Chiles Ltd

Project: **Regional Freight Hub**

Report: **Acoustics assessment**

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Executive summary

The project involves the development of approximately 177.7 hectares of land to enable the construction and operation of a Regional Freight Hub near Palmerston North (Freight Hub), connecting the road and rail freight networks. This includes changes to the existing local road and rail network to accommodate the Freight Hub.

An assessment has been made of construction and operational noise and vibration effects associated with the Freight Hub.

The existing environment in the vicinity of the Freight Hub has been assessed based on attended and unattended sound level measurements, and site observations. The area has been found to have a complex existing environment, affected by many significant noise sources but also with relatively quiet periods, particularly in locations slightly further from existing transport infrastructure and industrial activities. The area is in a transition with the ongoing development of the North East Industrial Zone (NEIZ) and progressively more anthropogenic sounds occurring.

In the absence of a specific assessment standard, the effects of operational noise from the Freight Hub site (Site) have been considered with reference to criteria from a range of analogous standards, and also through broader consideration of changes in sound levels and potential sound characteristics. Operational road-traffic noise from the new perimeter road has been assessed with reference to criteria in the applicable New Zealand Standard.

For operational vibration, a screening assessment has been made to check whether any houses could be close enough to a new section of rail track in the Freight Hub to be at risk of exceeding a guideline criterion.

Criteria from the applicable New Zealand Standard have been used to assess the effects of construction noise, and for construction vibration, criteria published by Waka Kotahi NZ Transport Agency (Waka Kotahi) based on international standards have been used. For both construction noise and vibration, locations have been identified where there is risk of exceeding criteria and then the practicality of management measures for construction activity has been considered.

A computer model has been used to predict noise contours around the Freight Hub, based on source data obtained from measurements at several existing rail facilities. For the new perimeter road, a prediction has been made of road-traffic noise at the nearest house using a Waka Kotahi online calculator.

Data from previous projects has been used to determine distances at which there may be risk of exceeding operational vibration and construction noise and vibration criteria.

The Freight Hub will have positive noise effects in a number of locations where road traffic volumes decrease and at houses which the existing North Island Main Trunk (NIMT) will be moved away from and will be screened by a new noise barrier.

With normal good practice management, construction noise and vibration effects should be minor due to the separation of works from most houses, the scope to avoid night works in most locations, and the ability to provide mitigation such as permanent or temporary screening, if required.

Without mitigation, the operation of the Freight Hub could result in noise above recommended criteria over a wide area. This would be likely to result in disturbance to residential activities, with the extent being dependent on the specific relationship of each individual house to the Freight Hub and existing noise sources.

Operational activity should have minor vibration effects due to the separation of the new rail tracks from houses.

Road-traffic on the new perimeter road is predicted to comply with guideline criteria, indicating that noise will be at a reasonable level compatible with residential activity. Changes in traffic volumes on other roads in the wider area due to the Hub, and the associated noise, are within reasonable expectations for the types of road.

The indicative layout of the Freight Hub has been developed to provide space for substantial noise barriers. With indicative barriers, predicted noise contours reduce, although guideline criteria would still be exceeded for unconstrained operation. This is recommended to be addressed through a Noise Management Plan for the Hub. The implementation of the Noise Management Plan should be supplemented by a Community Liaison Forum for the Site. Operational vibration should not need further control, but this should be verified under the Noise Management Plan.

Construction noise and vibration effects should be managed in accordance with standard practice, including implementation of a Construction Noise and Vibration Management Plan.

The Freight Hub will alter the existing noise environment in some areas, and construction and operational activity will be audible over a wide area. However, with the mitigation and controls recommended, the residual noise and vibration should be at reasonable levels and effects should be acceptable in this environment.

Glossary of abbreviations and terms

Term/abbreviation	Description
AADT	Annual average daily traffic
AEE	Assessment of Environmental Effects
BS 5228-2	British Standard 5228-2:2009 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration
CNVMP	Construction noise and vibration management plan
dB	Decibels
District Plan	Operative Palmerston North City District Plan
Freight Hub	KiwiRail's proposed Regional Freight Hub near Palmerston North
HV	Heavy vehicle
km	Kilometre
km/h	Kilometres per hour
L_{AE}	Sound exposure level, measured in dB. *For a single event such as a train pass-by lasting say 10 to 30 seconds, the L_{AE} is the total sound energy as if it all occurred in one-second*
$L_{Aeq(t)}$	Time-average sound level over period "t", measured in dB
$L_{Aeq(15min)}$	Time-average sound level over 15 minutes, measured in dB
$L_{Aeq(1h)}$	Time-average sound level over 1 hour, measured in dB
$L_{Aeq(24h)}$	Time-average sound level over 24 hours, measured in dB
$L_{A90(t)}$	Background sound level (level exceeded for 90% of the time) over period "t", measured in dB
L_{AFmax}	Maximum sound level, measured in dB
L_{dn}	Day night level, measured in dB *Average A-weighted level over 24 hours; night period penalised by +10 dB*
m	Metres
mm/s	Millimetres per second
NEIZ	North East Industrial Zone
NIMT	North Island Main Trunk
NMP	Noise Management Plan
NoR	Notice of Requirement
NS 8176	Norwegian Standard 8176:2017 Vibration and shock - Measurement of vibration in buildings from landbased transport and guidance to evaluation of its effects on human beings
NZS 6801	New Zealand Standard 6801:2008 Acoustics – Measurement of environmental sound
NZS 6802	New Zealand Standard 6802:2008 Acoustics – Environmental noise
NZS 6802	New Zealand Standard 6803:1999 Acoustics – Construction noise
NZS 6805	New Zealand Standard 6805:1992 Airport noise management and land use planning

NZS 6806	New Zealand Standard 6806:2010 Acoustics – Road-traffic noise – New and altered roads
NZS 6809	New Zealand Standard 6809:1999 Acoustics - Port noise management and land use planning
MCA	Multi Criteria Analysis
ONRC	One Network Road Classification
PNCC	Palmerston North City Council
PNGL	Palmerston North-Gisborne Line
ppv	Peak particle velocity
SMA	Stone mastic asphalt
$v_{w,95}$	Statistical maximum weighted velocity with 95% probability, measured in mm/s
vpd	Vehicles per day

1. Introduction

Purpose and scope of assessment

Chiles Ltd has been engaged by KiwiRail to assess operational and construction noise and vibration associated with the Freight Hub near Palmerston North. This assessment has informed the development of the Freight Hub including associated indicative mitigation measures. This assessment considered operational and construction noise and vibration, with a primary focus on operational noise as, due to the extent of the Freight Hub and nature of proposed activities, this has the greatest potential impacts and requires extensive mitigation beyond routine practice.

This assessment report has been prepared to accompany KiwiRail's Notice of Requirement (NoR) for a new designation for the Freight Hub. The assessment is of the potential noise and vibration effects of the Freight Hub as it is now proposed at the selected Site with the indicative layout.

This assessment includes a description of the Freight Hub and the existing noise environment, outlines the methodology in terms of criteria applied and approach to evaluation, sets out the assessment of noise and vibration effects and measures recommended to avoid, remedy or mitigate adverse effects.

Project shaping

Noise and vibration were considered during all stages of the Multi Criteria Analysis (MCA) used by KiwiRail to identify the location now proposed for the Freight Hub, as summarised in the MCA report. For noise and vibration, consideration was made in that process of the number of houses nearby within various distances, the routes for trucks and trains associated with the site, and the land-use surrounding the site. The selected site (Option 3) was identified in the MCA as having high impacts in terms of noise (where unmitigated), although all options had at least medium noise and vibration impacts. Other technical disciplines identified issues with the alternative options that had lesser noise and vibration impacts and hence the current site was selected.

Noise and vibration have been considered in the development of the indicative layout for the selected site. The following features of the indicative layout that assist in minimising noise and vibration.

- The marshalling yard and container terminal are as far south on the site as possible such that they are furthest from residential areas of Bunnythorpe and towards the NEIZ.
- The warehouse buildings are a continuous built form providing noise screening to the west, rather than being discrete buildings with gaps between.
- The NIMT is moved west allowing space for a high noise barrier and associated planting for visual treatment along the east boundary of the Freight Hub (and NIMT).
- Land behind houses on Maple Street has been included in the Designation Extent so that noise mitigation can be located close to the houses where it will be most effective.
- The new perimeter road reconnects to the existing Railway Road at Maple Street which avoids redistribution of traffic on minor roads around the west of Bunnythorpe.
- The log yard has been positioned to the west Freight Hub boundary away from houses on Maple Street.

Assumptions and exclusions in this assessment

Noise and vibration effects associated with operation of trains on the existing NIMT have not been considered. In particular, effects associated with future increases in railway traffic on the NIMT have not been assessed, as these could occur regardless of whether the Freight Hub is located in the proposed location, or somewhere else in the region. This is on the basis that KiwiRail has an existing designation for the NIMT under which it is authorised to operate the rail corridor and generate the corresponding effects. Likewise, any potential effects associated with reinstatement of a triangular railway junction between the Palmerston North–Gisborne Line (PNGL) and the NIMT have not been assessed.

At the Site itself there is an intricate relationship between the Freight Hub and the NIMT. While the NIMT will continue to function in the same manner as it does currently, the tracks will be modified due to the Freight Hub. As explained in this assessment, the changes to the NIMT are significantly beneficial in terms of reducing noise and vibration, but regardless, resulting effects from continued operation of the NIMT after these changes have not been assessed.

Alteration of the national locomotive or wagon fleet have not been considered as practicable options for mitigation of noise from the Freight Hub. Other than cost implications, this is primarily as renewal of the locomotive and wagon fleets is likely to require a long timeframe, beyond the potential development timeframe of the Freight Hub if it proceeds quickly. There are also likely to be practical limitations as to the scope for achievable reductions in noise from locomotives and wagons.

Noise from traffic associated with the perimeter road connection around the west of the Freight Hub has been assessed, and noise from heavy vehicles associated with the Freight Hub has been considered on the wider existing road network. There is current work being undertaken by Waka Kotahi and Palmerston North City Council (PNCC) in relation to the wider strategic road network around Palmerston North including potential changes around Bunnythorpe. The form of that future road network is unknown and therefore noise effects of vehicles associated with the Freight Hub using that unknown network cannot be assessed. It has been assumed that noise and vibration from road-traffic on the future network, including vehicles associated with the Freight Hub, will be appropriately addressed in the development and implementation of the road network.

The Freight Hub is a long-term development and will respond as necessary to future requirements of the railway network and technologies that arise. As such, while there is an indicative layout proposed, as the Site is developed this is likely to be adapted and refined. In terms of noise and vibration, the indicative layout provides a realistic basis to assess an envelope of potential effects. As set out in this report, the noise and vibration assessment is not dependent on the specific details of the indicative layout or staging.

The Freight Hub will be developed over time and in a way that means the noise and vibration effects will not be introduced immediately on opening. The detailed design of the Freight Hub, including in relation to noise and vibration, will follow in subsequent Outline Plan of Works. Further assessment and design of noise and vibration mitigation and management measures will occur at that time, which is an appropriate time for such actions.

Potential noise and vibration effects have been assessed in terms of existing houses in the vicinity of the Hub.

2. Project description

The Freight Hub is described in the Assessment of Environmental Effects (AEE). The following provides a summary description of the Freight Hub, including key matters relevant to this acoustics assessment.

The project involves the development of approximately 177.7 hectares of land to enable the construction and operation of the Freight Hub. The Freight Hub is an intermodal freight facility that connects the rail network with the road transport system. It will include the following key elements:

- marshalling yards including arrivals and departure tracks
- container terminal
- wagon storage
- maintenance and network services facilities
- freight forwarding facilities
- log handling
- bulk liquid storage
- train control and rail operation centre and administrative office buildings and associated carparking
- staff facilities including car parking
- stormwater management areas with associated planting
- noise management areas with associated planting
- access roads
- buildings and other activities ancillary to the project

The Freight Hub is expected to operate 24 hours a day and seven days a week.

KiwiRail has an existing freight yard at Tremaine Avenue in Palmerston North (Existing Freight Yard). With the development of the Project, it is proposed that the existing marshalling activities, log handling and freight forwarding operations, network services and maintenance facilities will be relocated from the Existing Freight Yard to the new Freight Hub. The passenger terminal and the network communications centre will remain at their existing location at the western end of the Tremaine Avenue site.

The project includes the land currently designated for the existing NIMT. The existing single NIMT track will be moved approximately 20 metres west from the current location and re-laid within the Site.

To enable the development and operation of the Freight Hub, the section of Railway Road between Roberts Line and south of Maple Street will need to be legally stopped. This will be accompanied by closure of the current eastern movement through the Railway Road/Roberts Line intersection to Roberts Line. A new perimeter road will be constructed which will connect Roberts Line west of Richardson Line to Railway Road at the northern end of the Site. The new connection is required to

provide access to the Site from the north and west. It will also serve the function of providing an alternative transport connection once Railway Road has been stopped.

Bulk earthworks are expected to be undertaken over several years to provide a finished flat level for the marshalling yards and container terminal. The remainder of the Freight Hub will be at a similar level.

KiwiRail is seeking to designate the land required for the Freight Hub. The Freight Hub has been developed to a concept design stage with an indicative site layout. The design will be further developed through future stages of the project. Before construction commences, KiwiRail will submit an Outline Plan of Works to PNCC to reflect the relevant physical works outlined above. The Outline Plan of Works is expected to be accompanied by a series of management plans to ensure that KiwiRail appropriately manages the effects of the Project and to keep the community and PNCC informed as the detailed design progresses.

The Freight Hub has been designed to accommodate freight and future rail needs out to 2050 (and beyond). It is anticipated that the Freight Hub will be developed over time in stages. The level of development at, and timing for, each stage may change due to detailed design and various external factors.

3. Existing environment

Description

The area around the Site includes significant noise sources with existing roads, rail, airport and industrial activity. However, these sources can be intermittent and many of them subside in the evening and at night, such that there are quiet periods with natural sounds dominating in many locations. The area is in a transition with the development of the NEIZ, and in terms of the noise environment there is an ongoing change whereby there are progressively more anthropogenic sounds occurring and anticipated in the area.

During public information days for the Freight Hub, many residents living near the Site described how they experience the area as having a relatively quiet rural environment, such that even distant noise sources like motorsport events at Manfield are sometimes audible. Residents living adjacent to the NIMT commented on loud noise that occurs as trains pass-by, and several residents commented that they were disturbed by construction and operational noise from more recent developments in the NEIZ. Residents commented less about existing road-traffic noise or airport noise.

This complex existing environment does not lend itself to simple categorisation in terms of noise. It is on the fringe of an urban area and is affected by many significant noise sources. However, it also features relatively quiet periods, particularly in locations slightly further from the transport infrastructure and industrial activities.

Sound level survey

Noise loggers were installed at four locations for a one-week period, to identify how sound varies throughout the day and night. These measurements were supplemented by a number of short-term attended measurements, where the sources of noise were able to be identified by the operator. The attended measurements were repeated day and night for each location. The measurement locations were selected to identify any potential difference in the acoustic environment in the area around the Freight Hub based on distance from different noise sources.

The monitoring locations are shown in Figure 1. Photographs of the installation locations and equipment details are provided in Appendix A. The four locations used for monitoring over one-week were selected as being representative of the existing environment at houses nearest to the Freight Hub that might be most affected by its operation.

These sound level surveys were undertaken in March 2020. This was during the initial restrictions (level 2) of COVID-19, and there is the potential that there was some change in traffic conditions although this is unlikely to have been material in terms of findings relating to the overall acoustic environment.

Weather conditions were obtained from the Palmerton North automatic weather station. Periods with wind speed of greater than 5 m/s were identified and excluded from the summary data in accordance with NZS 6801. No precipitation was recorded during the monitoring period. The exclusion of windy periods is necessary as wind on microphones can cause erroneous readings. However, the increased noise from vegetation moving in the wind, and from turbulent air, is a real part of the existing environment that people experience. As for most environmental noise assessments, because windy

periods are excluded the following summary data does not show higher sound levels that would be experienced at times.

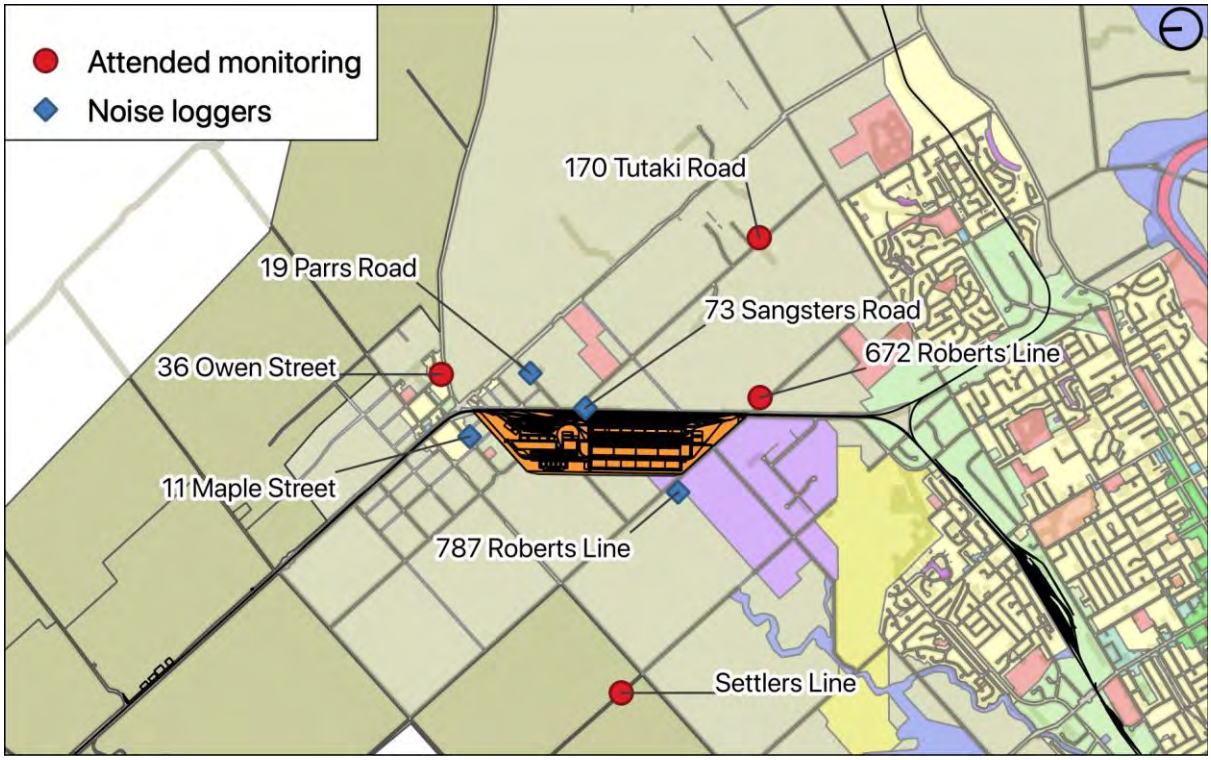


Figure 1 - Noise monitoring locations

The results of the noise logging are presented in Table 1 as range of measured levels and the median value for the following parameters:

- Time average level ($L_{Aeq(t)}$) over the 15-hour day period, and 9-hour night period
- Background level ($L_{A90(1h)}$) as the average of 1-hour samples in each day or night period

The distribution of sound levels on different days of the week is shown in Figures 2 and 3, and the median and average at each site across the day is shown in Figures 4 to 7. Full details at individual sites are shown in Appendix A.

Table 1 - Noise logger results, median values, dB

Location	Daytime (0700-2200h)		Night time (2200-0700h)	
	$L_{Aeq(15h)}$	$L_{A90(1h)}$	$L_{Aeq(9h)}$	$L_{A90(1h)}$
73 Sangsters Road	53 (49-55)	43 (39-46)	50 (46-53)	30 (28-40)
19 Parrs Road	47 (46-52)	37 (33-41)	40 (36-49)	28 (27-39)
787 Roberts Line	48 (45-51)	38 (35-42)	43 (42-51)	33 (29-41)
11 Maple Street	47 (45-50)	38 (35-43)	42 (36-48)	27 (24-35)

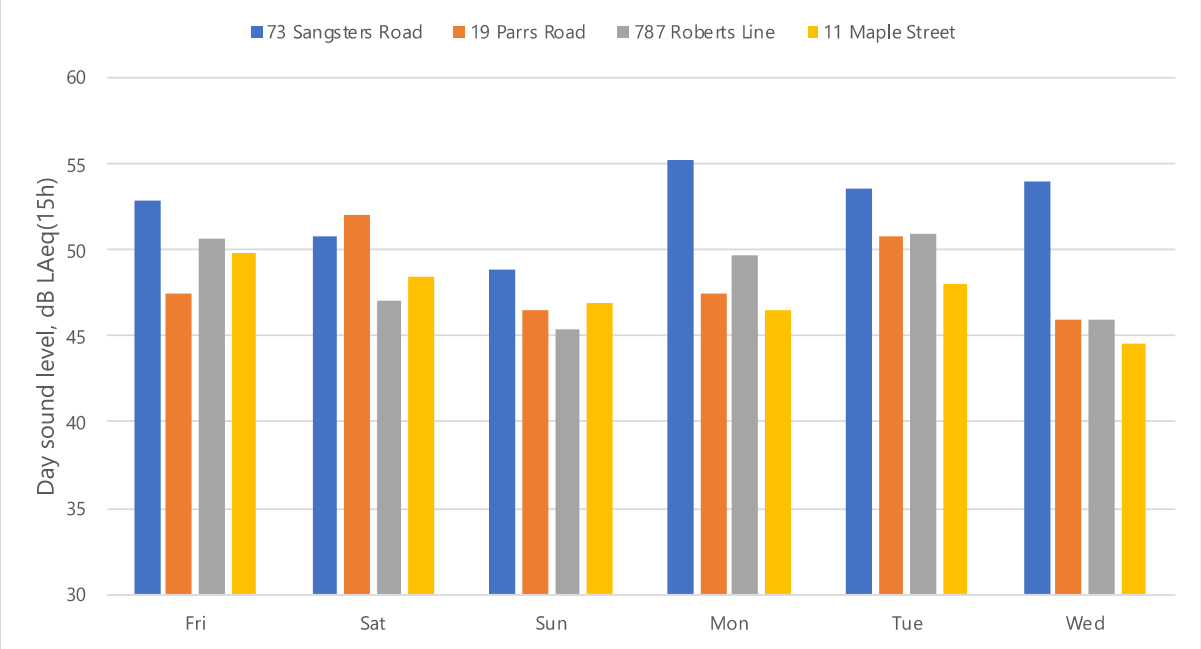


Figure 2 - Daytime sound level distribution across the week

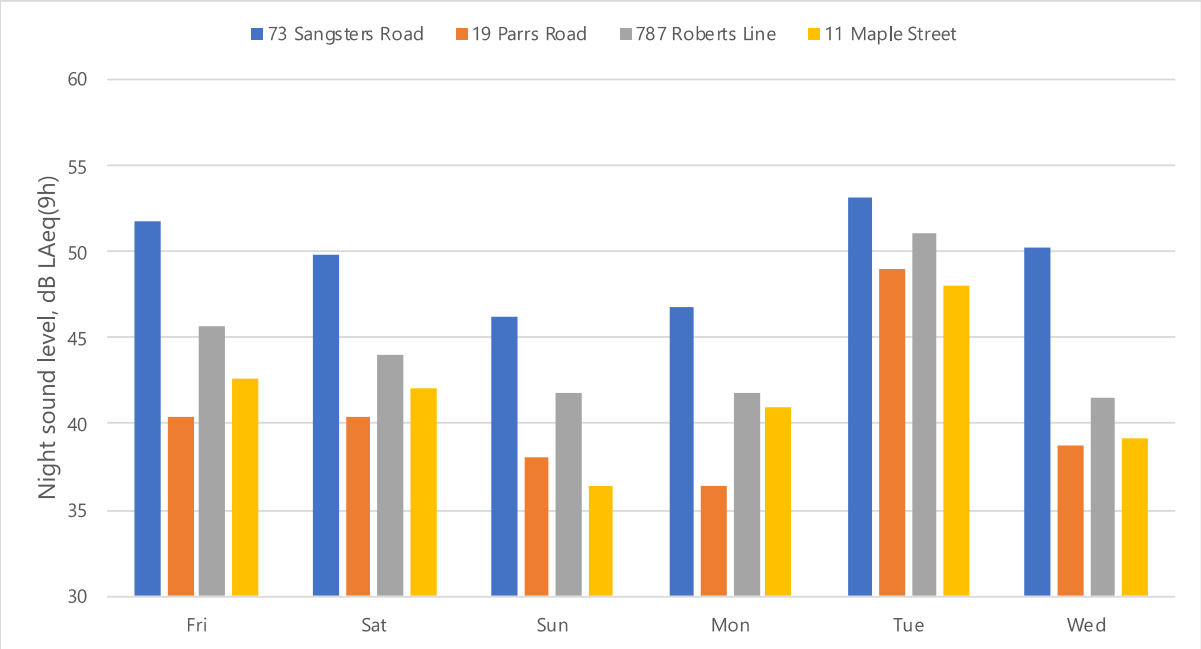


Figure 3 – Night-time sound level distribution across the week

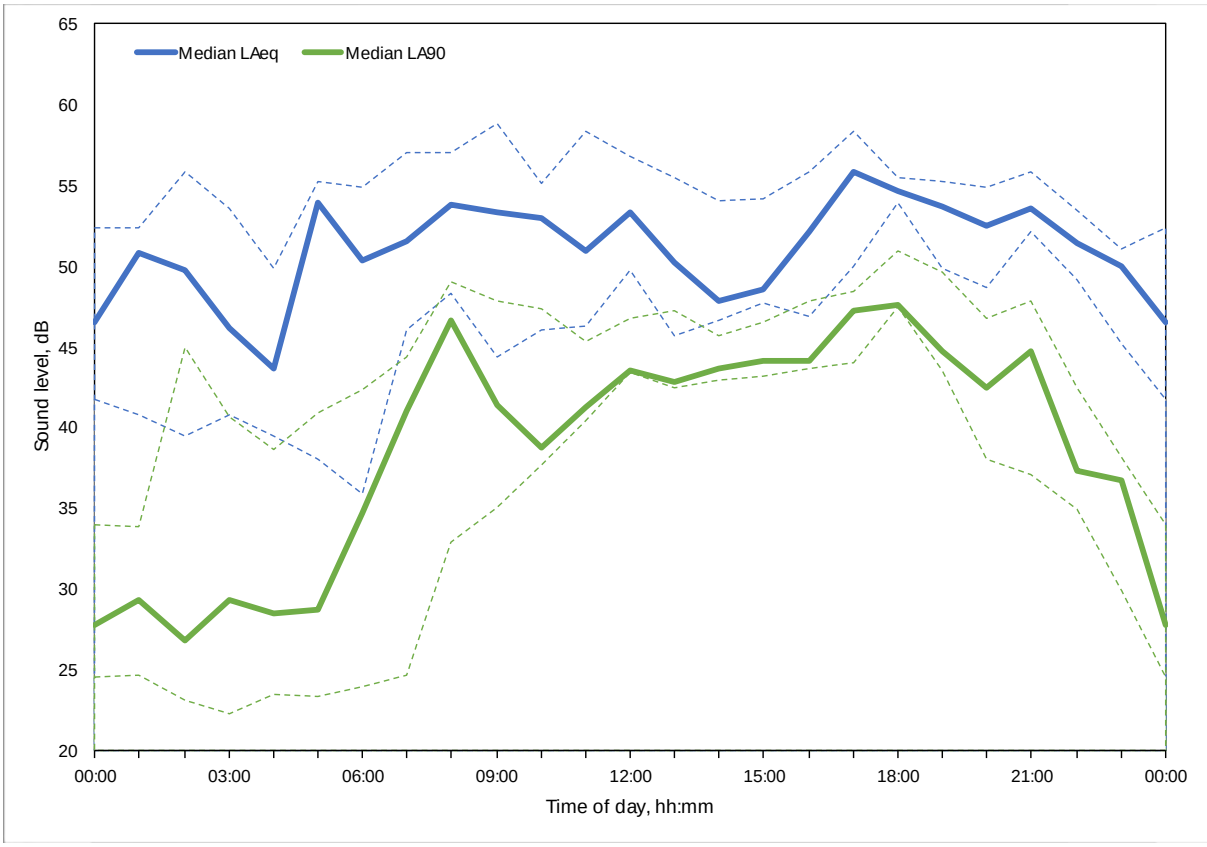


Figure 4 – Sound level profile at 73 Sangsters Road

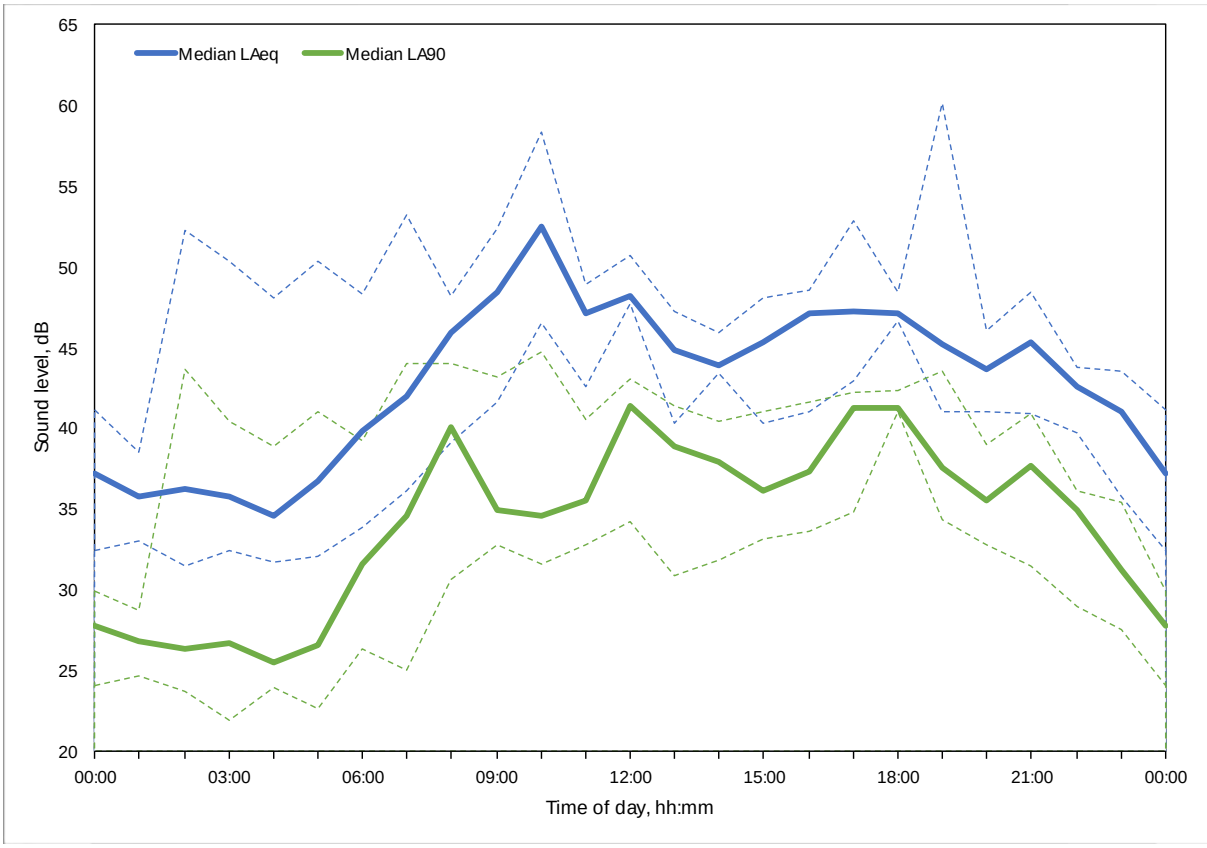


Figure 5 – Sound level profile at 19 Parrs Road

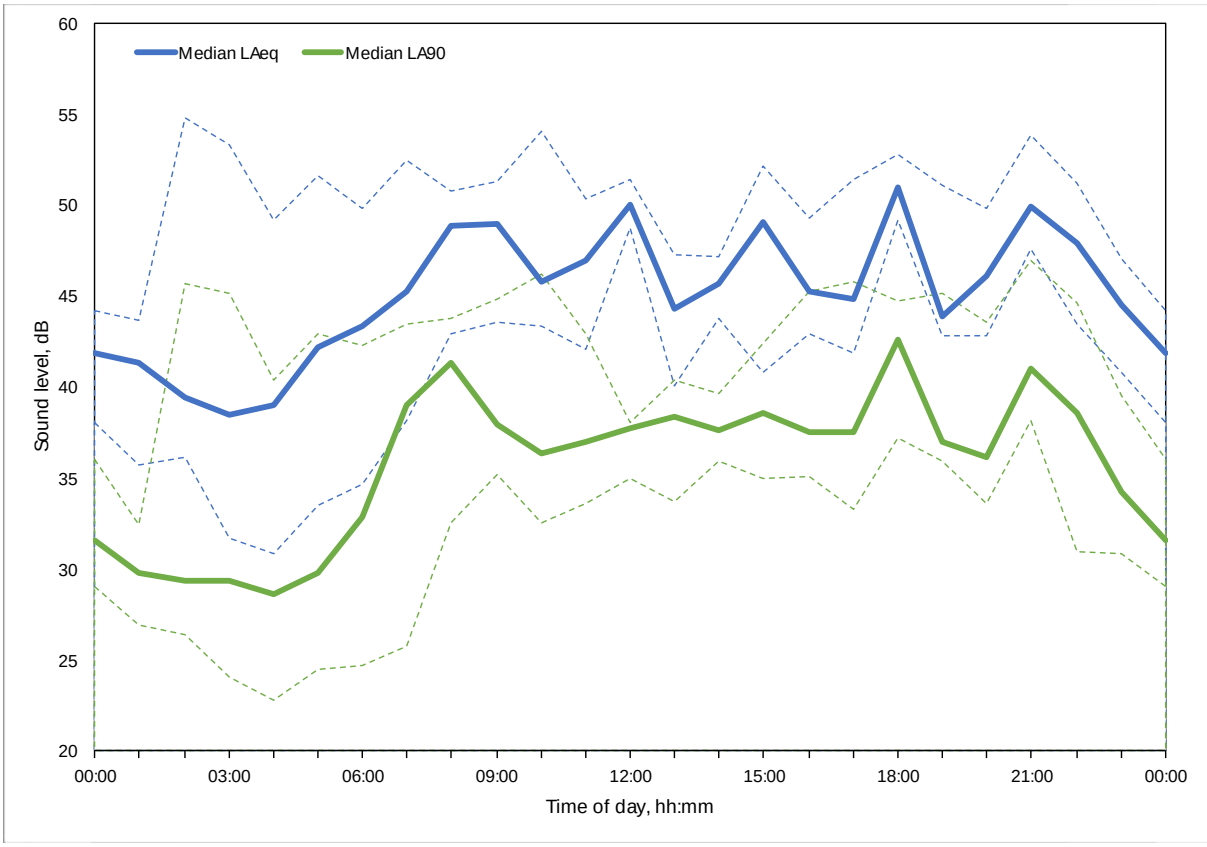


Figure 6 – Sound level profile at 787 Roberts Line

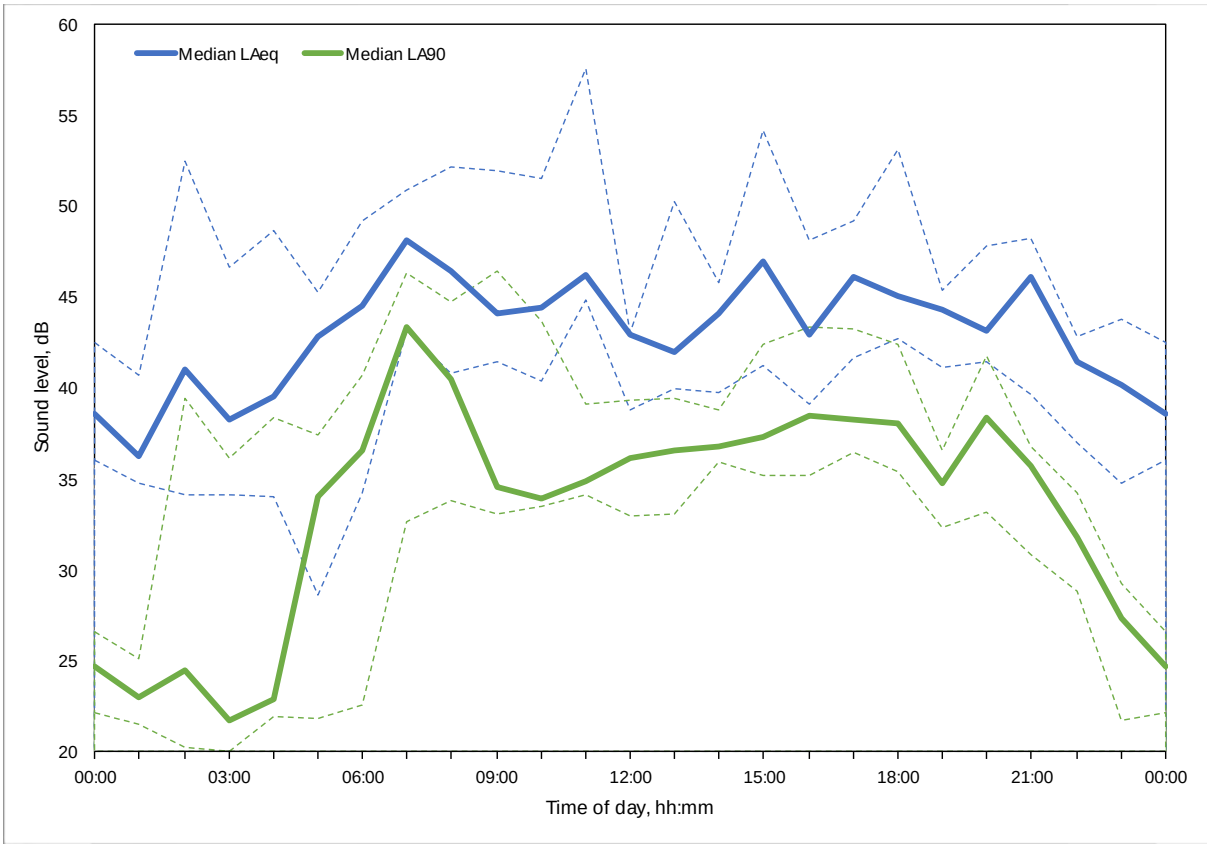


Figure 7 – Sound level profile at 11 Maple Street

The results of the attended measurements with observations are provided in Table 2.

Table 2 – Attended measurement results, dB, and observations

Address	Start time	$L_{Aeq(t)}$ *1	L_{AFmax}	$L_{A90(t)}$ *1	Observation
73 Sangsters Road	12/03/20 10:03	52	76	46	Distant traffic. Railway Road movements shielded by terrain
	11/03/20 23:10	50	64	40	Local and distant traffic. Individual vehicles on Railway Road audible for some time. Wind in trees
19 Parrs Road*2	12/03/20 10:54	44	60	39	Birds in trees, distant traffic
36 Owen Street	12/03/20 11:14	51	63	43	Traffic on Ashhurst Road, cicadas, general aviation, distant traffic
	12/03/20 00:19	33	42	27	Very distant traffic
170 Tutaki Road	12/03/20 10:21	50	67	40	Distant traffic, aircraft (ATR) departing from airport, general aviation, birds in trees
	12/03/20 00:04	36	43	35	Wind in trees, distant traffic (individual vehicles)
672 Roberts Line	12/03/20 10:33	52	62	43	General aviation, minimal traffic noise audible from Railway Road
	11/03/20 23:48	44	54	38	Distant traffic (Kelvin Mill Road), wind in trees
787 Roberts Line	12/03/20 09:27	57	80	42	Aircraft (ATR) taxiing at airport, distant traffic, local traffic
	11/03/20 23:39	39	54	36	Wind, slight rumble from distant traffic
Settlers Line	11/03/20 13:58	46	57	43	Traffic on Kairanga Bunnythorpe Road, cicadas, distant traffic
	11/03/20 23:25	39	54	35	Wind in trees, distant traffic, single vehicle passing on Kairanga Bunnythorpe Road

*1 Measurements were made over a time period sufficient to obtain stable readings, generally between 5 and 10 minutes

*2 The monitoring location at 19 Parrs Road was on private property that was not practical to access at night so only a daytime attended measurement was made. The logger at this location recorded day and night levels as shown in Figure 5.

There were no train pass-bys on NIMT during the attended measurements reported in Table 2. However, a train pass-by occurred immediately prior to and after the day and night measurements respectively, reported in Table 2 at 672 Roberts Line. During those pass-bys the train noise was observed to dominate the environment at 672 Roberts Line. Although not included in the measurements in Table 2, a reading was obtained of the maximum levels during each of the train pass-bys, which were 79 dB and 82 dB L_{AFmax} at 672 Roberts Line.

4. Methodology for assessing effects

This assessment has considered operational and construction noise and vibration effects. For operational vibration, operational road-traffic noise and construction noise and vibration, the assessment has been made at a high level considering relevant criteria and likely effects based on experience with comparable infrastructure works and implementation of standard controls. For on-site operational noise, a more detailed study has been made of indicative activity, modelled noise emissions, indicative noise barriers and bespoke controls.

Operational noise (on-site)

For this assessment the term 'on-site' refers to activity in the Freight Hub, and excludes the new perimeter road and ancillary areas for stormwater retention, noise barriers and landscaping outside the Freight Hub. The proposed designation and its associated conditions will apply to activity in the Freight Hub in place of underlying Palmerston North City District Plan (District Plan) noise limits and other rules. This assessment has therefore determined appropriate noise criteria for new activity in the Freight Hub with consideration of several different references. There is no applicable National Environmental Standard, and there is no New Zealand Standard specifically relating to noise from railway hubs. The general environmental noise standard NZS 6802 is applicable to rail-yards but only for activities other than trains.

The underlying zoning of the site in the District Plan is partly NEIZ and partly Rural Zone. While the District Plan noise limits would not apply to activities in the Freight Hub designation, they remain a relevant benchmark as to noise levels that could be reasonably expected in this environment. However, the District Plan also exempts trains on rail lines, including railway yards and sidings, from all noise limits other than in relation to testing/maintenance and loading/unloading.[1]

For reference, the noise limits for activity in the Rural Zone and NEIZ received in residential and rural areas are set out in Table 3, together with guideline values from NZS 6802. Noise criteria normally apply at houses or notional boundaries 20 metres from houses. However, the District Plan applies noise limits at all rural and residential zoned land, presumably to allow for future development. This is a stringent approach that occurs in a minority of other districts. For the Freight Hub, this assessment has primarily considered noise criteria and effects on existing houses (at the date the NoR is lodged) rather than on undeveloped rural land.

Table 3 – Reference noise criteria

	NEIZ	Rural Zone	NZS 6802
	Rule R12A.10.1.a	*Rule R9.11.1*	*Clause 8.6.2*
Daytime 0700h-1900h	55 dB $L_{Aeq(15\ min)}$	50 dB $L_{Aeq(15\ min)}$	55 dB $L_{Aeq(15\ min)}$
Evening 1900h-2200h	50 dB $L_{Aeq(15\ min)}$	45 dB $L_{Aeq(15\ min)}$	50 dB $L_{Aeq(15\ min)}$
Night 2200h-0700h	45 dB $L_{Aeq(15\ min)}$ 75 dB L_{AFmax}	40 dB $L_{Aeq(15\ min)}$ 70 dB L_{AFmax}	45 dB $L_{Aeq(15\ min)}$ 75 dB L_{AFmax}

[1] District Plan rule R6.2.6.2.e

It is common for major infrastructure, such as ports, airports and roads, which cannot practicably internalise all noise to achieve limits such as those in Table 3, to be subject to graduated criteria, with tiers of noise criteria set at different levels rather than a single limit. In those cases, noise limits in the order of 10 dB higher than the NEIZ noise limits are often applied in conjunction with other controls to manage noise effects.

The New Zealand airport and port noise standards[2] recommend criteria in terms of the "day/night level" or L_{dn}, which is an average level over 24 hours including a 10 dB penalty for noise at night. Comparisons with the District Plan noise limits are not exact as the airport and port criteria in the standards apply to noise averaged over 3 months or 5 days respectively, whereas the District Plan noise limits only allow for limited averaging during one day and none at night ("duration adjustment" under NZS 6802). An outline description of potential noise effects based on the port and airport criteria is set out in Table 4.

Table 4 – Port and airport reference noise criteria

Day/night noise levels	Approximate equivalent short-term levels	Potential noise effects
Less than 55 dB L_{dn}	Day - 55 dB $L_{Aeq(15\ min)}$ Night - 45 dB $L_{Aeq(15\ min)}$	Generally acceptable residential noise conditions. Similar to, but less stringent than the NEIZ noise limits due to the absence of an evening period and longer averaging.
Between 55 and 65 dB L_{dn}	Day – 55-65 dB $L_{Aeq(15\ min)}$ Night – 45-55 dB $L_{Aeq(15\ min)}$	Compromised residential noise conditions. While this may be accepted in the case of infrastructure that cannot practicably internalise effects, treatment of neighbouring houses may be required.
Greater than 65 dB L_{dn}	Day - 65 dB $L_{Aeq(15\ min)}$ Night - 55 dB $L_{Aeq(15\ min)}$	Generally unacceptable residential noise conditions.

As noted in Table 4, where noise effects cannot be internalised around ports and airports, affected houses are often treated with mechanical ventilation/cooling and upgraded sound insulation if required to achieve acceptable indoor noise levels with windows closed. This approach does not address outdoor amenity and is generally only justified where it is not practicable for the infrastructure to locate elsewhere or internalise noise effects. A similar approach is taken to road-traffic noise under NZS 6806.

Another reference point is rules in the District Plan that require new buildings for noise sensitive activities near existing railways to be designed to result in acceptable internal noise levels. For the Rural Zone, the District Plan requires a level of 35 dB $L_{Aeq(1h)}$ to be achieved inside bedrooms of new

[2] NZS 6805 (airports) and NZS 6809 (ports)

buildings within 100 metres of a railway track.[3] This internal requirement correlates to a railway noise level of approximately 50 dB $L_{Aeq(1h)}$ outside, if allowing for a reduction of approximately 15 dB from outside to inside with windows partly open for ventilation.

The District Plan rule uses a one-hour time period for railway noise ($L_{Aeq(1h)}$).[3] While not formally standardised, this metric is commonly used for railway noise in New Zealand as a shorter assessment time such as 15 minutes might not be representative of typical railway activity, which is inherently variable. For this current assessment it was initially considered that L_{dn} noise criteria should be adopted for the Freight Hub in the same manner as ports and airports. However, from discussions with PNCC's acoustics advisor, noise limits are now proposed in terms of the $L_{Aeq(1h)}$ for consistency with the way railway noise is already addressed in the District Plan (for new houses by existing railways). Additional L_{AFmax} noise limits are also proposed at night, in accordance with general noise rules in the District Plan and NZS 6802, to manage potential awakenings from short duration events (e.g. clangs).

From consideration of the above references the operational noise criteria in Table 5 were developed to assess the noise effects of the Freight Hub. The criteria have been set out in Categories to provide for a graduated response. The category notation is similar to that used for roads under NZS 6806, but the thresholds used have been tailored to the Freight Hub. The Category A criteria should be achieved as far as practicable through the design and operation of the Freight Hub. Where this is not practicable and levels at houses are within the Category B criteria, those houses should be investigated and acoustically treated if necessary to achieve reasonable internal levels. The Category C criteria should not be exceeded.

Table 5 – Proposed Freight Hub noise criteria

	Noise criteria	Comments
Category A	Day: <55 dB $L_{Aeq(1h)}$ Evening: <50 dB $L_{Aeq(1h)}$ Night: <45 dB $L_{Aeq(1h)}$ Night: <75 dB L_{AFmax}	Similar to existing noise allowed from the NEIZ. A change from existing Rural Zoned activity (R9.11.1), but noise would remain compatible with residential activity in both rural and residential zones.
Category B	Day: 55-65 dB $L_{Aeq(1h)}$ Evening: 50-60 dB $L_{Aeq(1h)}$ Night: 45-55 dB $L_{Aeq(1h)}$ Night: 75-85 dB L_{AFmax}	Houses may need to be acoustically treated and mechanically ventilated as necessary to meet a level of 35 dB $L_{Aeq(1h)}$ in bedrooms and 40 dB $L_{Aeq(1h)}$ in other habitable spaces.
Category C	Day: >65 dB $L_{Aeq(1h)}$ Evening: >60 dB $L_{Aeq(1h)}$ Night: >55 dB $L_{Aeq(1h)}$ Night: >85 dB L_{AFmax}	Freight Hub noise is likely to be incompatible with residential activity.

[3] District Plan rule R9.11.3

These proposed criteria in Table 5 are subject to the following:

- Trains on the NIMT are excluded.
- Road vehicles outside the site are excluded (i.e. vehicles on the perimeter road are excluded as this is assessed separately below).
- The criteria apply at the notional boundary of houses existing at the date the NoR is lodged (October 2020).
- Duration adjustments are not applied.
- Corrections for special audible characteristics are not applied to railway activity such as impulsive noises associated with shunting.

Having established noise criteria as set out in Table 5, the methodology for this assessment has been to:

- Make an acoustics computer model to predict noise emissions from the fully developed future Freight Hub for a busy daytime scenario.
- Identify areas where noise criteria (Category A) might be exceeded and work with the project team to adapt and refine the indicative site layout to reduce noise emissions at houses where practicable.
- Evaluate the noise received at surrounding houses and assess the potential noise effects of the Freight Hub.
- Consider noise mitigation and management that could be used to reduce adverse noise effects.
- Propose controls that should be implemented to maintain reasonable noise from the Freight Hub.

Operational noise (road-traffic)

Operational noise from road-traffic on the new perimeter road has been assessed. While this section of road is in the proposed designation, it is outside the operational Freight Hub and will also carry general traffic. For this assessment, the road has been considered separately from the Freight Hub both because road-traffic noise is subject to different criteria relating to different subjective responses, and because it will be subject to separate management processes.

There is no National Environmental Standard for operational road-traffic noise, and the District Plan explicitly excludes the sound of vehicles on roads from general noise limits.[4] In the absence of other standardised criteria, most major roading projects since 2010 have been subject to noise assessment in accordance with NZS 6806, which was written for this specific application. The District Plan references NZS 6806.[5]

NZS 6806 sets absolute rather than relative criteria to protect people living near roads from sleep disturbance and to provide a reasonable level of residential amenity. The method in NZS 6806

[4] District Plan rule R6.2.6.2.1.b
[5] District Plan section 6.2.4

provides performance targets and requires assessment of a number of different options for noise mitigation (often including barriers and low-noise road surfaces). The criteria from NZS 6806 are set out in the following table for new and altered roads.

Table 6 – NZS 6806 road-traffic noise criteria

	New road criteria	Altered road criteria
Category A	57 dB $L_{Aeq(24h)}$	64 dB $L_{Aeq(24h)}$
Category B	64 dB $L_{Aeq(24h)}$	67 dB $L_{Aeq(24h)}$
Category C (internal)	40 dB $L_{Aeq(24h)}$	40 dB $L_{Aeq(24h)}$

The new perimeter road would be classified as a new road under NZS 6806. Under NZS 6806, noise mitigation options are to be assessed and, if practicable, the Category A criterion should be achieved. If this is not practicable, then mitigation should be assessed against Category B. However, if it is still not practicable to comply with categories A or B, then mitigation should be implemented to ensure the internal criterion in Category C is achieved. Depending on the specific building, mitigation in Category C could include ventilation and/or sound insulation improvements ranging from upgraded glazing through to new wall and ceiling linings. In Category C there is no protection of outdoor amenity.

A full assessment of road-traffic noise from the new perimeter road in accordance with NZS 6806 should occur when the detailed design of the road is progressed, with details provided in the Outline Plan of Works. For the current assessment, noise at the nearest houses has been considered, with reference to future forecast traffic flows when the site is first opened for operation (currently anticipated in approximately 2031). Calculations have been made for an indicative location representative of the nearest house to the road using the Waka Kotahi web calculator.[6] Indicative mitigation has been considered to confirm whether there would be practicable options available at the time of detailed assessment. Noise effects have then been considered including indicative mitigation measures.

Traffic associated with the Freight Hub has also been considered on the wider roading network. An initial screening exercise has been made considering future (2031) forecast traffic flows on all roads in the area with and without the parts of the Freight Hub that are included in the traffic model for that year. Roads where there is forecast to be a large change in overall traffic, and heavy vehicles in particular, have been identified. A qualitative assessment has been undertaken of the likely impact of changes in road-traffic noise.

Operational vibration

For operational railway vibration there is no relevant National Environmental Standard, District Plan rules or New Zealand Standards. For previous assessments of rail (and road) vibration in New Zealand a Norwegian Standard, NS 8176, has often been applied as it has criteria and methods designed specifically for this application. NS 8176 recommends a criterion of 0.3 mm/s $v_{w,95}$ for operational rail

[6] https://nzta.govt.nz/roads-and-rail/highways-information-portal/tools/road-traffic-noise-calculator/

vibration from new railways. For rail activity in the Freight Hub, a vibration criterion of 0.3 mm/s $v_{w,95}$ is proposed to apply at all existing houses.

Trains in the Freight Hub will be on new ground and track formations, which will reduce potential vibration. On this basis the 0.3 mm/s $v_{w,95}$ criterion should be readily achieved if there is reasonable separation from houses, or could be achieved with standard controls if houses are closer. Standard controls include a range of resilient track forms such as resilient rail fasteners or ballast mats. To make a screening assessment, the location of the indicative tracks in the Freight Hub have been reviewed to confirm whether any are likely to be close enough to houses for there to be a risk of exceeding the vibration criterion. Controls for vibration to be implemented during the detailed design of the Freight Hub have been determined.

Construction noise and vibration

With respect to construction noise there are no relevant National Environmental Standards, but the District Plan requires use of the New Zealand Standard NZS 6803 for construction noise district-wide.[7] NZS 6803 sets out guideline criteria and management methods for construction noise. It is referenced in most other district plans and has been used for most if not all construction noise assessments in New Zealand for many years. For the Freight Hub construction, the long-term criteria from NZS 6803 are applicable as set out in Table 7.

Table 7 – NZS 6803 long-term construction noise criteria[8]

Time of week	Time period	$L_{Aeq(t)}$	L_{AFmax}
Weekdays	0630-0730	55 dB	75 dB
	0730-1800	70 dB	85 dB
	1800-2000	65 dB	80 dB
	2000-0630	45 dB	75 dB
Saturdays	0630-0730	45 dB	75 dB
	0730-1800	70 dB	85 dB
	1800-2000	45 dB	75 dB
	2000-0630	45 dB	75 dB
Sundays and Public Holidays	0630-0730	45 dB	75 dB
	0730-1800	55 dB	85 dB
	1800-2000	45 dB	75 dB
	2000-0630	45 dB	75 dB

[7] District Plan rule R6.2.6.2.1.g

[8] In accordance with NZS 6803, the noise limits in Table 7 apply at the façades of buildings. 3 dB should be subtracted from these levels if comparing them with other criteria discussed in this report which apply in a 'free-field' position in accordance with NZS 6802.

For most large infrastructure projects near existing houses, it is sometimes impracticable for certain construction processes to fully comply with the criteria in Table 7. Construction noise effects can usually still be managed to a reasonable degree through good practice, such as detailed in the Waka Kotahi guide,[9] including greater emphasis on effective stakeholder engagement.

For construction vibration, there are no relevant National Environmental Standards, District Plan rules or New Zealand Standards. In the absence of any national standards, Waka Kotahi developed construction vibration criteria based on standards from other countries, as set out in Table 8. The criteria relate both to perception of vibration resulting in disturbance for people, and also to potential cosmetic damage to buildings.

Table 8 – Waka Kotahi construction vibration criteria

Receiver	Location	Details	Category A ppv	Category B ppv
Occupied houses	Inside the building	Night 2000h to 0630h	0.3 mm/s	1 mm/s
		Day 0630h to 2000h	1 mm/s	5 mm/s
Other occupied buildings	Inside the building	Day 0630h to 2000h	2 mm/s	5 mm/s
Unoccupied buildings	Building foundation	Vibration transient	5 mm/s	BS 5228-2 Table B.2
		Vibration continuous		50% of BS 5228-2 Table B.2

These vibration criteria provide a tiered approach to allow the substantial variabilities in vibration sensitivities of people and buildings to be considered. Construction works would be managed to comply with the Category A criteria as far as practicable, and if vibration levels were predicted to exceed the Category A criteria then works would only proceed subject to site specific assessment of potential effects. The inclusion of higher "Category B" criteria allows a further graduated response whereby more intense assessment and monitoring is required if vibration levels are predicted to be above the Category B criteria than between the Category A and B criteria. Higher vibration levels are generally associated with rock removal (breaking/blasting), driven piling and compaction.

Construction noise and vibration have been assessed through consideration of typical distances at which compliance with the criteria in Tables 7 and 8 is achieved based on comparable infrastructure projects. Specific areas have been considered where houses are closer to works and where enhanced mitigation might be required to maintain compliance with the noise and vibration criteria, or to manage effects associated with any exceedances.

[9] Waka Kotahi *State highway construction and maintenance noise and vibration guide* 2019

5. Model forecast

Operational noise (on-site)

A computer noise model has been made for operational activity at the Freight Hub to predict indicative sound levels at nearby properties. The actual noise emissions from the Freight Hub are expected to fluctuate significantly with changing / varying activity on both a short- and long-term basis. The noise model is therefore based on a scenario set out below, which is intended to be representative of busy daytime operations for the fully developed Freight Hub. This gives an indication of the general extent of likely noise emissions, which has been used to inform the shaping of the indicative site layout and the evaluation of the effectiveness of potential noise barriers. This also forms a basis for assessing the potential operational noise effects of the Freight Hub. Future operation of the Freight Hub will require further measurement and modelling to determine actual noise emissions at different points in time as discussed in subsequent sections of this report.

Table 9 details the noise modelling parameters used for this assessment.

Table 9 – Noise modelling parameters

Parameter	Value
Operator	Michael Smith (Altissimo Consulting)
Software	Predictor 2021.1
Algorithm	ISO 9613-2
Temperature / Humidity	15°C / 20%
Ground absorption	0 (hard)
Terrain	Site modelled at 50m 1m resolution Digital Elevation Model (2018 Manawatu Wanganui Palmerston North)
Building heights	Warehouses and workshops – 10m
Receiver / grid height	1.5m above ground
Output	$L_{Aeq(1h)}$

Sound level measurements were made at other sites to obtain source data for the noise model. This included measurements at the Existing Freight Yard, KiwiRail Middleton site in Christchurch, Lyttelton Port rail log yard in Lyttelton and container terminal in Rolleston. Reference was also made to previous sound level measurements at the KiwiRail container terminal in Temuka.

On the basis of the information gathered from these other sites, the source sound levels listed in Table 10 have been used in the computer noise model for the Freight hub. For each source this table includes a brief description, the indicative sound levels assumed based on measurements, and photographs showing an example.

For events with a continuous or repeatable cycle, source data has been derived using the time average (L_{Aeq}) level. For short events, the sound exposure level (L_{AE}) has been used along with the number of events. A separate assessment for momentary sounds ('clangs and bangs') has been performed using maximum (L_{AFmax}) levels.

Table 10 – Sound sources

Item	Indicative sound levels at 10m	Photograph
Rail movements Noise from the locomotives are dominant source for smooth track, with similar noise emissions whether idling or moving through the site. A potentially significant noise source is brake squeal when stopping. When separating wagons, an air hose is released.	73 dB $L_{Aeq(15min)}$ (63 dB $L_{Aeq(15min)}$ at 70 m) 92 dB L_{AFmax} 89 dB L_{AE} 94 dB L_{AE}	
Container terminal (CT yard) Different vehicles can commonly be used to move containers: • Top loader • Reach stacker (shown in photograph) • Forklift	 70 dB $L_{Aeq(15min)}$ 96 dB L_{AE} 81 dB $L_{Aeq(15min)}$ 99 dB L_{AE} 70 dB $L_{Aeq(15min)}$ 92 dB L_{AE}	

Item	Indicative sound levels at 10m	Photograph
Refrigerated containers (reefers) These contain a generator as well as a cooling element / fan. When in a dedicated storage area these are normally connected to fixed power thus avoiding the need for the generator to run.	50 dB $L_{Aeq(15min)}$	
Log loader Logs are distributed using essentially a wheeled-loader with a large pair of claws on the front Loading from wagon	75 dB $L_{Aeq(15min)}$ 87 dB L_{AE}	

Item	Indicative sound levels at 10m	Photograph
Workshop Grinding, welding, impact drivers	85 dB $L_{Aeq(15min)}$ reverberant level within space	
Smaller workshop used for servicing locomotives on a daily basis. Cleaning, refuelling, lubricating etc.	65 dB $L_{Aeq(15min)}$ reverberant level within space	
Road truck for taking containers to and from container terminal	80 dB $L_{Aeq(15min)}$	

Item	Indicative sound levels at 10m	Photograph
Ventilation - roof mounted Exhaust fans	64 dB L_{Aeq}	

The sources listed in Table 10 have been used to create a scenario that is likely to be representative of a busy hour during daytime operations of the fully developed Freight Hub. The Freight Hub will also include a wide range of other sound sources not included in the model and it would not be practical to explicitly model every potential sound source. The sources that have been modelled should represent the louder activities and they have been modelled at relatively frequent rates. This conservatism in the model in effect allows for minor contributions from other activities that are not explicitly modelled.

The scenario modelled is set out in Table 11 and the modelled source locations are shown in Figure 8.

Table 11 – Modelled operating scenario

Ref	Activity	Source	Quantity	Plant on-time	Movements	Speed
R1	Mainline and A/D	2xloco, 1500m wagons	1	-	3/h	10 km/h
R2	Container yard	2xloco, 500m wagons	1	-	3/h	10 km/h
R3	Log yard / Workshop	2xloco, 500m wagons	1	-	3/h	10 km/h
R4	Marshalling	Locomotive	1	-	20/h	10 km/h
		Cut-off	-	-	10/h	-
		Break squeal	-	-	10/h	-
C1	Large CT site	Top loader	4	50%	-	-
C2	Small CT site	Forklift	2	50%	-	-
C3	Reefers	Reefer	100	100%	-	-
C4	Trucks (internal roads)	Road truck	-	-	50/h	15 km/h
L1	Log loaders	Log loader	2	50%	-	-
W1	Workshop activities - heavy engineering	Aggregated as emission from openings	2	100%	-	-
W2	Workshop activities - locomotive servicing	Aggregated as emission from openings	2	100%	-	-
W3	Ventilation	Fans	11	100%	-	-

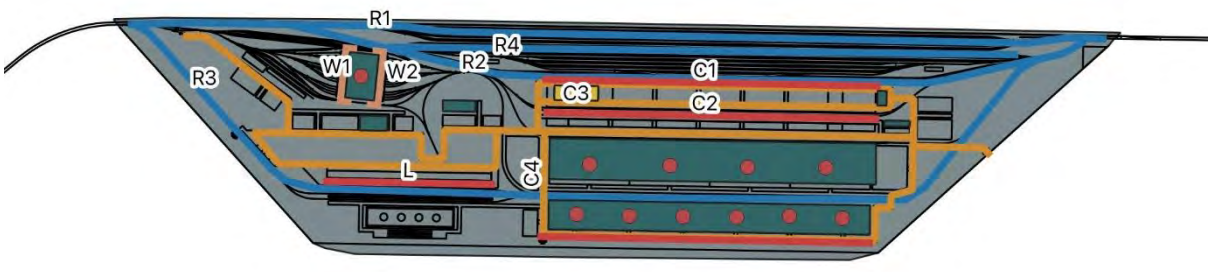


Figure 8 – Modelled source locations

For the scenario detailed above of busy daytime operations for the fully developed Freight Hub, the predicted noise levels are shown in Figure 9. These predicted levels do not include any noise mitigation such as noise barriers discussed later in this assessment. In Figure 9 the blue spots represent buildings. The building dataset has been partly filtered based on building size and zoning, but it still includes both residential buildings and some ancillary and commercial buildings.

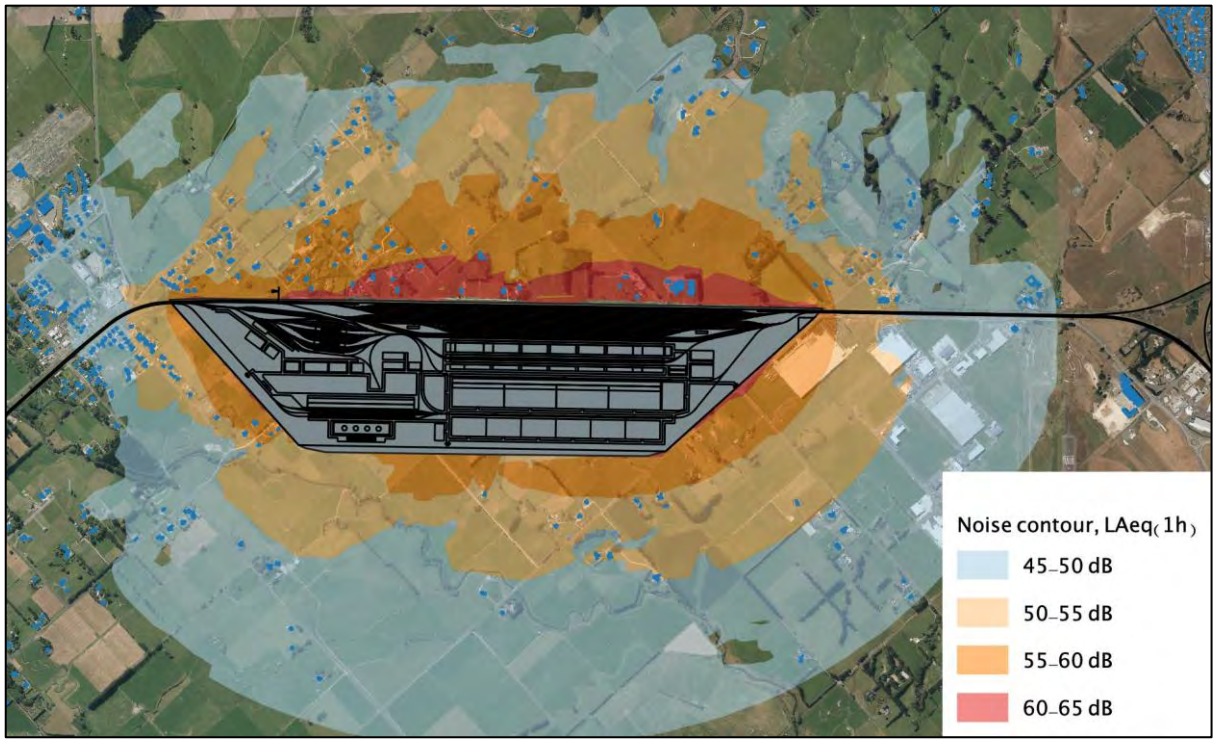


Figure 9 – Indicative noise contours without mitigation

Based on measurements at the other sites (Table 10), maximum noise levels from discrete one-off short duration events have been assumed to be 92 dB L_{AFmax} at a distance of 10 metres from the source. Based on the reduction in sound levels with distance, the maximum levels would meet the Category A 75 dB L_{AFmax} night-time criterion at around 70 metres from the source, without mitigation. If there was screening removing line-of-sight to the source (reducing sound by approximately -5 dB), this distance would reduce to approximately 40 metres.

Operation noise (road-traffic)

In terms of road-traffic noise on the new perimeter road the nearest affected house has been identified as 245 Te Ngaio Road. A prediction has been made of sound levels at this house from road-traffic on the new perimeter road for a future (2031) scenario with no specific noise mitigation. Sound levels at all other houses, which are further away should be less than at this location. A low noise road surface (stone mastic asphalt – SMA) has been included in the calculation given the moderate traffic volumes forecast on the new perimeter road and the current use of asphaltic mix surfaces for roads such as Roberts Line in the NEIZ. The details of the calculation are set out in Table 12. The calculated level of 54 dB $L_{Aeq(24h)}$ complies with the most stringent Category A criterion for new roads from NZS 6806.

Table 12 – Road-traffic noise calculation (245 Te Ngaio Road)

Parameter	Value
Traffic volume	7,000 vpd AADT (2031)
Heavy vehicles	18%
Speed	80 km/h
Gradient	1% *(actually 0.5% in the indicative design)*
Road surface	SMA
House position	45 m from edge of traffic lane 3.5 m receiver point above traffic lane
Propagation height	0.5 m *There is potentially terrain screening from the cut but this has not been modelled as the final form of the earthworks may vary.*
Ground	>90% absorbent
Angle of view	160°
Reflecting surfaces	0°
Predicted level from Waka Kotahi web calculator[10]	54 dB $L_{Aeq(24h)}$

Other than the new perimeter road, the following roads in Table 13 have been identified as potentially having an increase in traffic as a result of the Freight Hub that is significant in terms of noise. This includes traffic generated by the Freight Hub itself and also traffic redistributed on the network due to the new perimeter road. In terms of potential noise impacts, a significant increase has been taken as overall daily traffic volumes increasing by more than 50% and/or daily heavy vehicle volumes increasing by more than 100%, based on forecasts of 2031 traffic with and without the initial development of the Hub. Table 13 also shows the One Network Road Classification (ONRC) for each of these roads.[11]

Table 13 – Roads with significant traffic growth due to the Freight Hub

Road (ONRC)	Section	Forecast traffic
Stoney Creek Road (primary collector)	Ashhurst Road to Kelvin Grove Road	Approximate doubling of forecast traffic resulting in around 2200 vpd AADT (10% HV)
Roberts Line (secondary collector)	New perimeter road to Kairanga Bunnythorpe Road	Small change in overall forecast traffic but large increase in forecast heavy vehicles from less than 100 per day to more than 350 per day
Kairanga Bunnythorpe Road (primary collector)	Roberts Line to Milson Line	Increase in overall traffic and heavy vehicles resulting in around 2200 vpd AADT (23% HV)

[10] https://nzta.govt.nz/roads-and-rail/highways-information-portal/tools/road-traffic-noise-calculator/?id=34ca52c1ea

[11] https://www.nzta.govt.nz/roads-and-rail/road-efficiency-group/one-network-framework/

Due to the new perimeter road, the project results in complete removal of traffic on the existing Railway Road between Roberts Line and just before Maple Street. There would also be a substantial reduction in traffic on Roberts Line between Railway Road and Kelvin Grove Road.

Operational vibration

Previous measurements and assessments[12] have shown that the vibration criterion of 0.3 mm/s $v_{w,95}$ can typically be met within approximately 60 metres of a new track formation, for trains on the NIMT. Vibration can vary substantially depending on localised ground conditions so this reference distance is only an approximate guide.

There are no houses within more than 100 metres of indicative tracks in the Freight Hub to the south, west and north of the site. As such the 0.3 mm/s $v_{w,95}$ criterion should be achieved with no mitigation necessary. To the east of the Freight Hub, the nearest houses are in the order of 60 metres from the indicative track locations (excluding the NIMT with its tracks in new locations). As such, while compliance with the 0.3 mm/s $v_{w,95}$ criterion is likely, slight variations to the Freight Hub layout or track formations and propagation might cause an exceedance.

Construction noise and vibration

Buffer distances of 50 and 200 metres have been used to identify areas affected by different extents of construction noise and vibration. These approximate distances are based on experience with comparable works on numerous other projects.

Houses within a buffer distance between 50 and 200 metres from the proposed Designation Extent have been identified in the blue shaded area in Figure 10. People at these houses may be affected by construction noise and vibration to some extent, but compliance with noise and vibration criteria will generally be achieved using standard practices. Such practices may include selection of lower noise equipment and processes where available, and localised temporary screening around any items of noisier equipment.

Houses within a 50 metre distance of the proposed Designation Extent have also been identified in Figure 10 in the orange shaded area. At these locations enhanced mitigation might be required to maintain compliance with construction noise and vibration criteria.

[12] URS, Peka Peka to North Ōtaki Expressway Project, Operational noise and vibration assessment, https://www.nzta.govt.nz/assets/projects/peka-peka-to-otaki-application/docs/technical-report-14.pdf

Figure 10 – Construction noise and vibration buffer areas

6. Assessment of effects

For the purposes of this assessment, effects have been assessed in terms of:

- Positive effects;
- Temporary effects arising from construction; and
- Effects arising from the operation of the Freight Hub.

Positive effects

The Freight Hub will ultimately result in the Existing Freight Yard stopping. The noise benefit of this has not been further assessed as it depends on the nature of unknown future activity that occupies the existing rail yard once it is vacated by KiwiRail. However, it is likely there will be a reduction in noise effects at surrounding houses, particularly to the north. Even if there is future industrial and commercial activity on this site it would be subject to the standard District Plan noise limits.

There will be a reduction in noise and vibration effects from trains on the NIMT between Roberts Line and Bunnythorpe due to:

- Realignment of the NIMT west, slightly further from houses to the east.
- A flat alignment of the NIMT over this section with a constant height, minimising varying locomotive power. Currently this section of the NIMT undulates significantly.
- New tracks for the NIMT on uniformly compacted ground minimising discontinuities and structures likely to give rise to vibration.
- Removal of all road crossings over the railway, avoiding the need for any bells or use of train horns.

Houses to the east of Railway Road between Roberts Line and just before Maple Street will benefit from the complete removal of road-traffic on Railway Road in their vicinity. Currently this section of Railway Road has a 100 km/h speed limit, a chip seal road surface, numerous intersections and undulating height, all of which contribute to noise levels and also noticeable sound characteristics from individual vehicles.

There will be a substantial reduction in road-traffic, particularly heavy vehicles, and corresponding noise effects at houses on Roberts Line between Kelvin Grove Road and Railway Road.

Adverse effects - temporary

Figure 10 shows a 200 metre and 50 metre buffer around the designation. There are four areas where construction works in the proposed designation could potentially be closer than 50 metres to houses:

1. Behind houses on Maple Street;
2. By houses on Te Ngaio Road;
3. Around the stormwater retention ponds/wetlands to the west; and
4. At various locations near the east site boundary.

These four areas are marked in red on Figure 11 below.

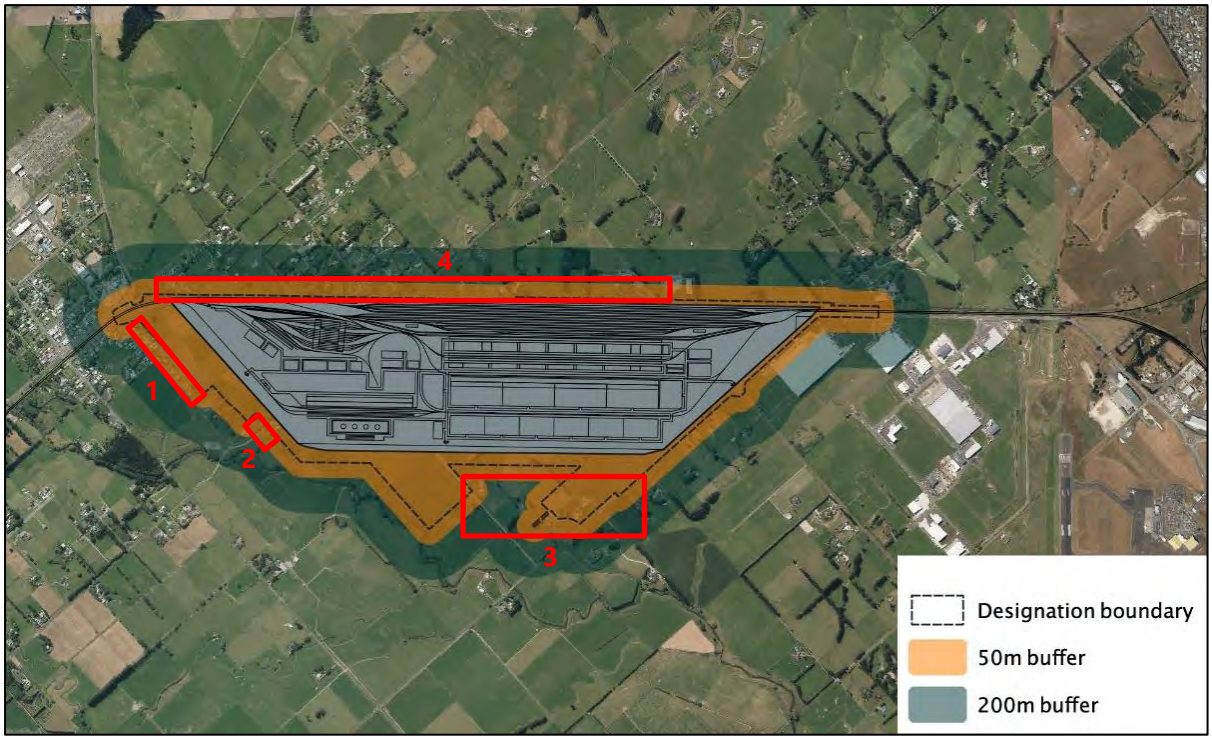


Figure 11 – Houses within 50 metres of the designation boundary

For the area behind houses on Maple Street, the only construction work within 50 metres would be the formation of a permanent noise barrier and associated planting. This work would be relatively short-term and only involving standard earthworks/construction equipment. There should be no constraints on the time of day for these works as they are not affected by traffic management and should not involve any processes such as continuous concrete pours. Therefore it should be practicable for these works to be undertaken during daytime only and as there are no unusual construction activities expected, compliance with the noise and vibration criteria should be achieved.

As outlined later in this assessment, a permanent noise wall is recommended on the designation boundary between the houses on Te Ngaio Road and the new perimeter road. That wall should ideally be constructed at the outset of construction works, but if that timing is not practicable, alternatively a temporary construction hoarding could be erected here to provide noise screening. With such screening, the construction works in the vicinity of the houses on Te Ngaio Road should be able to comply with the construction noise criteria. The construction of the new perimeter road would need to be managed to maintain compliance with construction vibration criteria in this location. This should be practicable such as through use non-vibratory rollers for compaction if necessary.

There are houses by the west stormwater retention ponds/wetlands. In these areas there are standard earthworks required for the ponds. As such, there are a range of options that are available to maintain compliance with the noise and vibration criteria in these areas, including use of lower powered / smaller equipment, attenuation on equipment or temporary site screening if necessary.

To the east of the Site there are various locations where houses are within 50 metres of the designation boundary. Along this boundary the main works relate to the formation of a bund and wall as a permanent noise barrier. There are also works required for installation of hydraulic structures such as pipes and culverts. All of these works can generally be conducted during the daytime, and while

there are significant bunds and walls, these should involve standard earthworks and construction processes. It should be practicable to maintain compliance with the noise and vibration criteria in these areas, including temporary screening if necessary.

On the basis that normal good practice is followed, including screening where necessary, works should generally comply with the construction noise and vibration criteria in all areas. The works will cause temporary daytime disturbance to residents, but most people should be able to continue normal domestic activities with only minor adjustments, particularly if there is effective advanced communication about when construction activities are due to occur. It is unlikely that significant night works would be needed near houses, other than potentially short-term activity that may be required to connect to the existing road and rail networks. Therefore, any potential sleep disturbance effects should be limited. On this basis I consider that adverse noise and vibration effects from construction within the designation should be minor.

Adverse effects – operational

Figure 9 shows indicative noise contours for daytime activity in the fully developed Freight Hub without noise mitigation. These contours show that without mitigation, the Freight Hub has a relatively large noise footprint with predicted levels exceeding the recommended Category A, B and potentially C criteria in Table 5. This daytime activity would be clearly audible and potentially disturbing at houses to the east, north and west of the Freight Hub. Noise from the Freight Hub might interfere with people trying to concentrate on a task or relax at their homes. If similar levels of activity occurred at the Freight Hub at night then it is likely that many residents in the area would suffer from sleep disturbance due to noise above the Category A night criteria. At locations more than a few hundred metres away from the existing Railway Road and the NIMT, components of the Freight Hub such as the marshalling yard, container terminal and potentially maintenance facilities and log yard would cause a significant change to the existing noise environment. As such, it is considered that the Freight Hub is likely to have unacceptable noise effects without mitigation as Category A and B criteria would be exceeded at many houses including houses away from existing noise sources. The extent of the noise effects would vary significantly at different houses depending on the exposure from the Freight Hub and existing environment. Appropriate mitigation will be addressed in the next section of this report.

As houses in all directions are 60 metres or more from new tracks in the Freight Hub (excluding the NIMT), operational vibration from trains should be able to comply with the 0.3 mm/s $v_{w,95}$ criterion. While vibration may be felt by people, the adverse effects should be minor. For houses to the east of the Site, which are also those closest to the tracks, the operational vibration should be significantly less than existing vibration from the existing NIMT because the tracks are shifting to the west, into the Site.

Predicted road-traffic noise levels at the nearest house to the new perimeter road are within the most stringent NZS 6806 Category A. While the new road-traffic will be clearly audible at the nearest houses and represents a significant change from the existing environment, compliance with the recommended criteria indicates the resulting levels will be reasonable in terms of being compatible with ongoing residential activity. People should still be able to continue normal domestic activities without undue disturbance.

In general it has been found that most traffic associated with the Freight Hub distributes on roads that are forecast to be busy in future regardless of the Freight Hub such as Campbell Road to the north, Railway Road to the south, Ashhurst Road to the east, and Richardsons Line to the west. On these roads, the traffic generated by and redistributed by the Freight Hub should not cause a significant increase in noise. Likewise, the Freight Hub does not have a material effect on the wider road network in terms of noise. Three sections of road have been identified where a material increase in traffic as a result of the Freight Hub and corresponding noise may occur as set out in Table 13.

The affected sections of Kairanga Bunnythorpe Road and Stoney Creek Road are both designated as primary collectors in the ONRC. While there is an increase in traffic and noise forecast on these roads, this is within normal expectations of changes that typically occur on the roading network. Given the existing primary collector function of these two roads the increase in noise associated with an increase in traffic should be acceptable.

The affected section of Roberts Line (from the new perimeter road to Kairanga Bunnythorpe Road) is a secondary collector in the ONRC. However, Section 12A of the District Plan identifies this section of Roberts Line as part of a strategic route for freight movements. The number of heavy vehicles forecast to use this road is more than 350 per day by 2031. This heavy vehicle traffic is greater than might be anticipated on this classification of road, but the overall traffic volume is modest at around 1100 vpd AADT. There are only a few houses near this section of Roberts Line and the nearest is approximately 25 metres from the traffic lane. On this basis, while there will be an increase in noise caused by the increase in heavy vehicles, the noise effects at the nearby houses should be minor and anticipated based on the District Plan.

7. Measures to avoid, remedy or mitigate adverse effects

Operational noise (on-site)

As discussed above, the Freight Hub would have unacceptable noise effects without mitigation as the Category A and B criteria would be exceeded over a wide area, including houses away from existing noise sources such as the NIMT and Railway Road. To address this issue, various options for noise barriers have been tested in the computer noise model. For this Site the performance of noise barriers is critically dependent on the detailed topography as many of the nearby houses are at a higher elevation than the site. This varies along the Site boundaries.

It has been found that to reduce operational noise to the extent reasonably practicable, substantial barriers are required on the east and north boundaries of the Freight Hub. The barriers were not considered in the above assessment of operational noise effects as they are solely noise mitigation elements that have been added to address effects of the activity. The locations and heights of the noise barriers in the indicative design have been determined through investigation in the computer noise model of where barriers would be effective, and with consideration of the practicability of barriers through discussions with the Project team. This process has been designed primarily to ensure sufficient space is available for effective barriers to reduce Freight Hub operational noise levels to within the Category A criteria as far as practicable. There will need to be further optimisation of barrier locations and heights during the detailed design. The following barriers are included in the indicative design:

- East boundary – a continuous barrier over 3 km long formed by a combination of an earth bund/embankment and a concrete wall. The heights of the bund and wall would vary along the east boundary depending on the fluctuations of the existing terrain, but they are designed to always maintain the top of the wall at 5 metres above the level of the Freight Hub.
- North boundary – a 3 metre high barrier, mainly formed by an earth bund other than where space is not available when it would be a concrete wall. Due to the terrain, the top of the barrier relative to the Hub would range from 5 to 8 metres above the Freight Hub. This barrier would also provide screening of the new perimeter road.

Houses on the west of the Freight Hub are slightly further away and partly screened by the warehouse buildings. However, there is still an internal site access road on the west of the Freight Hub and entrances to warehouses facing west. Therefore a 3 metre high barrier has been modelled, formed either as a timber or concrete wall. If the area to the west of the Freight Hub was to become part of the NEIZ in future, with no houses within 500 metres of the Hub, then this noise barrier would not be required.

With the barriers described above, Figure 12 shows the predicted noise contours.

The noise contours in Figure 12 have reduced significantly compared to Figure 9 (without barriers). With the noise barriers, for daytime operations, the predicted levels from the Hub are less than the 55 dB $L_{Aeq(1h)}$ Category A criterion at most locations. For unconstrained continuous operations, the 45 dB $L_{Aeq(1h)}$ Category A night criterion would be exceeded over a wide area. However, as many

elements of the Freight Hub would be primarily daytime activities, such as the workshops, the contours would decrease at night.

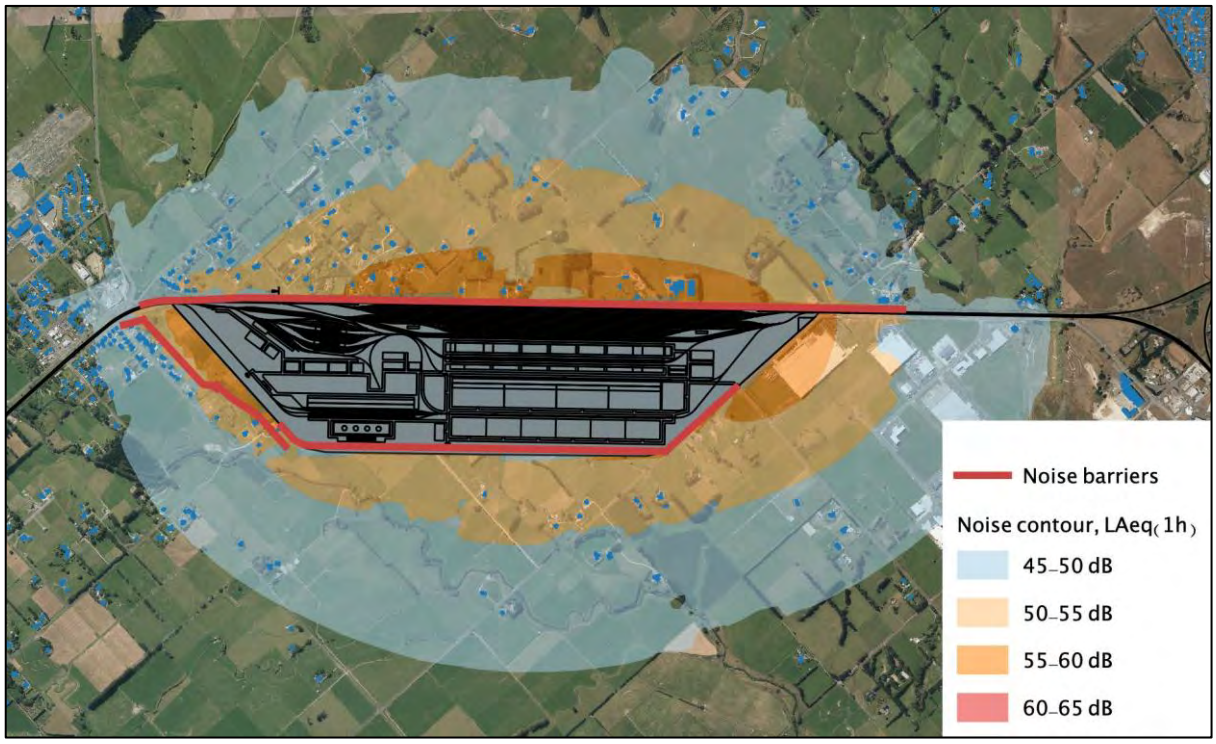


Figure 12 – Indicative noise contours with noise barriers

As the Category A criteria are not fully achieved, even with substantial noise barriers (over 5km total length at 3 to 5 metres high) additional measures are needed to control potential noise effects. The following management process would mitigate noise effects:

- Future noise modelling of activity at the Freight Hub, prior to each stage of development (at the Outline Plan stage) and prior to any significant changes in activity such as the introduction of a new noisy activity or substantial expansion of an existing activity. This should also include confirmation of predicted compliance with the railway vibration criterion.
- In association with the future noise modelling, refinement/optimisation of noise barrier heights, potentially with some localised increases to the height of the east barrier where houses are elevated.
- Operation of the Site by KiwiRail, and all third parties, in accordance with a Noise Management Plan (NMP). This would set out matters such as the noise and vibration criteria, noise modelling and barrier design, good practice site noise management measures, and community liaison and complaints processes.
- Investigation of all houses where an exceedance of the Category A criteria is predicted and treatment as necessary to achieve acceptable internal noise levels of 35 dB $L_{Aeq(1h)}$ in bedrooms and 40 dB $L_{Aeq(1h)}$ in other habitable spaces. This should only apply to houses existing at the date the NoR is lodged.
- Permanent noise monitoring at two reference locations, with one to the east and one to the north of the Freight Hub. The monitoring would inform the management of the Site under the

NMP and would provide a proactive means of identifying any unanticipated noisy activities on the Site. The monitoring would also provide a record to allow review and investigation into any issues arising.

In terms of general good practice measures addressed in the NMP, this would include matters such as:

- Avoidance of tonal alarms, where practicable.
- Refrigerated containers being connected to mains power,
- Doors on the workshop kept closed, and the workshop building being acoustically insulated,
- Use of swing nose crossings if practicable,
- Locomotives not left idling unnecessarily,
- Minimise use of train (and truck) horns,
- Horn types on shunt locomotives to be selected to minimise noise outside the site,
- Maintenance of brakes on shunt locomotives to prevent squealing
- Couplings maintained to be kept tight; no loose (uncoupled) shunting,
- All wagon handbrakes to be released before a train moves,
- All container handling and vehicle circulation areas to be level and free from drainage and avoidable discontinuities in high traffic wheel paths, and
- Equipment operators to be trained to reduce impact noises from container handling.

For community liaison, the NMP should rely on a community liaison forum whereby the following can be achieved:

- KiwiRail and other Freight Hub operators can discuss upcoming changes and activity with residents;
- Residents can raise any noise issues of concern; and
- KiwiRail, operators and residents can jointly review noise monitoring records and any issues and complaints arising.

Noise effects on future residential development in the area should be managed by the District Plan, which is outside the scope of this assessment but could potentially be by extension of the existing rules for houses within 100 metres of a railway or by introduction of control boundaries around the Freight Hub in the same manner as the existing airport control boundaries.

Operational vibration

Operational vibration should comply with the 0.3 mm/s $v_{w,95}$ criterion, without specific mitigation. As such, there should be acceptable levels of vibration that do not cause undue disturbance to neighbours and therefore mitigation is not necessary or warranted. However, this should be confirmed during the detailed design of the Freight Hub and, if necessary, mitigation such as resilient track forms should be used to maintain compliance with the criterion.

Construction noise and vibration

As described previously, if construction activities are managed in accordance with normal good practice, including screening if required, then noise and vibration effects should be minor. A standard approach adopted for most major infrastructure is to use a Construction Noise and Vibration Management Plan (CNVMP) to provide a structure through which issues can be identified and actioned. Such a control is appropriate for the Freight Hub to give effect to the assumption of normal good practice being applied.

8. Conclusions

The operational and construction noise and vibration from the Freight Hub have been assessed. A range of potential noise and vibration effects have been identified including, without mitigation, operational noise effects arising from predicted levels above recommended criteria, likely to result in disturbance to people in houses over a relatively wide area. The extent of operational noise disturbance would vary across the area depending on the relationship of each house to the Freight Hub and existing noise sources.

Substantial noise barriers are recommended around the Freight Hub, with the detailed design to be confirmed at the Outline Plan of Works stages. It is recommended this process is subject to a NMP that also addresses good practice management of the site and residual noise effects through treatment of buildings where the recommended Category A noise criteria are not achieved.

New tracks in the Freight Hub are separated from houses such that the recommended vibration criterion will be able to be achieved.

Road-traffic on the new perimeter road is predicted to be at a reasonable level at nearby houses with no further assessment or mitigation required from a noise perspective. Traffic generated by and redistributed by the Freight Hub on other roads in the area, generally occurs on roads that are already busy such that the additional traffic should only have a minor noise effect. For a few roads with larger percentage increases in traffic, the resulting traffic volumes and corresponding noise should remain reasonable for the types of roads.

Construction will use standard processes, and noise and vibration effects should be minor if normal good practice controls are applied.

The Freight Hub will significantly alter the existing noise environment in some areas, and construction and operational activity will be clearly audible over a wide area. However, with the mitigation and controls recommended the residual noise and vibration should be at reasonable levels and effects should be acceptable in this environment.

Appendix A – Sound level survey site details

Noise loggers were deployed at four sites:

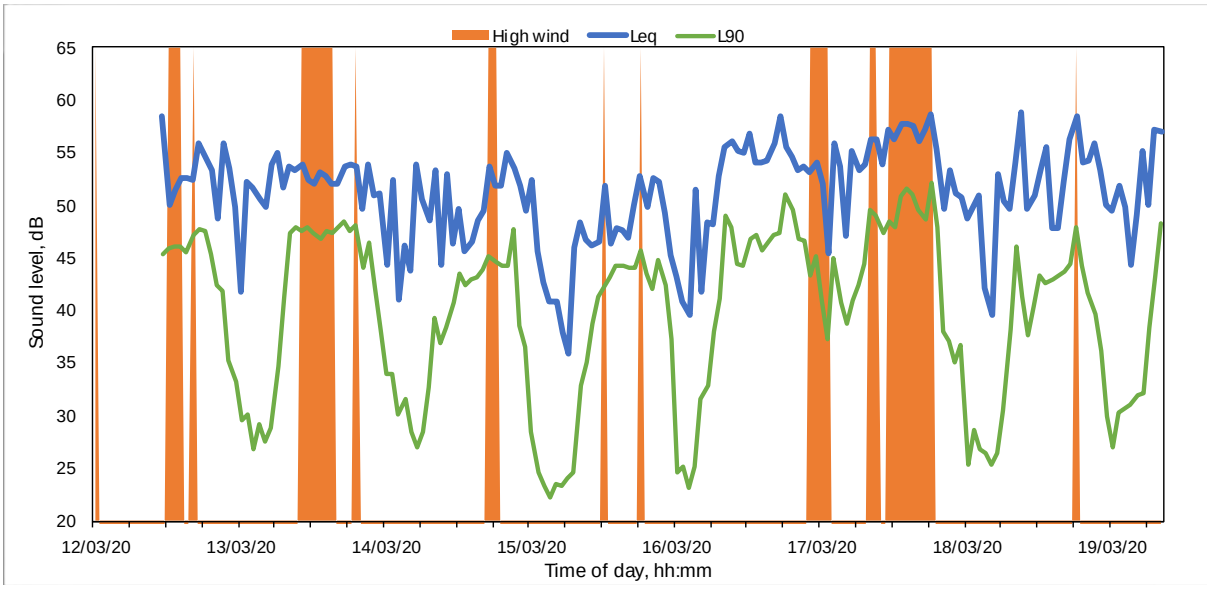
- 73 Sangsters Road
- 19 Parrs Road
- 787 Roberts Line
- 11 Maple Street

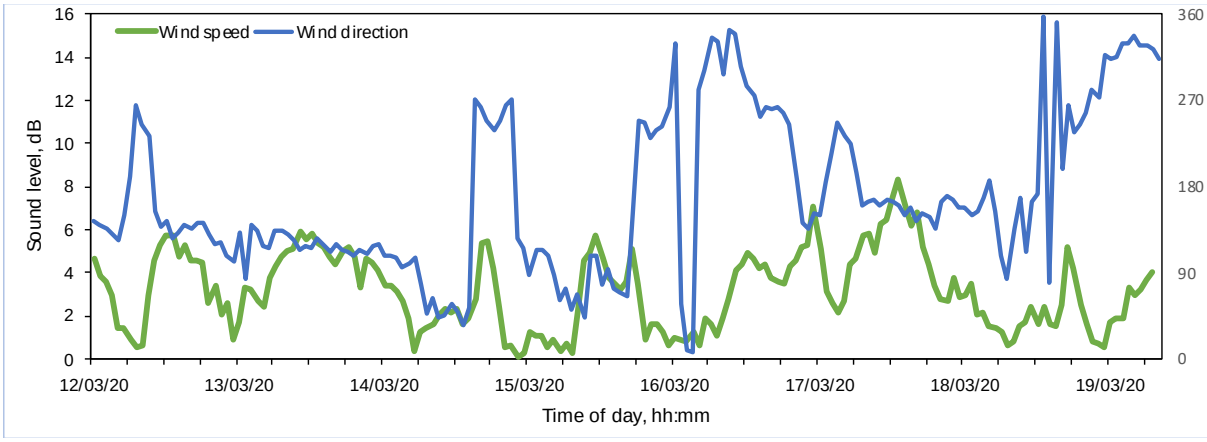
For each of these four sites the tables and figures in the following pages in this appendix set out:

- the location, operator, and equipment
- table of daily sound levels
- sound level time history plot
- wind speed and direction time history plot
- aerial photograph
- photographs showing the logger location in four directions

Parameter	Setting/source
Operator	Michael Smith
Address	73 Sangsters Road, NZTM 18223773m N, 5536075m E
Equipment	ARL Ngara Type 1 SLM Serial 8781F3 calibrated 12/3/19

	Daytime (0700-2200h)		Night time (2200-0700h)	
Date	$L_{Aeq(15h)}$	$L_{A90(1h)}$	$L_{Aeq(9h)}$	$L_{A90(1h)}$
13/03/20	53	45	52	32
14/03/20	51	40	50	32
15/03/20	49	39	46	28
16/03/20	55	46	47	29
17/03/20	54	44	53	40
18/03/20	54	41	50	28





Aerial photograph showing monitoring location

North view

East view

South view

West view

Parameter	Setting/source
Operator	Michael Smith
Address	19 Parrs Road, NZTM 1824139m N, 5536610m E
Equipment	ARL Ngara Type 1 SLM Serial 87813F calibrated 20/4/18

	Daytime (0700-2200h)		Night time (2200-0700h)	
Date	$L_{Aeq(15h)}$	$L_{A90(1h)}$	$L_{Aeq(9h)}$	$L_{A90(1h)}$
13/03/20	47	39	40	28
14/03/20	52	36	40	28
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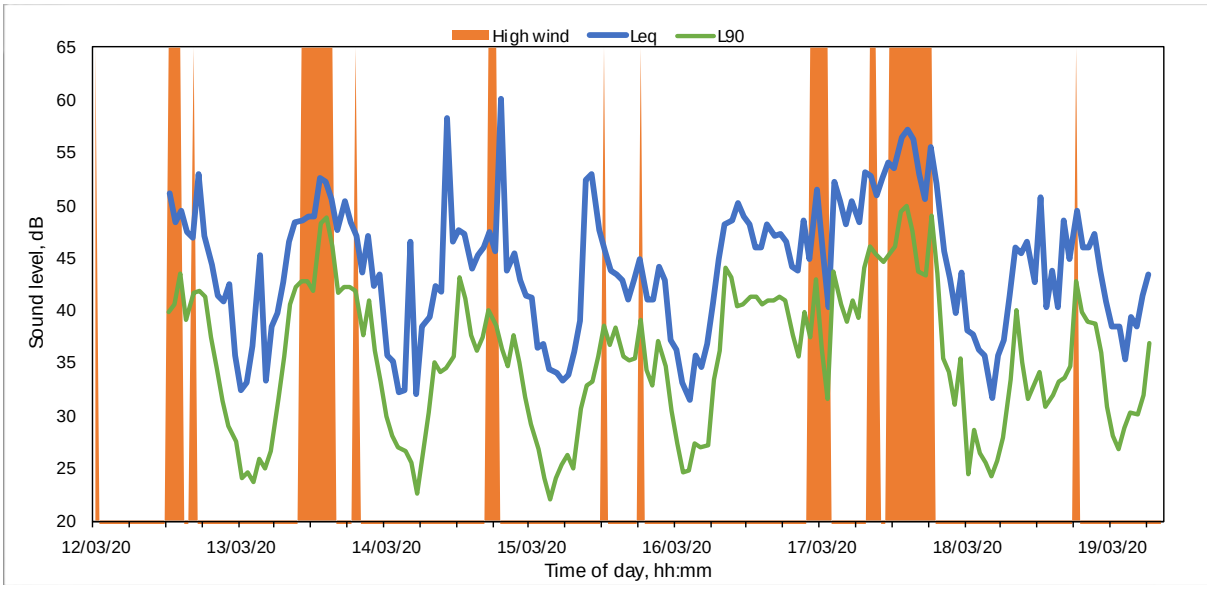
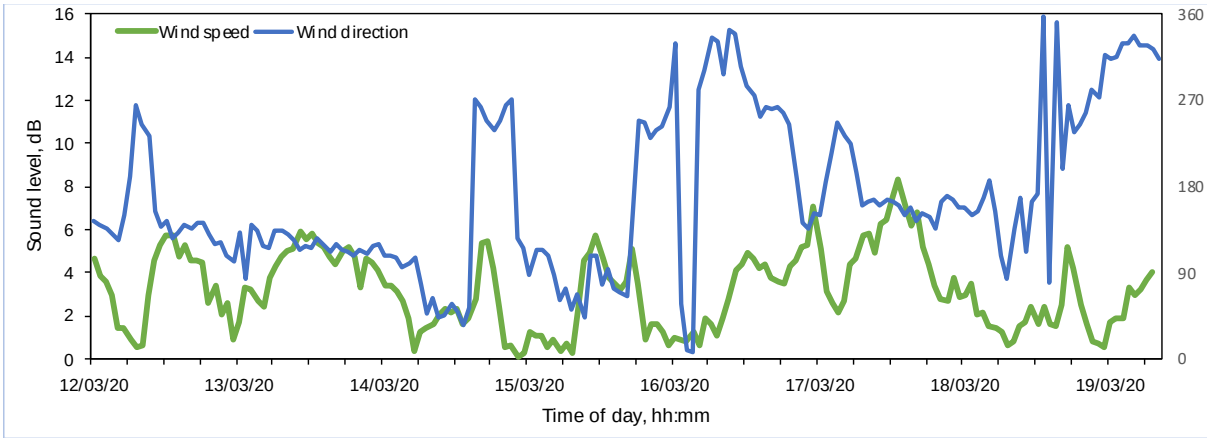
17/03/20	51	41	49	39
18/03/20	46	34	39	28





Aerial photograph showing monitoring location

North view

East view

South view

West view

Parameter	Setting/source
Operator	Michael Smith
Address	787 Roberts Line. NZTM 1822902m N, 5535180m E
Equipment	ARL Ngara Type 1 SLM Serial 8781F9 calibrated 3/3/20

	Daytime (0700-2200h)		Night time (2200-0700h)	
Date	$L_{Aeq(15h)}$	$L_{A90(1h)}$	$L_{Aeq(9h)}$	$L_{A90(1h)}$
13/03/20	51	42	46	33
14/03/20	47	37	44	33
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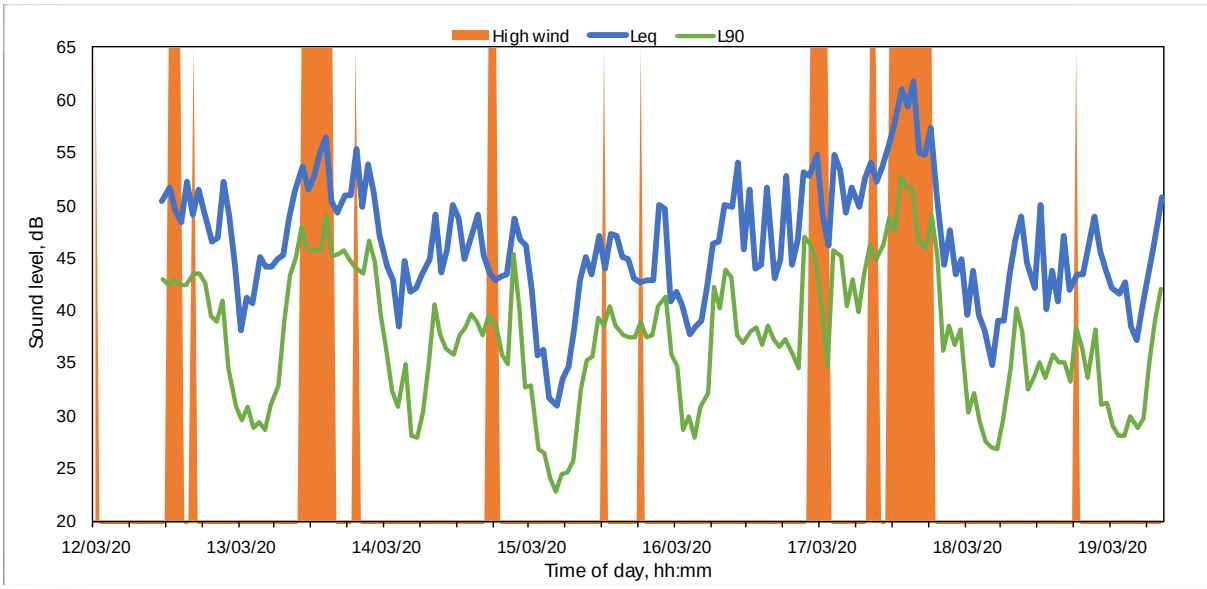
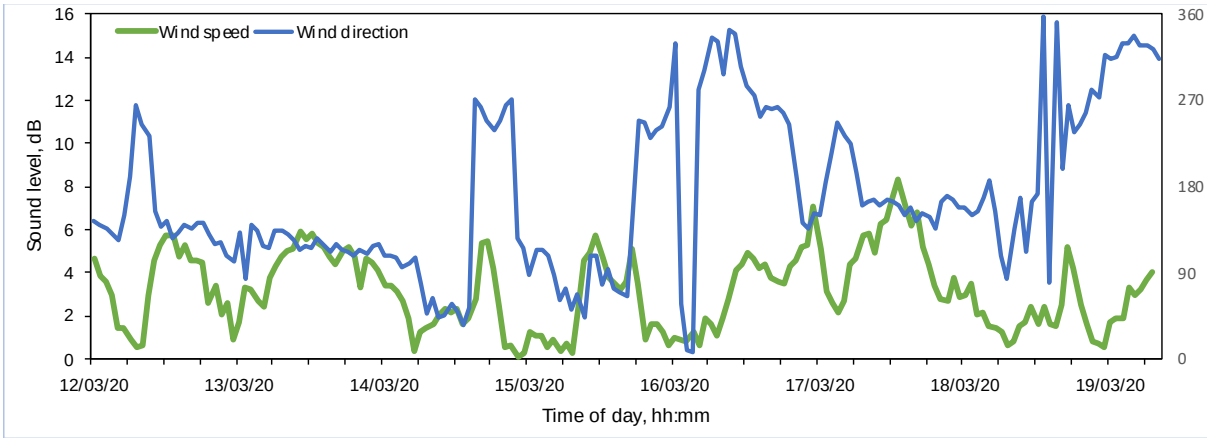
18/03/20	46	35	42	29





Aerial photograph showing monitoring location

North view

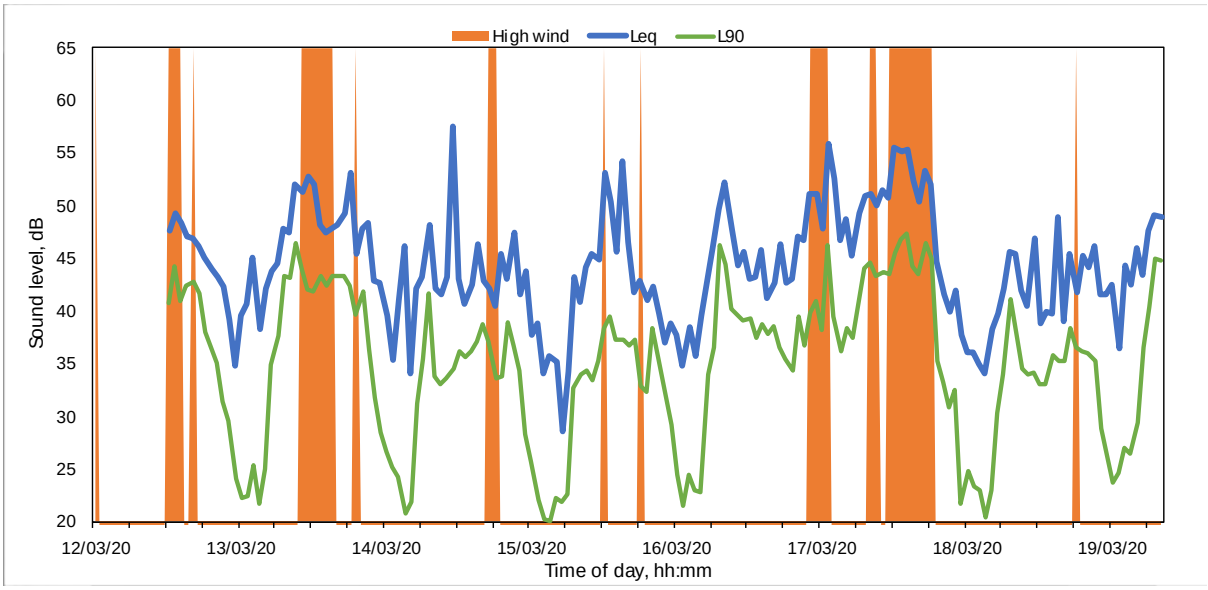
East view

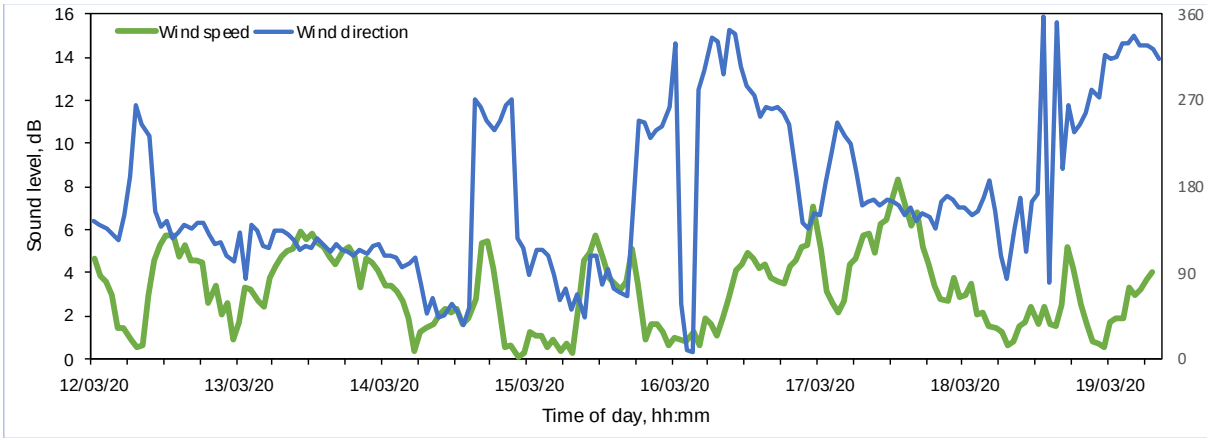
South view

West view

Parameter	Setting/source
Operator	Michael Smith
Address	11 Maple Street, NZTM 1823529m N, 5537237m E
Equipment	NTi XL2-TA Type 1 SLM Serial A2A-17220-E0 calibrated 24/1/20

	Daytime (0700-2200h)		Night time (2200-0700h)	
Date	$L_{Aeq(15h)}$	$L_{A90(1h)}$	$L_{Aeq(9h)}$	$L_{A90(1h)}$
13/03/20	50	43	43	28
14/03/20	48	36	42	28
15/03/20	47	35	36	24
16/03/20	47	39	41	27
17/03/20	48	39	48	35
18/03/20	45	36	39	26





Aerial photograph showing monitoring location

North view

East view

South view

West view