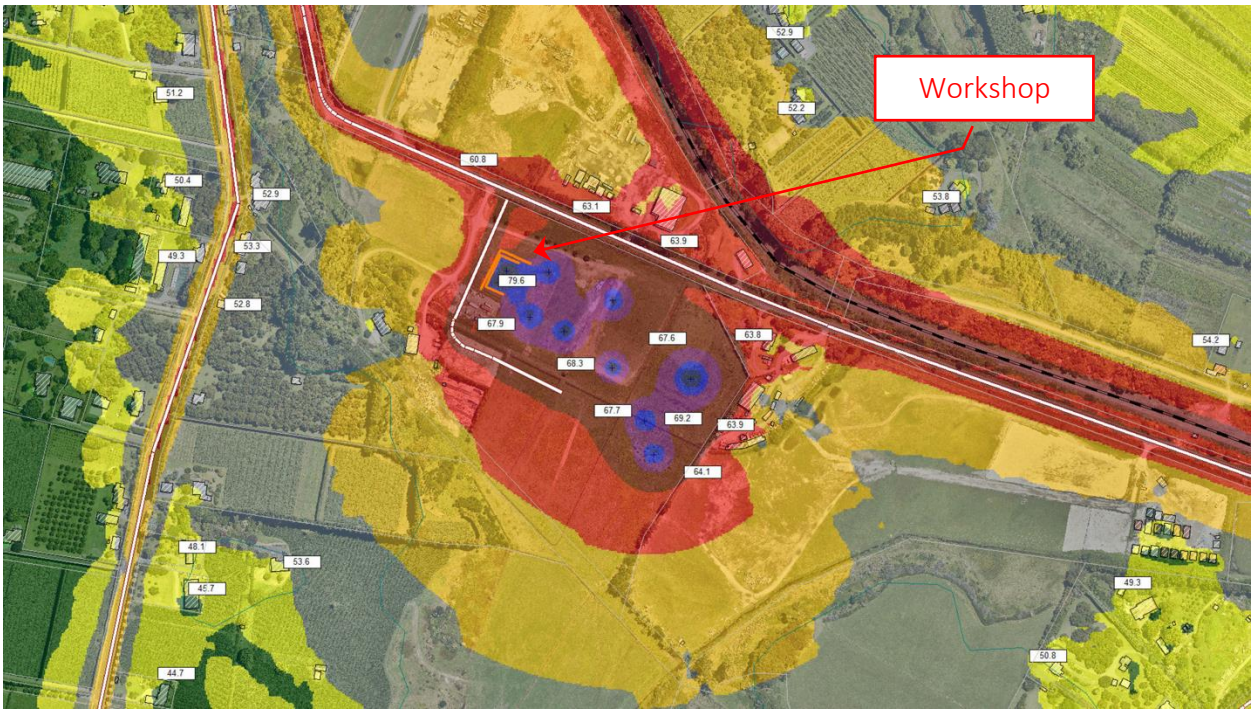


Figure 19 - Predicted Noise Levels – Daytime Compliance - Refurbishment at NW corner

9.3 Predicted Noise Levels – Night-time Compliance Assessment

The only noise sources from the proposed container facility at night would be from powered refrigerated containers (reefers) with up to 100 held in the facility. Modelling was done for 100 Reefers held overnight, all powered on, in stacks of 2, all assumed to be running. We note that night-time ambient noise includes traffic on public roads as collated with monitored noise levels.

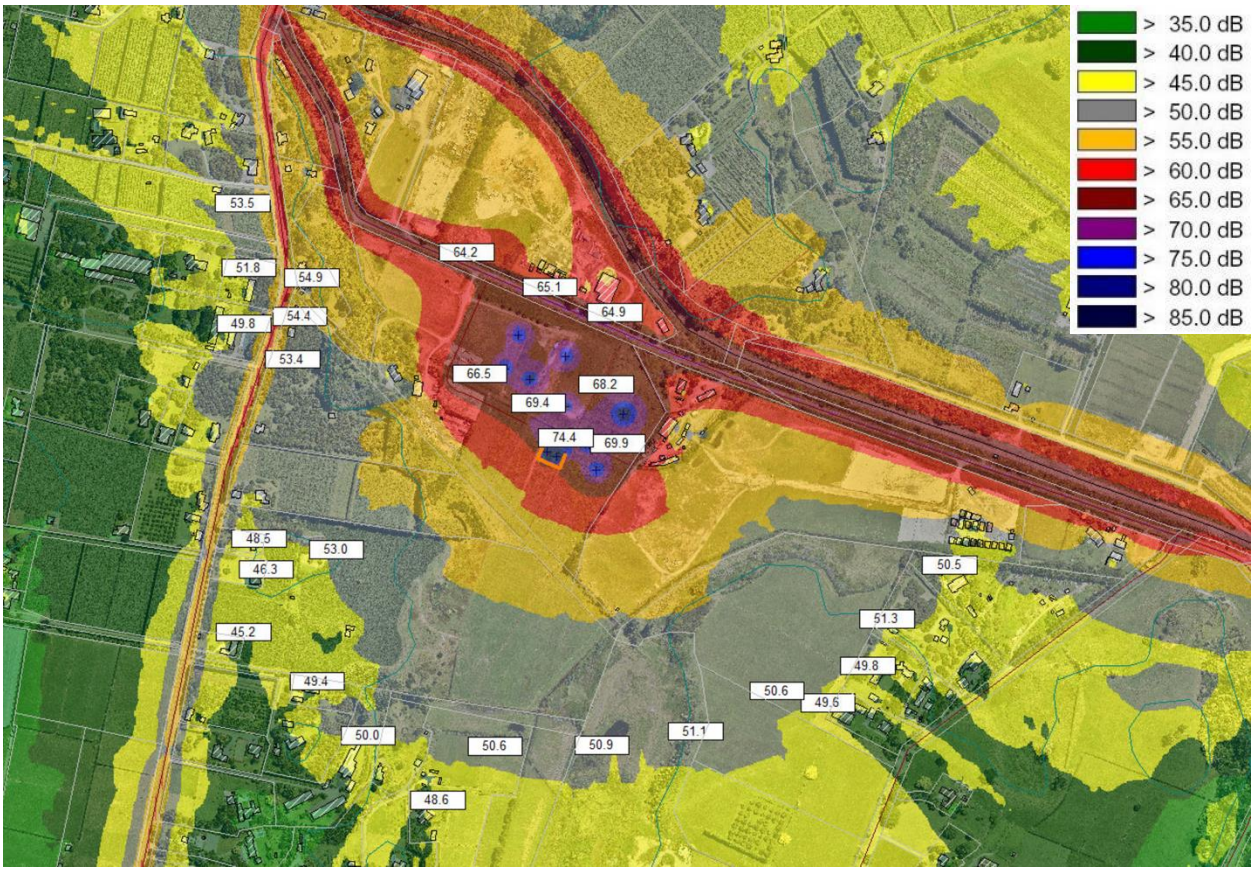
Modelling includes the potential mitigation measures of locating the containers at the north-eastern end of the site and orienting all containers whereby the mechanical plant faces towards Te Puna Station Road. In addition, the northern, western and eastern sides of the Reefer stack are shielded by a stack of containers (non-refrigerated) to shield noise propagation to the closest dwellings. This is reflected in the models, and furthermore is noted in the recommendations of this report as a key component of any Noise Management Plan required for the operation of the facility.

As per the predictive model in the figure above, with adequate shielding and controlled locations and number of reefers, noise levels can be managed within compliance at all receivers.

9.4 Predicted Noise Levels – Amenity Assessment

The following predictive model is for amenity assessment only as it includes noise sources exempt from compliance assessment (additional traffic on public roads.) This predictive model is intended to represent the general effects of the proposed facilities (with mitigation measures) on the surrounding environment regardless of compliance considerations.

For the purposes of amenity assessment, noise levels from public roads are assumed to increase with the additional traffic to and from the subject site going along the full length of Te Puna Station Road. Cumulative noise levels from traffic including addition movements, and proposed operation of the container company would be as per the following figure:



As per the predictive model above, noise levels in the vicinity would increase by circa 4-7dBA above current ambient levels, from the proposed operation including increased traffic on public roads. We note in context of amenity that:

- The general threshold of human differentiation of noise levels is circa 3dBA, and as such a 1-2dBA difference would not be generally noticeable.
- a 5dBA difference is considered louder, albeit “just louder”
- An 8dBA difference would be considered “noticeably louder”.

10 Recommendations

10.1 Container Operation

Container Operation should be managed by a Noise Management Plan (NMP) to be submitted to the Council for approval prior to the commencement of any operations, and would include, inter alia, the following considerations relevant to noise generated from the operation:

- Operations to be limited to hours of 7am to 6pm.
- Limits on equipment sizes (e.g. forklifts limited to no larger than 45 Tonnes.)
- Procedures for placing and stacking containers to minimise steel on steel impact
- All forklifts to be equipped with broadband reversing buzzers in lieu of tonal beepers.
- Location and construction of workshop within stacked container enclosure (e.g. to be established at the centre of the Container site, facing North towards Te Puna Station Road, or at the NW corner facing east and supplemented by 3x stacked containers behind and to the North.)
- All steel works, including refurbishment works (drilling, cutting, grinding, etc.) to be located within the workshop stacked container enclosure.
- Controls on any amplified music.
- Truck routes should be designed to avoid reversing.
- Reefers (refrigerated containers) limited in number (e.g. no more than 100) and stack height.
- Reefers expected to be powered overnight to be located in a designated area (e.g. North-eastern end)
- Reefer mechanical plant to be oriented in a designated direction (e.g. facing Te Puna Station Road)
- Area of reefers powered overnight to be shielded from closest dwellings (e.g. using stacked containers around the area.)
- Monitoring to be undertaken at the commencement of operations to establish equipment and procedural limits (e.g. number of reefers, etc.)
- Regular monitoring of noise levels to ensure continued compliance.

10.2 Internal Road

It is recommended that:

- Full length of internal road should be sealed.
- Speed humps should not be installed on sections used by heavy vehicles

10.3 Other Industrial Operations

We note it is not possible to assess potential mitigation measures for the other industrial facilities, as the nature and locations of these operations are unknown at this stage.

Nevertheless, it is recommended that the locations, orientations, and construction of the other industrial facilities (if buildings are proposed) should be reviewed for acoustic mitigation of industrial noise.

We note for reference here that noise levels from the other industrial operations at the western end of the site (with the exception of internal traffic already included in the cumulate levels,) when assessed at the notional boundaries of the closest rural receivers to the west should be limited based on noise from the container operation (e.g. noise from other operations limited to 48dBA, whereby the cumulative compliance limit is L_{eq} 55dBA).

This is to avoid cumulative noise exceeding the limits at these receivers, due to noise from the container operation combined with existing ambient noise likely to be above LA_{eq} 50dBA. This would also depend on the number of proposed operations and how each would cumulatively contribute to the noise levels at the closest receiver.

As it is not possible to assess these operations at this stage, all other industrial operations should each be managed by a specific Noise Management Plan (NMP) to be submitted to the Council for approval prior to the commencement of any operations, and would include, inter alia, the following considerations relevant to noise generated from the operation:

- Noise limits based on the cumulative levels at the closest receivers.
- Operations to be limited to hours of 7am to 6pm.
- Operational restrictions (e.g. no reversing with tonal beepers, etc.)
- Limits on equipment sizes
- Limits on locations, mounting, shielding and operation of building mechanical plant.
- Shielding of high noise sources.

We note that it is possible for the development to allow one occupancy\operation higher noise levels at the expense of others. An example of this would be if the container operation generates noise levels during daytime of 53dBA at a dwelling, then the cumulative noise from the other operations when measured at the same receiver should not exceed 48dBA in order to maintain noise within compliance at that receiver.

As such, it is recommended that any proposed Noise Management Plan is assessed in conjunction with all other existing management plans associated with the development.

11 Conclusions

With regards to the proposed container facility, provided it is managed through a Council approved Noise Management Plans (NMPs), taking into account best practice measures, operational limits, activity locations, and mitigation measures, noise levels from the proposed operations can be managed within the compliance limits at all receivers.

The facility requires a number of mitigation measures and controls to maintain compliance with the applicable noise limits. We note that the overnight holding of powered refrigerated units (reefers) warrants specific considerations and strict controls due to noise being generated during highly noise sensitive night-time periods.

A number of potential mitigation measures are listed in this report, albeit this is not purported to be an exhaustive list, and other measures may be required depending on the details of the proposed operation.

With regards to the other proposed facilities, it is not possible to assess noise levels from these operations, as the nature and locations of these operations are unknown at this stage. Nevertheless, it is recommended that the locations, orientations, and construction of all industrial facilities across the development (if buildings are proposed) are reviewed for acoustic mitigation of noise prior to building consent.

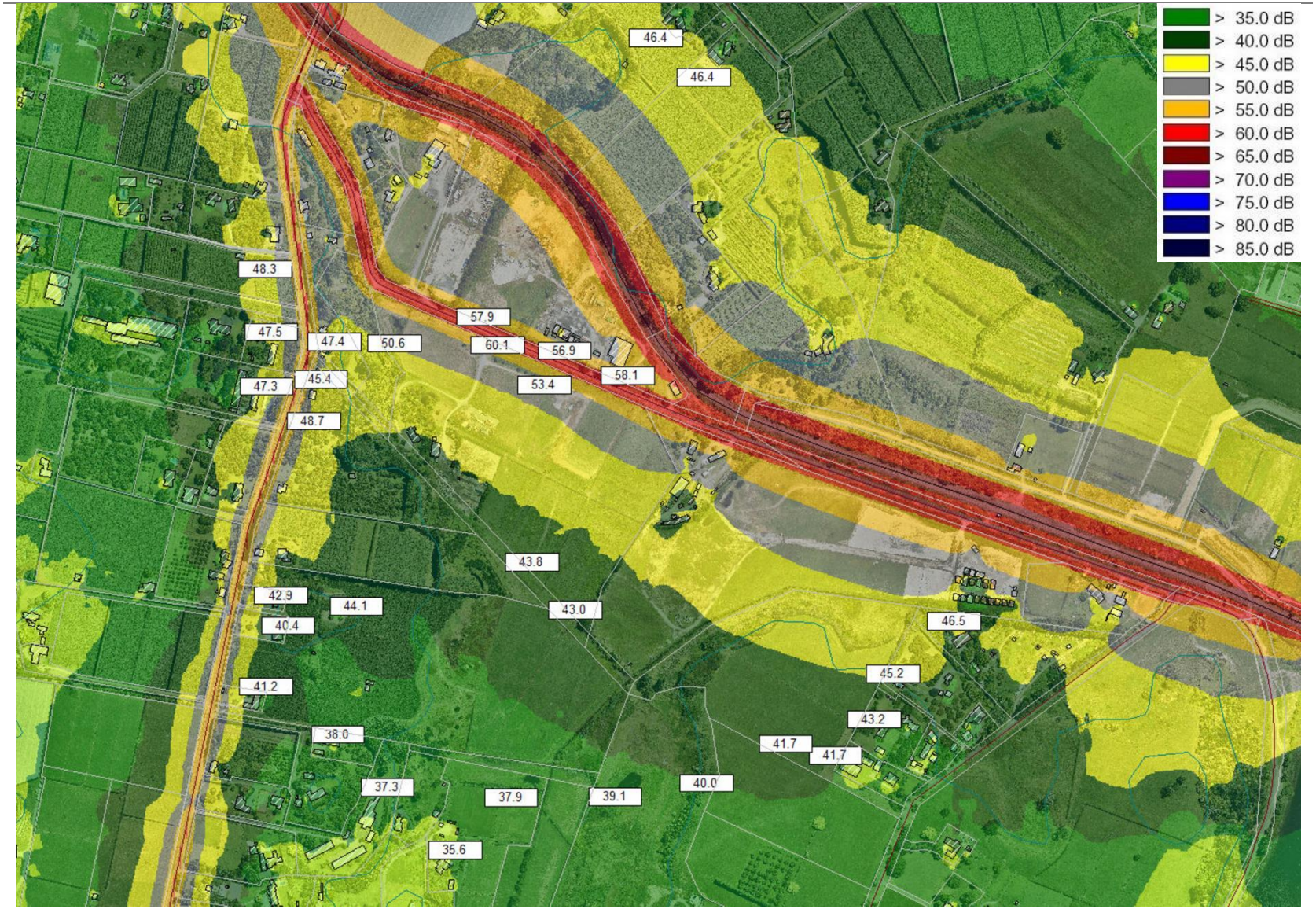
It is our opinion that the facilities, each separately and potentially as a development collectively, should be governed by Noise Management Plans (NMPs) covering, inter alia, operational restrictions, mitigation measures and compliance criteria.

Each NMP or change to an existing NMP must be submitted to, approved and certified by the relevant authority (in this case the District Council) prior to any operation or change of operation commencing. Each NMP must be assessed in conjunction with all other existing NMPs associated with the development.

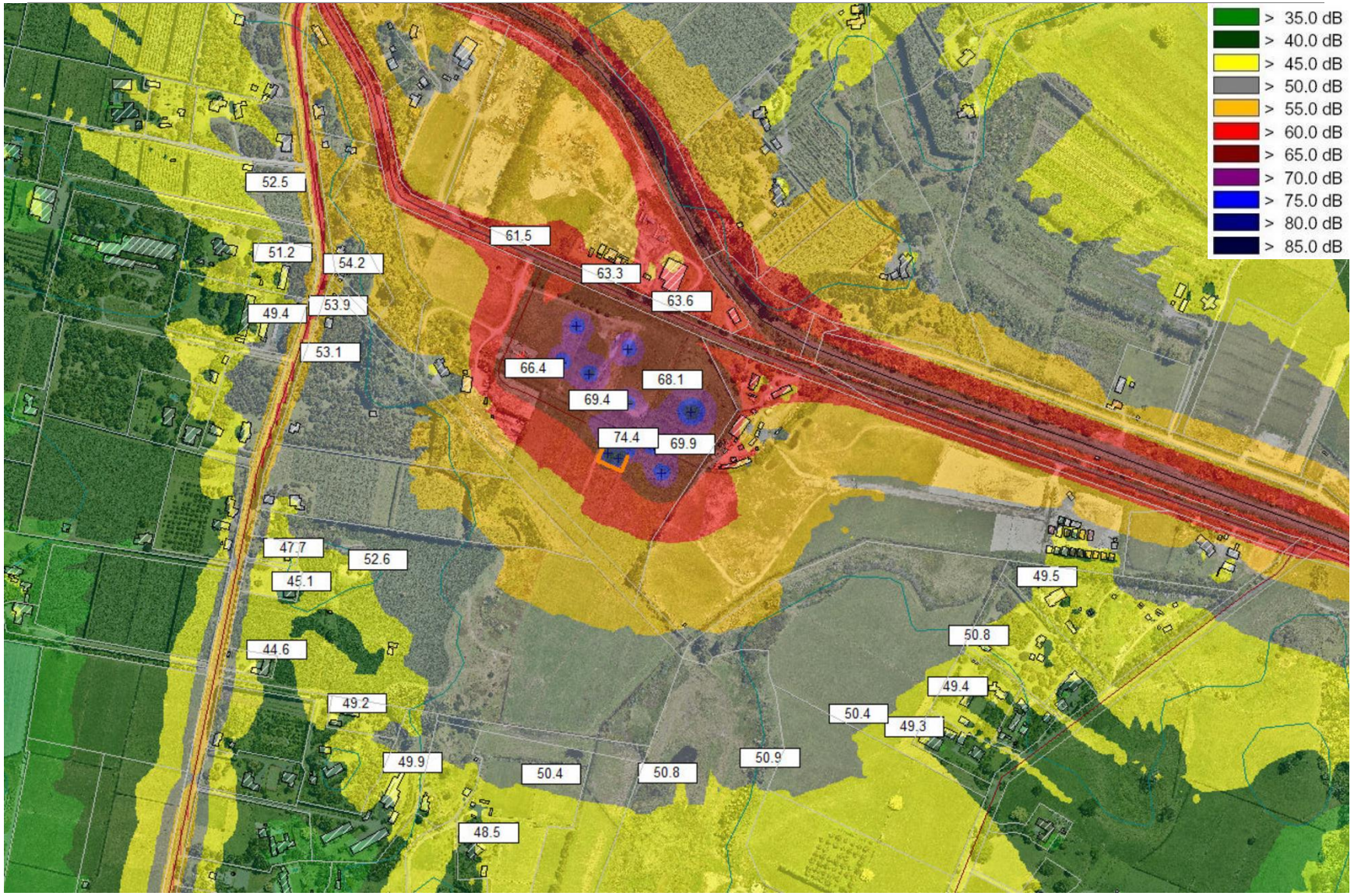
For the avoidance of doubt, this may mean that latter (or some) occupancies may have more restrictive noise limitations (i.e. lower allowed noise levels) if the cumulative levels towards to the compliance limit are taken up by earlier or other occupancies\operations.

Appendix I – Sample Noise Propagation Models

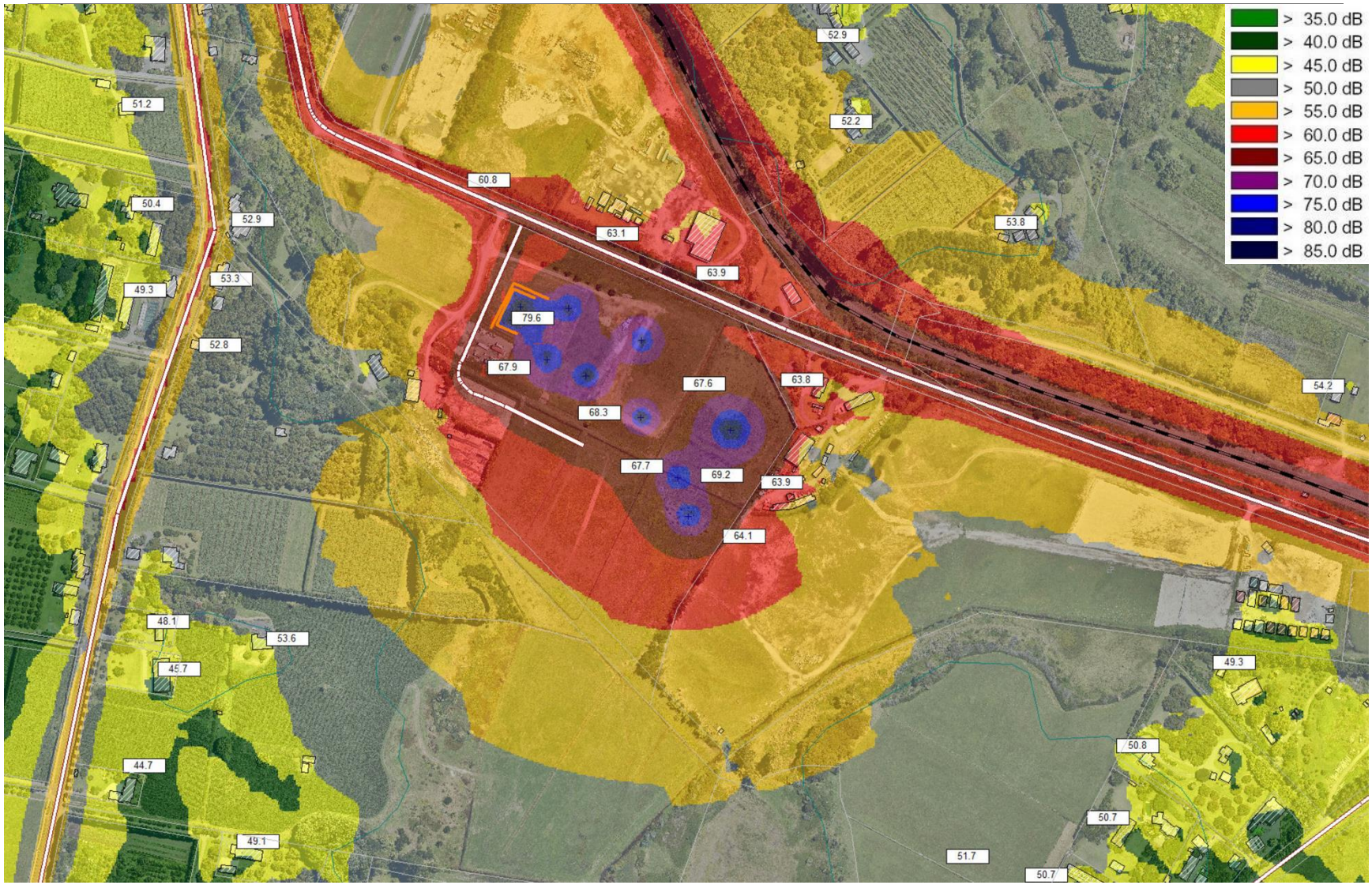
Model	Receiver Height
Ambient Noise Levels	1.5m above ground level



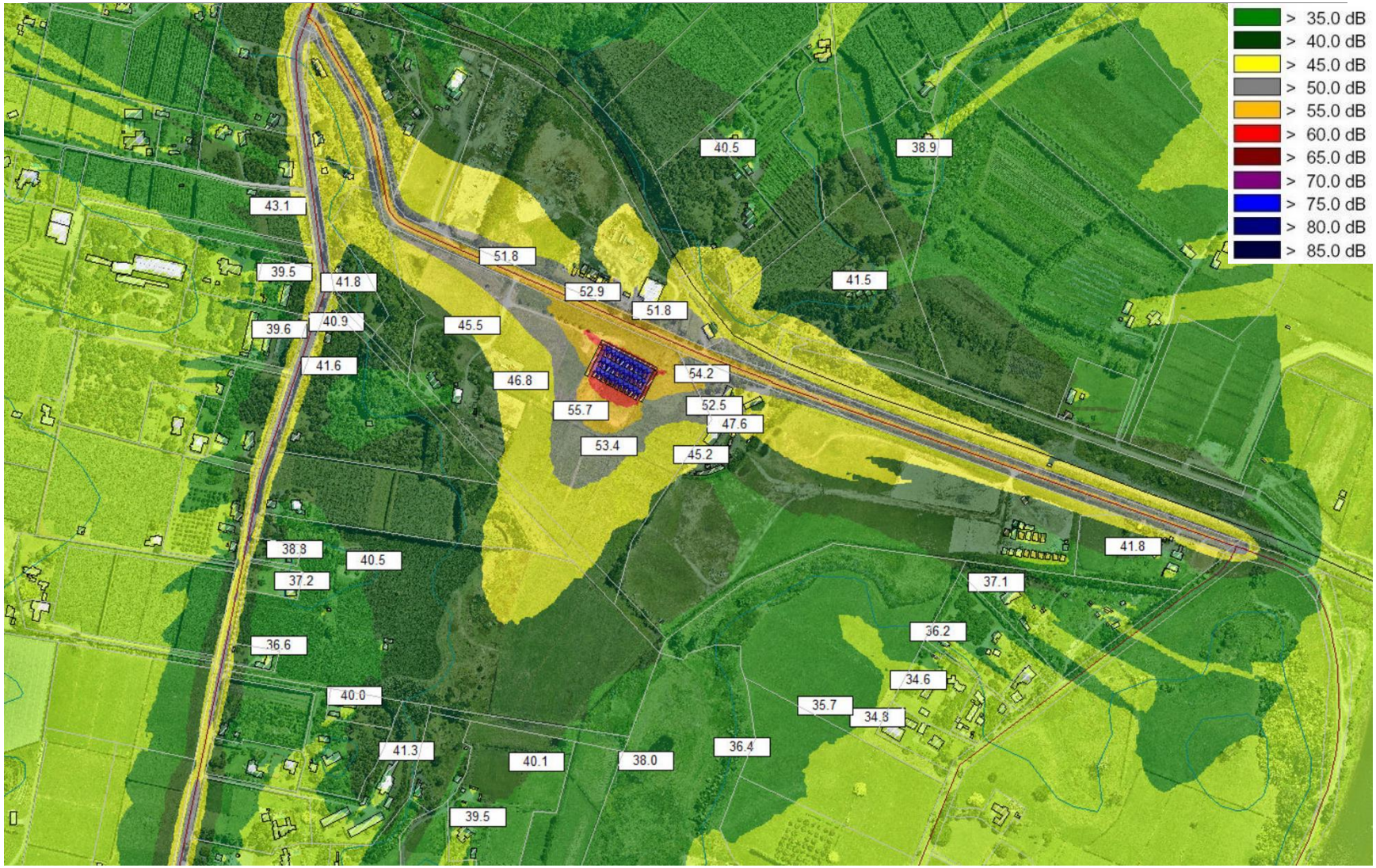
Model	Receiver Height
Predicted Noise Levels (Daytime Compliance) – Full Activities at Container Operation – Public Traffic as it stands	1.5m above ground level



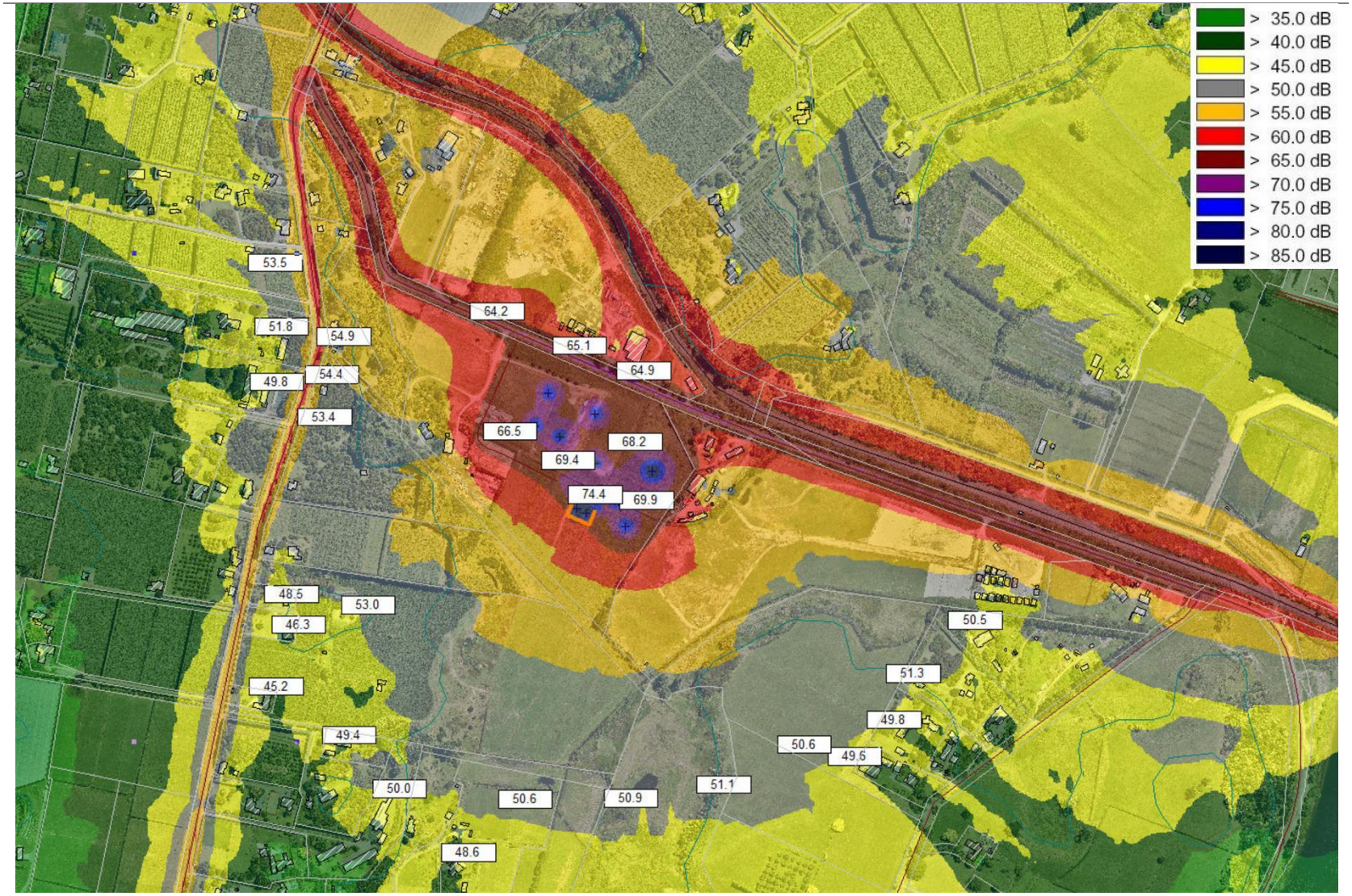
Model	Receiver Height
Predicted Noise Levels / Alternative Refurbishment facility location (Daytime Compliance) – Full Activities at Container Operation – Public Traffic as it stands	1.5m above ground level



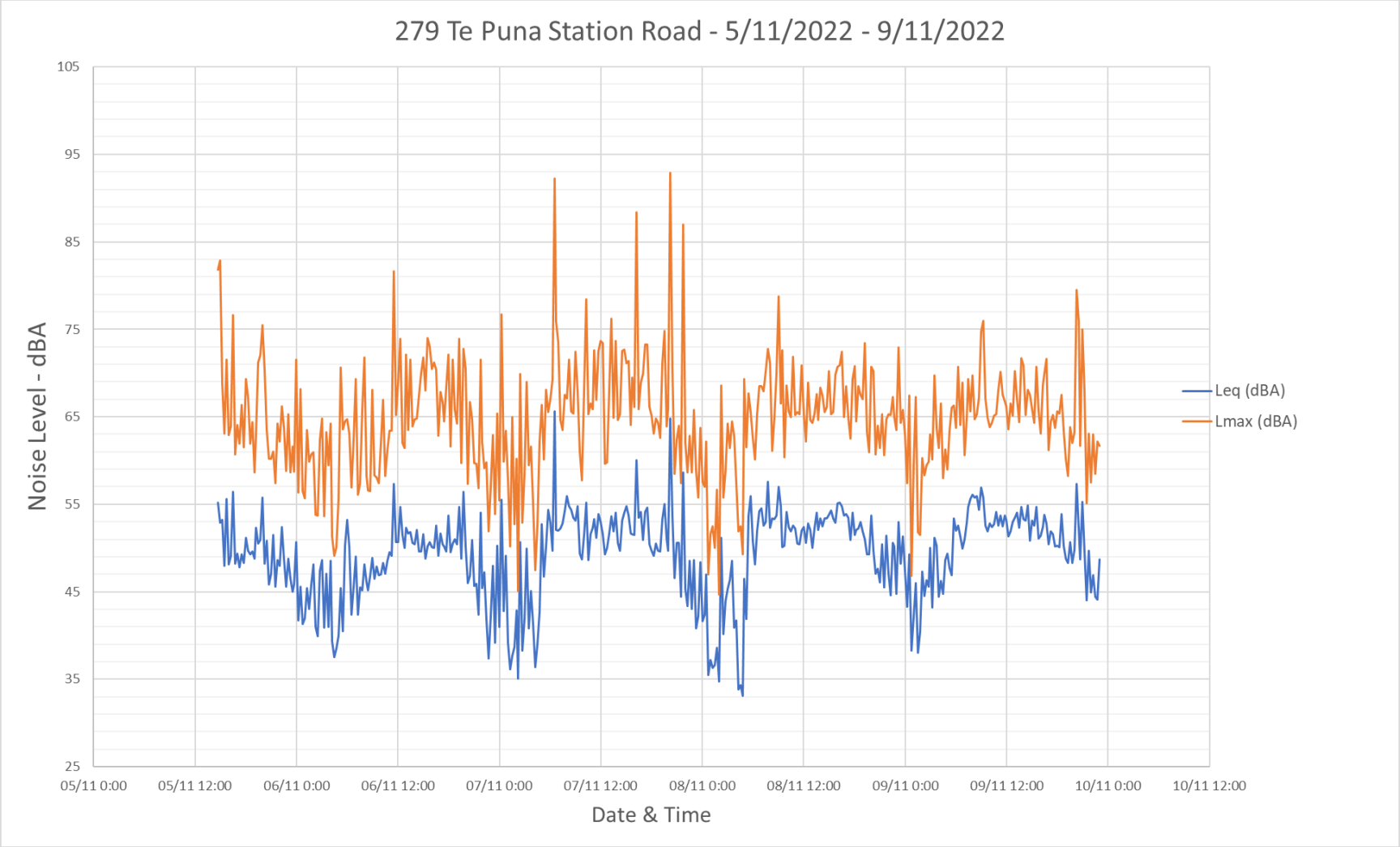
Model	Receiver Height
Predicted Noise Levels (Night time Compliance)– Reefers – Public Traffic as it stands	1.5m above ground level

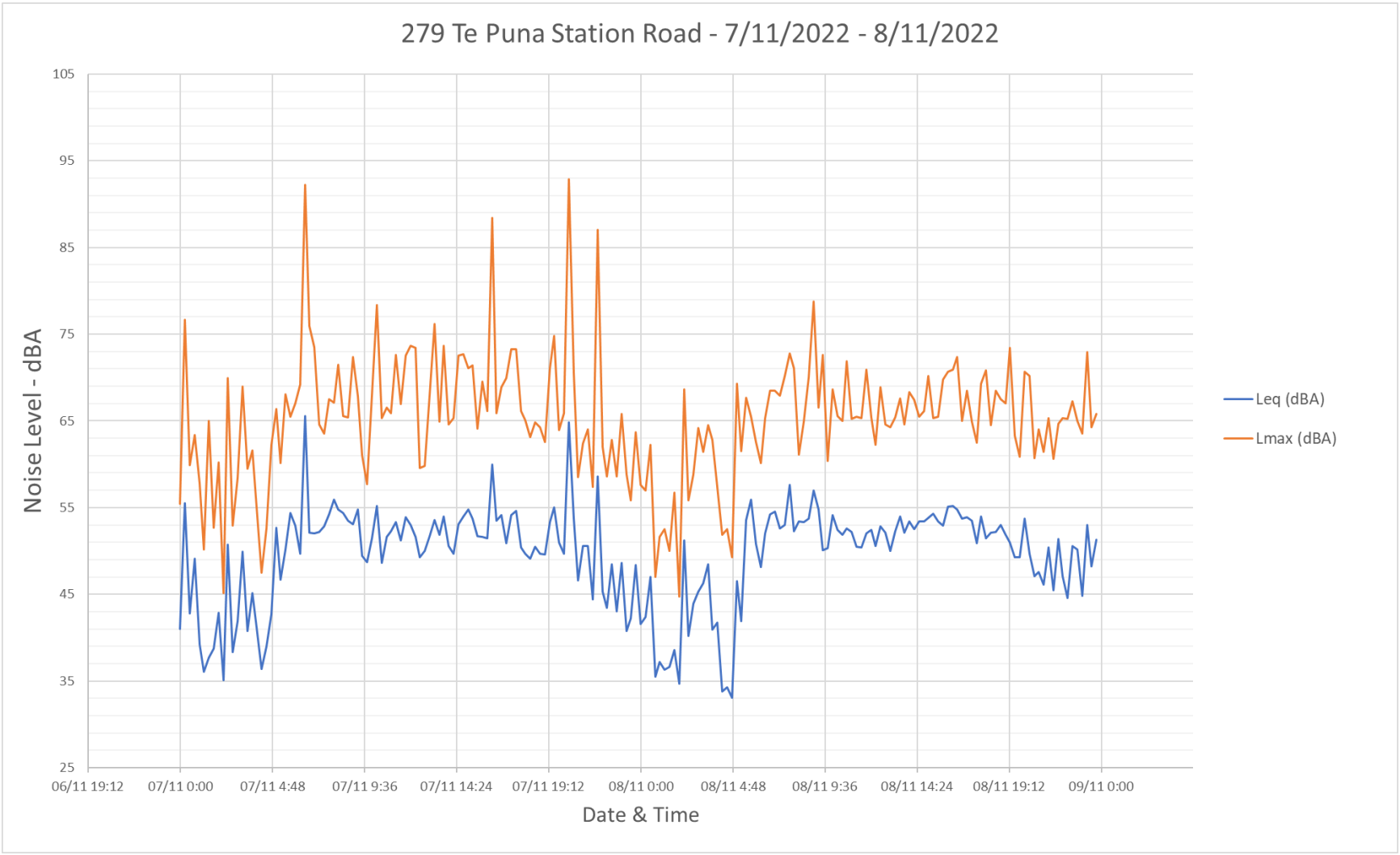


Model	Receiver Height
Predicted Noise Levels (daytime amenity assessment)– Full Activities at Container Operation – Public Traffic increased	1.5m above ground level



Appendix II – Noise Monitoring Graphs


279 Te Puna Station Road - 5/11/2022 - 9/11/2022
Noise Level - dBA
105
95
85
75
65
55
45
35
25
05/11 0:00
05/11 12:00
06/11 0:00
06/11 12:00
07/11 0:00
07/11 12:00
08/11 0:00
08/11 12:00
09/11 0:00
09/11 12:00
10/11 0:00
10/11 12:00
Date & Time
Leq (dBA)
Lmax (dBA)


279 Te Puna Station Road - 7/11/2022 - 8/11/2022
Noise Level - dBA
105
95
85
75
65
55
45
35
25
06/11 19:12
07/11 0:00
07/11 4:48
07/11 9:36
07/11 14:24
07/11 19:12
08/11 0:00
08/11 4:48
08/11 9:36
08/11 14:24
08/11 19:12
09/11 0:00
Date & Time
Leq (dBA)
Lmax (dBA)

Appendix III – Calibration Certificates

Acoustic Research Labs Pty Ltd
Unit 36/14 Loyalty Rd
North Rocks NSW AUSTRALIA 2151
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter
IEC 61672-3:2013
Calibration Certificate
Calibration Number C21781

Client Details	Tech Rentals NZ 101A Station Road Penrose Auckland 1061
Equipment Tested/ Model Number :	ARL Ngara
Instrument Serial Number :	8781F3
Microphone Serial Number :	16056
Pre-amplifier Serial Number :	28550

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	24.4°C	**Ambient Temperature :**	24.5°C
Relative Humidity :	48.4%	**Relative Humidity :**	48.1%
Barometric Pressure :	100.7kPa	**Barometric Pressure :**	100.7kPa

Calibration Technician :	Lucky Jaiswal	**Secondary Check:**	Harrison Kim
Calibration Date :	18 Nov 2021	**Report Issue Date :**	22 Nov 2021

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*N.A*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*N.A*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.13dB*	*Temperature*	*±0.1°C*
1kHz	*±0.13dB*	*Relative Humidity*	*±1.9%*
8kHz	*±0.14dB*	*Barometric Pressure*	*±0.014kPa*
Electrical Tests	*±0.10dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to SI units.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

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(IANZ Accredited laboratory)

Calibration, Sales & Service of Audiological and Acoustical Equipment

SUMMARY CALIBRATION CERTIFICATE FOR A SOUND LEVEL METER

EARCON ACOUSTICS LTD
Level 26
188 Quay Street
Auckland 1010

Job Number: SO015351-2664183 **Date of report:** 17 August, 2021

Measurement Procedure: The above instrument was tested using Diatec procedure ECSP10 and to the requirements of IEC 61672-3:2013 Electroacoustics - Sound Level Meters - Part 3: Periodic Tests. The laboratory is accredited for compliance to ISO/IEC 17025. All tests and measurements reported here are traceable to New Zealand and Australian National Standards.

Item tested:

Sound Level Meter:	Bruel & Kjaer	2270	**Serial No:**	2664183
Designation:	Class: 1			
Firmware version:	HW v3.0, BZ7222 v4.7.6			
Microphone:	B&K	4189	Serial No:	2643235
Applied Data:	Body - B&K, 2270. Windscreen - Default, Flat			
Notes:	-			
Date of test:	17 August, 2021			
Tested by:	RJ			

Ambient conditions at the time of tests:

Temperature: 23.5 °C Humidity: 43.8 %RH Atmospheric pressure: 1003.4hPa

Tests Performed:	*Clause*	*Result*
Absolute Calibration	10	**Pass**
Acoustical Frequency Weighting	12	**Pass**
Self Generated Noise	11.1	**Recorded**
Electrical Noise	11.2	**Recorded**
Long Term Stability	15	**Pass**
Electrical Frequency Weightings	13	**Pass**
Frequency and Time Weightings	14	**Pass**
Reference Level Linearity	16	**Pass**
Toneburst	18	**Pass**
Peak C Sound Level	19	**Pass**
Overload Indicator	20	**Pass**
High Level Stability	21	**Pass**

Result: Passed all tests.

Statement of Compliance: The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent organisation responsible for approving the results of pattern evaluation tests performed in accordance with IES 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC61672-1: 2013.A full technical report is available if required.

(.....)
Robert Jaques
Authorised IANZ signatory

IANZ
ACCREDITED CALIBRATION LABORATORY
ACCREDITATION No: 527

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Postal address: PO Box 74103, Greenlane, Auckland 1546, New Zealand.
Phone: +64 9 279 8833 **Fax:** +64 9 279 8883 **Email:** info@diatec-diagnostics.co.nz **Web:** www.diatec-diagnostics.co.nz

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Calibration, Sales & Service of Audiological and Acoustical Equipment

MICROPHONE CALIBRATION CERTIFICATE

17 August 2021 **Job No**: SO015351-2643235

Earcon Acoustics Ltd
Level 26
188 Quay Street
Auckland 1010

IANZ Accredited Laboratory 537

Measurement results reported are traceable to SI units via recognised National Standards.
Tested using Diatec procedure; Proc_Microphone_Calibration.

Test Date: 17 August 2021 **Type**: Bruel & Kjaer 4189 **Serial No**: 2643235

Ambient Temperature: 23.5°C ± 1°C **Ambient Pressure**: 1002.3 hPa

Visual Check: OK

Comments: Some dust on diaphragm. Gently brushed loose particles off.

Open Circuit Sensitivity by Insert Voltage Method: OK

Value: **-25.95** dB re 1 volt/Pa (**50.42** mV/Pa) at **1000.0** Hz

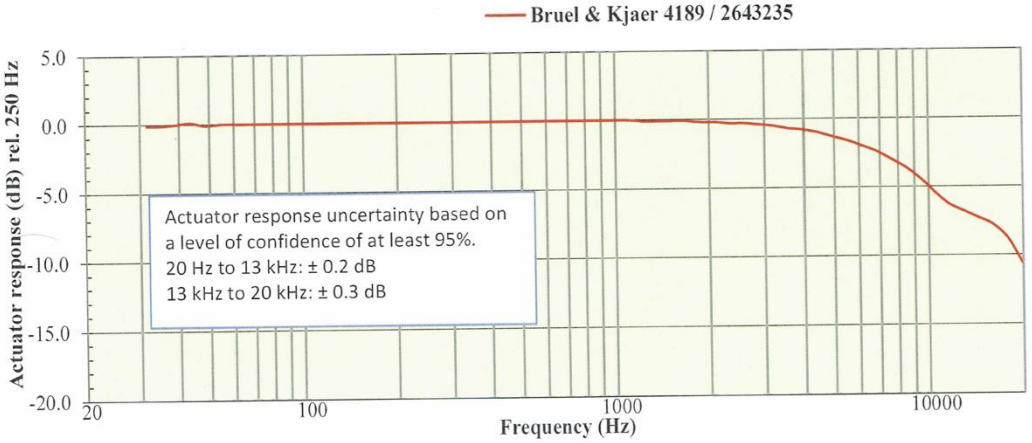
Reference Calibrator: Bruel and Kjaer Type 4226 **Serial No**: 2623634

Uncertainty in this result is estimated to be ±0.06 dB with a confidence level of 95% using a coverage factor of 2.02.

Relative Frequency Response (Electrostatic Actuator): OK

See attached plot of the pressure response of the microphone.

Test performed by: R Jaques (IANZ Signatory)



IANZ ACCREDITED CALIBRATION LABORATORY ACCREDITATION Nº: 537

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Calibration, Sales & Service of Audiological and Acoustical Equipment

SUMMARY CALIBRATION CERTIFICATE FOR A FILTER SET

19 August 2021

Earcon Acoustics Ltd
Level 26
118 Quay Street
Auckland 1010

IANZ Accredited Laboratory 537

Measurement results reported are traceable to SI units via recognised National Standards.

Tested using Diatec procedure; Proc_Filter_Calibration.

B&K 2270	Serial No. 2664183
Firmware	BZ7223 v 4.7.6
Filter Class	1
Job Number	SO015351-2664183
Date of test	19 August 2021
Tested by	RJ

Measurement Procedure

The above instrument was tested according to those parts of IEC 61260-3 (2016) specified in the terms of our IANZ registration using Diatec procedure: Proc_Filter_Calibration.

Tests and Results

The following tests were performed:

1.	Test of Relative Attenuation at Midband Frequency (Clause 13)	Pass
2.	Level Linearity (Clause 11.5, 11.7)	Pass
3.	Overload Indicator (Clause 11.5	Pass
4.	Lower Limit of Linear Operating Range (Clause 12)	Pass
5.	Relative Attenuation (Clause 10.2)	Pass

The filter submitted for testing successfully completed the periodic tests of IEC 61260-3, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about conformance of the filter to the full specifications of IEC 61260-1:2014 because (a) evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of filter fully conformed to the relevant class specifications in IEC 61260-1:2014 and (b) because the periodic tests of IEC 61260-3 cover only a limited subset of the specifications in IEC 61260-1:2014.

A full technical report is available if required.

(Robert Jaques)
Authorised IANZ signatory

IANZ
ACCREDITED CALIBRATION LABORATORY
ACCREDITATION NR: 537

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Glossary of Terms- Acoustics

Ambient Noise: the total noise, at a given place, a composite of sounds from many sources near and far.

Asymmetric: a waveform not identical on both sides of the mean or zero line, lacks symmetry.

Average: in acoustics where dB levels are extensively used, average may not mean adding up the values and then dividing by the number of samples.

Octave: a range of frequencies whose upper frequency limit is twice that of its lower frequency limit. For example, the 1000 Hertz octave band contains noise energy at all frequencies from 707 to 1414 Hertz.

In acoustical measurements, Sound Pressure Level is often measured in octave bands, and the centre frequencies of these bands are defined by ISO - 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, 16 kHz to divide the audio spectrum into 10 equal parts.

The sound pressure level of sound that has been passed through an octave band pass filter is termed the octave band sound pressure level.

One-third Octave Bands, there are three similar bands in each octave band.

1/1, 1/3, 1/6, 1/12, and 1/24 octaves are all used in acoustics.

Background Noise: the noise at a given location and time, measured in the absence of any alleged noise nuisance sources, also known as Residual Noise.

Broadband Noise: also called wideband noise - noise whose energy is distributed over a wide section of the audible range as opposed to Narrowband Noise.

Class 1: precision grade sound level meters for laboratory and field use - also known as Type 1.

Continuous Spectrum: sound spectrum whose components are continuously distributed over a given frequency range.

Frequency Weighted Sound Levels: Frequency weightings correlate objective sound measurements with the subjective human response. The human ear is frequency selective; between 500 Hz and 6 kHz our ears are very sensitive compared with lower and higher frequencies.

A-weighting: the A-weighting filter covers the full audio range - 20 Hz to 20 kHz and the shape is similar to the response of the human ear at the lower levels

C-weighting: a standard frequency weighting for sound level meters, commonly used for higher level measurements and Peak - Sound Pressure Levels.

Z-weighting: Z for 'Zero' frequency weighting, which implies no frequency weighting. In reality the range is 10 Hz to 20 kHz ±1.5 dB.

dB Level: is the Logarithm of the ratio of a given acoustic quantity to a reference quantity of the same kind. The base of the logarithm, the reference quantity, and the kind of level must be indicated.

decibel: dB : a relative unit of measurement widely used in acoustics, electronics and communications. The dB is a Logarithmic unit used to describe a ratio between the measured level and a reference or threshold level of 0dB. The ratio may be Sound Power, Sound Pressure, voltage or Sound Intensity, etc.

Deltatron ®: trade name for IEPE - Integrated Electronics Piezoelectric.

FFT: Fast Fourier Transform : a digital signal processing technique that converts a time record into a narrow band constant bandwidth filtered spectrum. Measurements are defined by specifying the frequency span and a number of lines (or filters).

Frequency: f : the number of times that a Periodic function or vibration occurs or repeats itself in a specified time, often 1 second - cycles per second. It is usually measured in Hertz (Hz).

Frequency Analysis: analysing an overall broadband noise to identify the different contributions in different parts of the audio spectrum. Typically the analysis in made using 1/1-Octave, 1/3-Octave or narrow band (FFT) Analysis.

Frequency Band: a continuous range of frequencies between two limiting frequencies.

Hertz: Hz : the unit of Frequency or Pitch of a sound. One hertz equals one cycle per second.

Impact Sound: the sound produced by the collision of two solid objects. Typical sources are footsteps, dropped objects, etc., on an interior surface (wall, floor, or ceiling) of a building.

Infrasound: sound whose frequency is below the low-frequency limit of audible sound (about 16 Hz).

Integrating (of an instrument): indicating the mean value or total sum of a measured quantity.

kHz: kilohertz : 1 kHz = 1000 Hz = 1000 Hertz.

LA: A-weighted, Sound Level.

LA10: is the noise level just exceeded for 10% of the measurement period, A-weighted and calculated by Statistical Analysis.

LA90: is the noise level exceeded for 90% of the measurement period, A-weighted and calculated by Statistical Analysis.

LAn: noise level exceeded for n% of the measurement period with A-weighted , calculated by Statistical Analysis - where n is between 0.01% and 99.99%.

LAeq: A-weighted, equivalent sound level. A widely used noise parameter describing a sound level with the same Energy content as the varying acoustic signal measured - also written as dBA Leq

LAF: A-weighted, Fast, Sound Level.

LAFmax: A-weighted, Fast, Maximum, Sound Level.

LAFmin: A-weighted, Fast, Minimum, Sound Level.

LAIeq: A-weighted, Impulse, Leq, Sound Level.

LAmax: A-weighted, Maximum, Sound Level

LAS: A-weighted, Slow, Sound Level.

LASmax: A-weighted, Slow, Maximum, Sound Level.

LASmin: A-weighted, Slow, Minimum, Sound Level.

LC: C-weighted, Sound Level.

LCE: C-weighted, Sound Exposure Level

LCeq: C-weighted, Leq, Sound Level

LCF: C-weighted, Fast, Sound Level.

LCFmax: C-weighted, Fast, Maximum, Sound Level.

LCpeak: C-weighted, Peak, Sound Level.

Leq: Equivalent Sound Level

Lpeak: Peak Sound Level

LZ: Z weighted, Sound Level.

LZE: Z-weighted, Sound Exposure Level

LZeq: Z-weighted, Leq, Sound Level.

LZF: Z-weighted, Fast, Sound Level.

LZFmax: Z-weighted, Fast, Maximum, Sound Level.

LZFmin: Z-weighted, Fast, Minimum, Sound Level.

Multi-spectrum: a one or two-dimensional array of spectra, consisting of two or more spectra that were recorded during the same measurement

Narrowband Noise: noise which has its energy distributed over a relatively small section of the audible range.

Natural Frequency: the frequency at which a resiliently mounted mass will vibrate when set into free vibration. The frequency of oscillation of the free vibration of a system if no Damping were present.

Noise: any sound that is undesired by the recipient. Any sound not occurring in the natural environment, such as sounds emanating from aircraft, highways, industrial, commercial and residential sources. Interference of an electrical or acoustical nature.

Octave: a range of frequencies whose upper frequency limit is twice that of its lower frequency limit. For example, the 1000 Hertz octave band contains noise energy at all frequencies from 707 to 1414 Hertz.

Octave Band analyser: an instrument that measures Sound Levels in octave bands.

Peak-to-Peak: the amplitude difference between the most positive and most negative value in a time waveform, that is, the total Amplitude.

Piezoelectric: PE : any material which provides a conversion between mechanical and electrical energy. Piezo is a Greek term which means 'to squeeze'. If mechanical stresses are applied to a piezoelectric crystal, then an electrical charge results. Conversely, when an electrical voltage is applied across a piezoelectric material, the material deforms.

Pitch: is a subjective auditory sensation and depends on the frequency, the harmonic content, and to a lesser extent on the loudness of a sound.

Spectrum: the description of a sound wave's resolution into its components of frequency and amplitude.

Third Octave Band: Octave bands sub-divided into three parts, equal to 23% of the centre frequency. Used when octave analysis is not discrete enough. Divides the audio spectrum into 33 or more equal parts with Constant Percentage Bandwidth filter.

Tone: sound or noise recognisable by its regularity. A simple or Pure Tone has one frequency. Complex tones have two or more simple tones, the lowest tone frequency is called the Fundamental, the others are Overtones.

Vibration: mechanical oscillations occur about an equilibrium point. The oscillations may be periodic such as the motion of a pendulum or random.