Styles Group
Acoustics & Vibration Consultants

FTAA SUBSTANTIVE ASSESSMENT – ACOUSTICS

PROPOSED URBAN DEVELOPMENT MILLDALE STAGES 14-17

PREPARED FOR

Fulton Hogan Land Development

DATE

5 August 2026

Assessment prepared by Styles Group for Fulton Hogan Land Development.

Rev:	Date:	Comment:	Version:	Prepared by:	Reviewed by:
1	6/07/26	Initial draft for project team review	Draft	Jamie Exeter, MASNZ Principal Styles Group	Jon Styles, MASNZ Director and Principal Styles Group
2	5/08/26	Updates for WWTP changes and project team review	Final		

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Appendices

1.0 Introduction

Fulton Hogan Land Development Limited (the **Applicant**) has engaged Styles Group to assess the noise and vibration effects associated with the Milldale Stages 14-17 Project (the **Project**) and to prepare this report in support of the substantive application under the Fast-track Approvals Act 2024 (**FTAA**).

The Project relates to approximately 231 ha of land centred around Wainui Road in Wainui, Auckland (the **Project Area**). The proposal provides for a comprehensively planned urban development including residential neighbourhoods, a supporting commercial node, transport and servicing infrastructure, water and wastewater treatment plants, open space, wetland restoration, an ecological restoration area, and associated enabling works.

The substantive application is supported by a comprehensive set of technical assessments and plans addressing the environmental, servicing, and infrastructure matters associated with the proposal. This report should be read alongside the Planning Report and other technical reports and drawings appended to the substantive application.

A glossary of acoustics terms is provided in Appendix A.

2.0 Purpose and scope of report

This report addresses matters relating to construction noise and vibration and operational noise associated with the Project.

The purpose of this report is to:

a) Calculate the potential noise and vibration emissions during the proposed construction works based on typical and worst-case scenarios.

b) Calculate the potential operational noise emissions from the proposed water and wastewater treatment plants.

c) Assess the potential noise and vibration emissions in terms of the permitted standards of the Auckland Unitary Plan (the **AUP**) and identify any exceedances.

d) Recommend noise and vibration mitigation measures.

e) Describe the potential noise effects of the Project in the context of the existing environment and the provisions of the AUP.

We have prepared noise level predictions using manual calculations and computer noise modelling software (DGMR iNoise). All calculations have been undertaken in accordance with ISO 9613-1/2 *Attenuation of sound during propagation outdoors* and with the following Standards and guidelines where applicable:

- NZS 6801:2008 *Acoustics – Measurement of environmental sound*.
- NZS 6802:2008 *Acoustics – Environmental noise*.

- NZS 6803:1999 Acoustics – Construction noise.
- Association of Australasian Acoustical Consultants (**AAAC**) *Guideline for Interpreting and Applying NZS 6803-1999.*

A glossary of acoustical terms used in this document is attached as Appendix A.

3.0 Statement of qualifications and experience

The author of this report, Jamie Exeter, is a Principal at Styles Group Acoustics & Vibration Consultants and has over 21 years' experience in acoustics. Jamie has specialised for more than 18 years in the measurement, prediction, and assessment of environmental noise and vibration under District Plans and the Resource Management Act. He has worked on several FTAA applications for both applicants and Councils. Styles Group has collectively worked on a significant number of FTAA applications.

Jamie holds a Diploma in Audio Engineering (2004) and is a professional Member of the Acoustical Society of New Zealand. He served as an elected council member from 2012 until 2018.

Jamie has contributed to a wide range of construction projects including large scale residential and commercial developments and many of New Zealand's largest infrastructure projects. He regularly undertakes peer review work for local authorities throughout New Zealand and provides expert evidence at hearings and during district plan processes. Jamie is one of three authors of the AAAC *Guideline for Interpreting and Applying NZS 6803-1999*, the New Zealand Standard for measuring and assessing construction noise.

The reviewer, Jon Styles has been the Director and Principal of Styles Group Acoustics and Vibration Consultants for over 22 years. He has twice served as the President of the Acoustical Society of New Zealand and has been an elected Council Member for more than 19 years. He is also on the Board of Directors of the AAAC.

Jon has over 26 years' experience providing advice on managing noise and vibration effects and is an experienced expert witness for Council, Environment Court, District Court, High Court, and Board of Inquiry hearings.

The author and reviewer confirm that, in preparing this report, they have read and complied with the Environment Court of New Zealand's Code of Conduct for Expert Witnesses (Practice Note 2023). This report addresses matters within their expertise. They confirm they have not omitted any material facts that could alter or detract from the opinions expressed. Information that has been supplied by the client or obtained from external sources is identified in this report and has been assumed to be accurate.

4.0 Proposed activities

The proposed construction and operational activities are outlined in the following sections. Our modelling of these activities is discussed further in this report.

4.1 Construction stage

- Site clearance – vegetation removal, wood chipping, and demolition of onsite structures.
- Bulk earthworks – excavation, compaction, and truck movements.
- Civil structures – retaining walls, culverts, and bridges involving drilling and hydraulic piling, and works north of the Orewa River to upgrade existing tracks, and culverts.
- Civil construction – roads, jointly owned access lots (**JOALs**), utilities, and drainage including construction of a water reservoir, a water treatment plant (**WTP**), and a wastewater treatment plant (**WWTP**).
- Construction of dwellings and commercial buildings.

All construction work will be undertaken on Monday to Saturday, excluding public holidays. There will be no works on Sundays.

The construction hours will generally be between 7:30 am and 6:00 pm. The activities outside of hours will be deliveries of materials and oversized plant to the Site (to avoid peak traffic hours and early morning concrete pours. These will all take place between 6:30 am and 7:30 am. There will be no activity on the Site before 6:30 am or after 6:00 pm.

All site clearance, earthworks, and civil works associated with the Project will be undertaken in accordance with a Construction Noise and Vibration Management Plan (**CNVMP**). The CNVMP will be prepared and submitted to Auckland Council for certification before construction works begin. Further details are provided in Section 7.3.

4.2 Operational stage

- Occupation of residential dwellings.
- Commercial activities such as retail and food and beverage outlets within the commercial node.
- Operation of the WTP and WWTP. The operation of the reservoir will not generate noise.

5.0 The Project Area

Figure 1 shows the Project Area and the AUP zoning and identifies the approximate locations of the WWTP and commercial node.

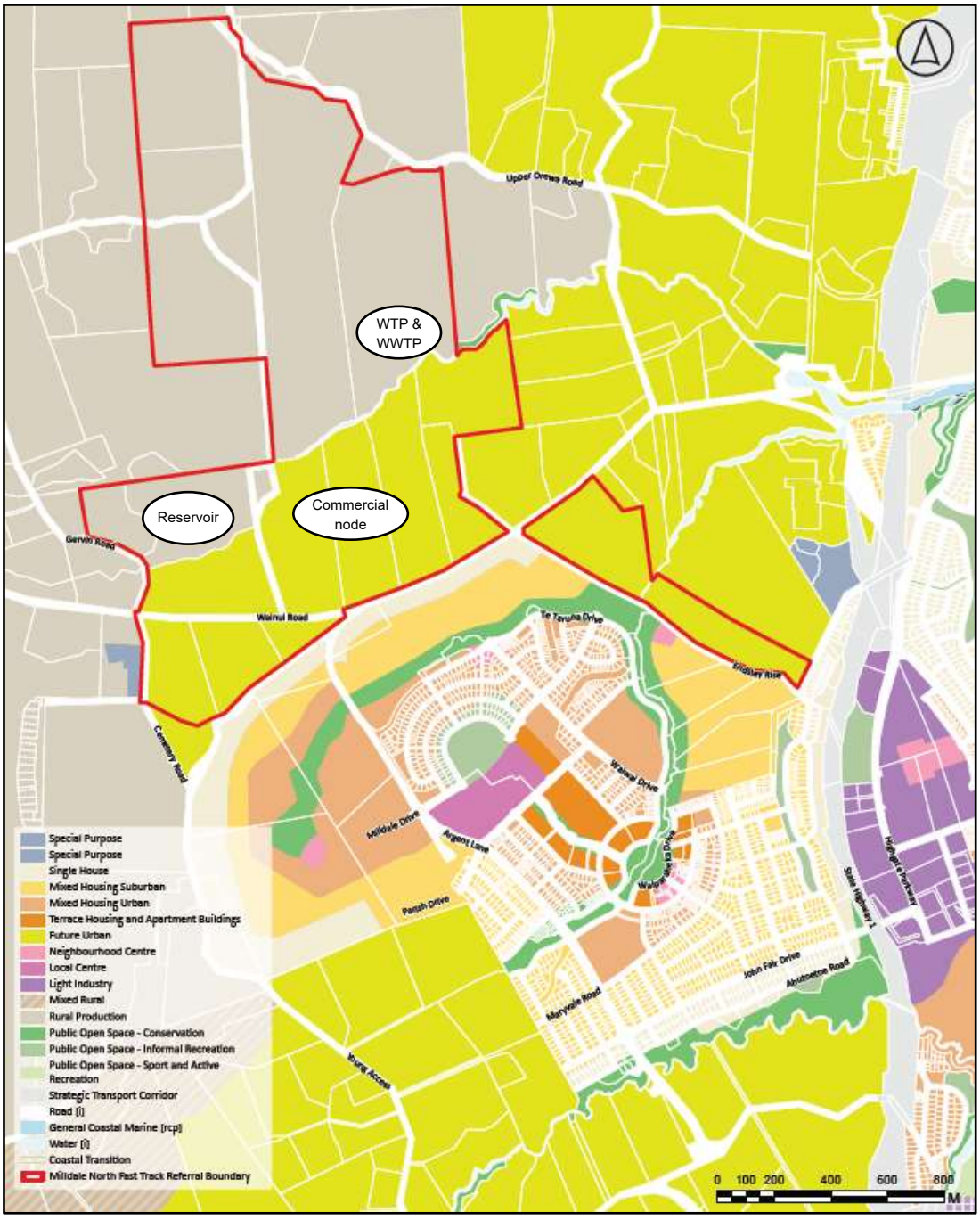


Figure 1: The Project Area and AUP zoning

The development of Milldale Stages 1 to 5 is now complete. Stages 6, 7, and 9 and the Town Centre are currently under construction. We understand that Stages 8, 10, 11, and 12 will be completed and occupied before construction work begins in the Project Area.

The portion of the Project Area to be developed for residential purposes is south of the Orewa River and zoned Future Urban Zone. The remainder of the Project Area to the north is zoned Rural Production and will be used for the WTP and WWTP and as an ecological restoration area.

6.0 The Receivers

A ‘Receiver’ is a location on another site where noise or vibration is assessed in accordance with the AUP and the relevant Standards. For this project, the relevant location for construction noise and vibration assessments is at any occupied building on another site. The relevant locations for operational noise are anywhere within the notional boundary of a site in the Future Urban Zone or a rural zone, anywhere within the property boundary of a site in the Special Purpose – Cemetery Zone or a residential zone, and at the façade of any building in the Business – Neighbourhood Centre Zone. Figure 2 and Table 1 identify the Receivers within approximately 100 m of the Project Area.

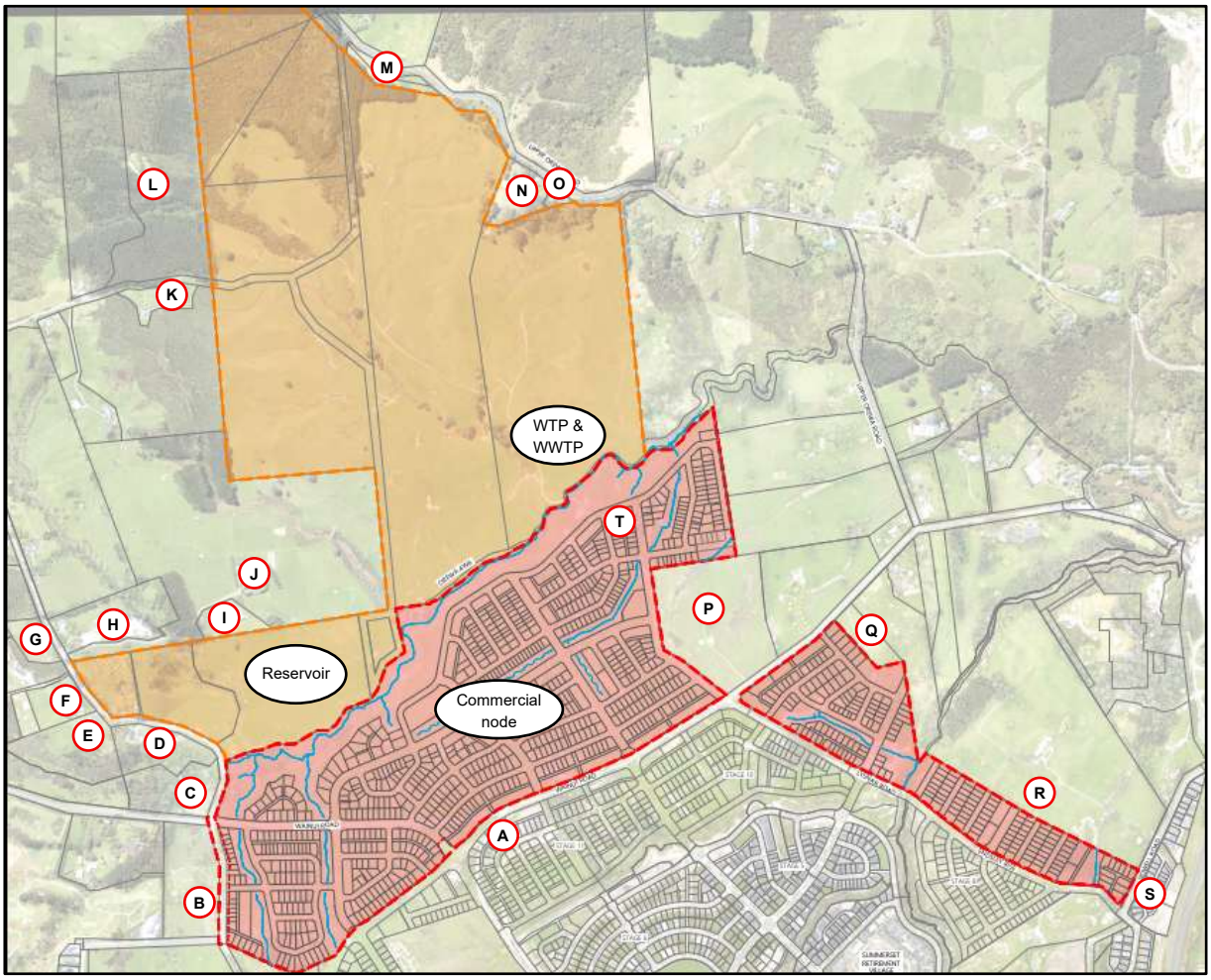


Figure 2: The nearest Receivers

Table 1: The nearest Receivers

Receiver (Figure 2)	Address	Description
A	Nearest Lot in Wainui Precinct (Stage 11)	A Lot within the Residential Single House Zone and the Wainui Precinct of the Milldale development. Construction noise and vibration levels assessed at this location are representative of those at the nearest and most exposed residential and commercial sites within the Wainui Precinct (Milldale Stages 8, 10, 11, and 12). The Wainui Precinct is entirely separated from the Project Area by local roads.
B	Wainui Settlers Cemetery	A cemetery within the Special Purpose Zone.
C	1 Gervin Rd	Dwelling in Rural Production Zone
D	27 Gervin Rd	Dwelling in Rural Production Zone
E	39 Gervin Rd	Dwelling in Rural Production Zone
F	43 Gervin Rd	Dwelling in Rural Production Zone
G	75 Gervin Rd	Dwelling in Rural Production Zone
H	72A Gervin Rd	Dwelling in Rural Production Zone
I	62 Gervin Rd	Dwelling in Rural Production Zone
J	64 Gervin Rd	Dwelling in Rural Production Zone
K	186 Gervin Rd	Dwelling in Rural Production Zone
L	171A Gervin Rd	Dwelling in Rural Production Zone
M	215 Upper Harbour Hwy	Dwelling in Rural Production Zone
N	163 Upper Harbour Hwy	Dwelling in Rural Production Zone
O	159 Upper Harbour Hwy	Dwelling in Rural Production Zone
P	462 Wainui Rd	Dwelling in Future Urban Zone
Q	427 Wainui Rd	Dwelling in Future Urban Zone
R	36 Sidwell Rd	Dwelling in Future Urban Zone

Receiver (Figure 2)	Address	Description
S	45 Sidwell Rd	Dwelling in Residential Single House Zone representing the nearest and most exposed sites in a residential zone.
T	Nearest Lot to proposed WTP and WWTP	A proposed Lot within the Project Area representing the nearest and most exposed residential activity to operational noise from the WTP and WWTP.

7.0 Construction noise and vibration assessment

The proposed construction works include vegetation clearance, earthworks, roading and infrastructure works, stream works, bridge works, construction of dwellings, and other activities involving the use of heavy machinery, power tools, and vehicle movements.

The equipment required to undertake the proposed works is identified in Section 7.4. The proposed high-noise and vibration generating activities include vegetation removal with a chainsaw, wood chipping, and vibratory piling for the bridge works.

The proposed construction period will be staged intermittently over approximately eight years. No construction work will be undertaken before 6:30 am, at night, or at any time on Sundays or public holidays.

Sections 7.1 and 7.2 outline the AUP permitted construction noise and vibration limits,

7.1 AUP permitted construction noise standards

E25.6.1.3 of the AUP requires all construction noise to be measured and assessed in accordance with NZS 6803: 1999 *Acoustics – Construction Noise*.

The permitted construction noise limits are set out in E25.6.27, as follows:

> **E25.6.27. Construction noise levels in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone**
>
> 1) Noise from construction activities in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone must not exceed the levels in Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone when measured 1m from the façade of any building that contains an activity sensitive to noise that is occupied during the works.

Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone

Time of week	Time Period	Maximum noise level (dBA)	
		L_{eq}	L_{max}
Weekdays	6:30am – 7:30am	60	75
	7:30am – 6:00pm	75	90
	6:00pm - 8:00pm	70	85
	8:00pm - 6:30am	45	75
Saturdays	6:30am – 7:30am	45	75
	7:30am – 6:00pm	75	90
	6:00pm - 8:00pm	45	75
	8:00pm - 6:30am	45	75
Sundays and public holidays	6:30am – 7:30am	45	75
	7:30am – 6:00pm	55	85
	6:00pm - 8:00pm	45	75
	8:00pm - 6:30am	45	75

2) Noise from construction activities in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone must not exceed the levels in Table E25.6.27.2 Construction noise levels for noise affecting any other activity when measured 1m from the façade of any other building that is occupied during the works.

Table E25.6.27.2 Construction noise levels for noise affecting any other activity

Time Period	Maximum noise levels L_{eq} (dBA)
7:30am – 6:00pm	75
6:00pm – 7:30am	80

3) For a project involving a total duration of construction work that is less than 15 calendar days, the noise levels in Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone and Table E25.6.27.2 Construction noise levels for noise affecting any other activity above may be increased by 5dB in all cases.

4) For a project involving a total duration of construction work that is more than 20 weeks the noise limits in Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone and Table E25.6.27.2 Construction noise levels for noise affecting any other activity above may be decreased by 5dB in all cases.

Activities sensitive to noise are defined in Chapter J of the AUP as 'any dwelling, visitor accommodation, boarding house, marae, papakāinga, integrated residential development, retirement village, supported residential care, care centres, lecture theatres in tertiary education facilities, classrooms in education facilities and healthcare facilities with an overnight stay facility'.

The permitted construction noise limits under E25.6.27 have been determined based on the following:

- The works are outside of the Business – City Centre Zone and the Business – Metropolitan Centre Zone.
- All construction work will be within the time period of 7:00 am to 6:00 pm on Monday to Saturday.
- The project will involve a total duration of construction work that exceeds 20 weeks.
- The nearest neighbouring sites include activities sensitive to noise (dwellings).
- The general construction hours will be 7:30 am to 6:00 pm, but deliveries and concrete pours will begin from 6:30 am.

The relevant AUP construction noise limits at 1 m from the most exposed façades of any occupied dwellings are therefore:

- Monday to Saturday 6:30 am to 7:30 am: 55 dB L_{Aeq} and 70 dB L_{Amax}.
- Monday to Saturday 7:30 am to 6:00 pm: 70 dB L_{Aeq} and 85 dB L_{Amax}.

7.2 AUP permitted construction vibration standards

The AUP permitted construction vibration standards are provided in E25.6.30.

E25.6.30. Vibration

1) Construction and demolition activities must be controlled to ensure any resulting vibration does not exceed:

   a. the limits set out in German Industrial Standard DIN 4150-3 (1999): Structural vibration – Part 3 Effects of vibration on structures when measured in accordance with that Standard on any structure not on the same site; and

   b. the limits in Table E25.6.30.1 Vibration limits in buildings in any axis when measured in the corner of the floor of the storey of interest for multi-storey buildings, or within 500mm of ground level at the foundation of a single storey building.

Table E25.6.30.1 Vibration limits in buildings

Receiver	Period	Peak Particle Velocity Limit (mm/s)
Occupied activity sensitive to noise	Night time 10pm to 7am	0.3 mm/s
	Daytime 7am to 10pm	2 mm/s
Other occupied buildings	At all times	2 mm/s

Works generating vibration for three days or less between the hours of 7am to 6pm may exceed the limits in Table E25.6.30.1 Vibration limits in buildings above, but must comply with a limit of 5mm/s peak particle velocity in any axis when measured in the corner of the floor of the storey of interest for multi-storey buildings, or within 500mm of ground level at the foundation of a single storey building, where:

i. all occupied buildings within 50m of the extent of the works generating vibration are advised in writing no less than three days prior to the vibration-generating works commencing; and

ii. the written advice must include details of the location of the works, the duration of the works, a phone number for complaints and the name of the site manager.

The criteria specified in E25.6.30.1.a are designed to prevent cosmetic damage to buildings, while those in E25.6.30.1.b aim to mitigate potential effects on people inside buildings.

7.2.1 Vibration building damage limits

The DIN 4150–3:1999 Standard referenced in E25.6.30.1.a recommends vibration limits for avoiding cosmetic building damage according to the design, occupancy, and sensitivity of the subject building. The classifications are:

- Line 1: Buildings used for commercial purposes, industrial buildings, and buildings of similar design
- Line 2: Dwellings and buildings of similar design and/or occupancy
- Line 3: Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g., listed buildings under preservation order).

We have based our assessment against the permitted construction vibration limits on Line 2 of the DIN 4150–3:1999 criteria applying at the neighbouring residential dwellings.

Line 3 would apply to any receiving structure that is deemed by a suitably qualified person to be particularly sensitive to vibration and/or of great intrinsic value e.g., a heritage building. We are not aware of any nearby Line 3 structures.

The guideline values provided in DIN 4150–3:1999 also depend on whether the vibration is ‘short-term’ or ‘long-term’. Short-term vibration is defined by the Standard as vibration which does not occur often enough to cause structural fatigue, and which does not produce resonance. Long-term vibration is all other types of vibration. In our experience, measurements in low-rise structures typically show that construction vibration meets the short-term criteria.

The DIN 4150–3:1999 frequency-dependent values for short-term vibration are illustrated in Figure 3. Dominant frequencies for construction vibration in dwellings are typically less than 50 Hz.

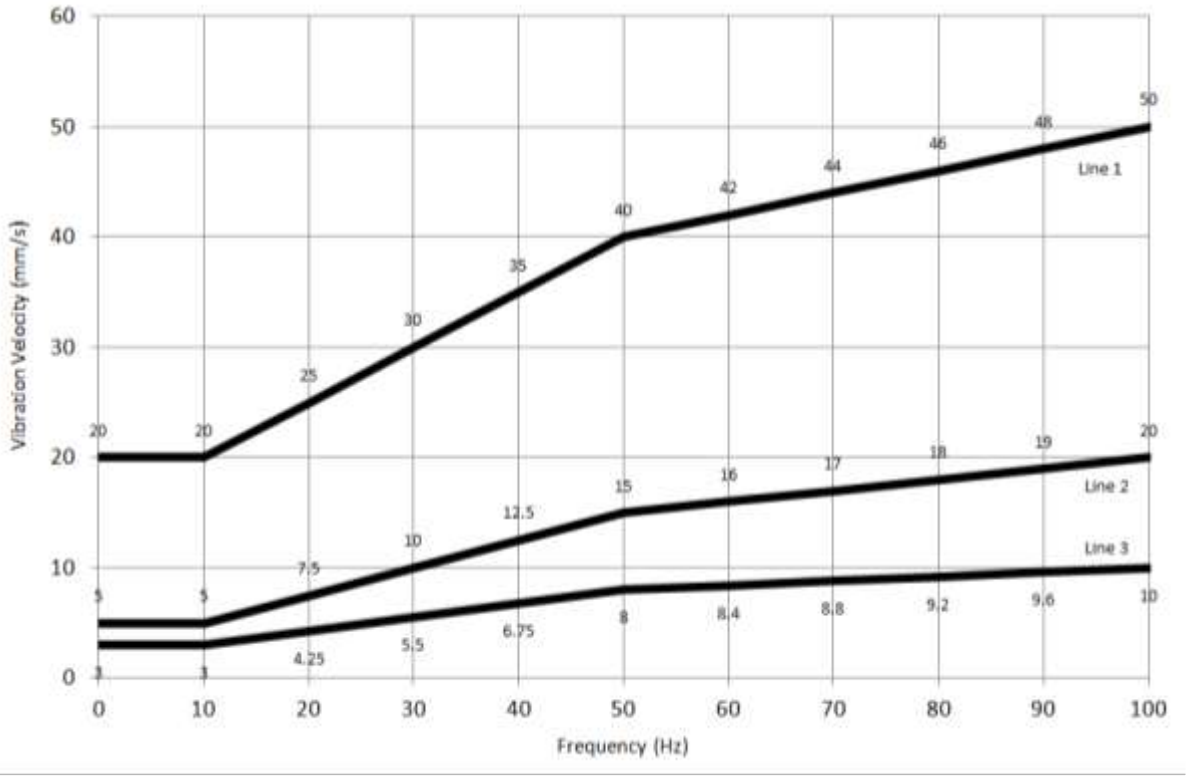


Figure 3: DIN 4150–3:1999 guideline values for short-term vibration

7.2.2 Vibration amenity limit

Construction works will only be carried out during the daytime, and vibration will be generated for more than three days. The permitted construction vibration amenity limit under E25.6.30.1.b is therefore 2 mm/s PPV when measured within any occupied building.

The vibration amenity limits do not apply at any building that is not occupied during the construction activity being monitored.

7.3 Construction noise and vibration mitigation measures

We recommend that the following mitigation measures are adopted for the Project to minimise construction noise and vibration effects on the neighbouring sites:

1. A CNVMP covering the site clearance, earthworks, and civil works will be prepared and submitted to Auckland Council for certification before construction begins. The objectives of the CNVMP will be to:
    a. Set out the procedures to identify and adopt the best practicable options for minimising adverse construction noise and vibration effects on neighbours.
    b. Define the procedures to be followed to ensure that the project construction noise and vibration limits are being complied with.

    The CNVMP will be prepared in accordance with AAAC guidelines, which recommend that a CNVMP contents page should include the following:

    1.0 Introduction

    2.0 Project description

        2.1 Site and neighbours

        2.2 Construction methodology

        2.3 Timeframes and hours of operation

        2.4 Key personnel

    3.0 Noise and vibration performance standards

    4.0 Noise and vibration levels

        4.1 Reference levels for high-noise and vibration generating activities

        4.2 Compliance distances (without and with mitigation)

    5.0 Community Engagement

        5.1 Consultation

        5.2 Communication

        5.3 Complaints response

    6.0 Mitigation and management

        6.1 Scheduling

        6.2 Equipment selection

        6.3 Noise barriers and enclosures

        6.4 General mitigation measures

        6.5 Mitigation of specific activities

        6.6 Training

2. The occupants of dwellings within 100 m of the site (identified in Section 6.0) will receive written communication at least five days before construction work begins. This communication will provide an overview of the works, approximate dates for the noisiest activities, and contact details for any questions or concerns.
3. Temporary construction noise barriers (**barriers**) will be installed on the site boundaries or around construction activities to reduce noise emissions where required for compliance with the permitted construction noise limits. The barriers will be at least 2.4 m high and will block the line of sight between the noisy activity and the occupied dwelling. They will be made from solid timber (e.g. 12 mm plywood) or proprietary construction noise panels.
4. One, or both, of the following measures will be adopted where necessary to ensure construction noise levels comply with the AUP limits at the upper level of an occupied dwelling:

    i. Barriers will be positioned close to the equipment and made high enough to block the line of sight between the noisy activity and the upper level of the dwelling

    ii. Smaller, quieter equipment will be used.

    This requirement will be included in the project CNVMP.
5. Construction work will only take place on Monday to Saturday. There will be no construction work undertaken on Sundays and public holidays.
6. Any machinery, concrete trucks, or other heavy vehicles operated in the Project Area between 6:30 am and 7:30 am will be set back from all occupied dwellings by:

    i. At least 130 m when unmitigated.

    ii. At least 45 m when acoustically screened.

    This will ensure compliance with the applicable AUP permitted construction noise limits.

7. Vibratory pile driving, mulching, chipping, bored piling, and chainsaw work will only take place between 7:30 am and 6:00 pm on Monday to Saturday.
8. Chipping and mulching will not take place within 60 m of any occupied building.

7.4 Construction noise levels

Table 2 shows the proposed construction activities and reference sound levels based on measurement data. We have used these references to calculate reasonable worst-case construction noise levels at the neighbouring sites. Our references are generally consistent with the data provided in NZS 6803:1999 Appendix C *Guide to Sound Level Data on Site Equipment and Site Activities* but are more relevant to modern construction equipment than the Standard.

Table 2 also displays the minimum separation distances for each activity to comply with the relevant AUP daytime permitted noise limits based on the following assumptions:

- The minimum distance stated is from the noise generating plant to the assessment position at 1 m from the most exposed façade of the building (e.g. from the excavator engine to 1 m from the building façade).
- The plant is being used continuously at the reference distance over a 15-minute sample period (i.e. 100% on-time) unless otherwise stated.
- The distances include a +3 dB adjustment to the noise levels for reflections from the façade of the receiving building (as required by NZS 6803:1999).
- Acoustically reflective ground is assumed between the noise source and the Receiver for distances up to 30 m. For separation distances greater than 30 m, a range is shown to include the effects of ground absorption (applied to calculate the shorter compliance distance).
- The mitigated compliance distances are based on barriers effectively screening the assessment point from the noise generating activity and reducing the L_{Aeq} noise level by 10 dB.

Table 2: Reference noise levels and compliance distances 07:30 AM to 6:00 PM

Construction activity	Unmitigated $L_{Aeq(15\ min)}$ noise level at 10 m	Unmitigated compliance distance	Mitigated compliance distance (with noise barrier)
Vibratory pile driving	88 dB	106 m	N/A*
Mulcher / chipper	83 dB	43 – 60 m	19 m
Bored piling with a 20-t excavator	79 dB	29 – 38 m	12 m

Construction activity	Unmitigated $L_{Aeq(15\ min)}$ noise level at 10 m	Unmitigated compliance distance	Mitigated compliance distance (with noise barrier)
Demolition of existing structures in the Project Area using a 20-t excavator	79 dB	29 – 38 m	12 m
Petrol chainsaw felling trees (based on 33% on-time)	78 dB	26 – 34 m	11 m
D6, D7, or D8 bulldozer working in small area	76 dB**	27 m	9 m
Padfoot vibratory compaction roller 15-t – 20-t	76 dB**	27 m	9 m
Drilling with a 12-t excavator	75 dB	24 m	8 m
Plate compactor	74 dB	22 m	7 m
Cut and fill, clearing, and loading trucks with a 40-t – 50-t excavator	72 dB	17 m	6 m
Cat 825 static compactor 30-t	72 dB**	17 m	6 m
Driving timber posts for retaining walls with an excavator mounted 600 kg drop hammer	72 dB	17 m	6 m
Drilling with a 6-t – 10-t excavator	72 dB	17 m	6 m
55-t mobile crane	70 dB	14 m	5 m
Cut and fill, clearing, and loading trucks with a 20-t excavator	69 dB	12 m	4 m
Cat 815 static compactor 18-t	69 dB**	12 m	4 m
Vibratory compaction roller 5-t – 7-t	69 dB**	12 m	4 m
Concrete pump and truck discharging	69 dB	12 m	4 m
Cut and fill, clearing, and loading trucks with a 12-t excavator	67 dB	10 m	3 m
Single drum static compaction roller 5-t	67 dB**	10 m	3 m
Vibratory compaction roller 3-t	67 dB**	10 m	3 m

Construction activity	Unmitigated $L_{Aeq(15\ min)}$ noise level at 10 m	Unmitigated compliance distance	Mitigated compliance distance (with noise barrier)
Large generator	66 dB	9 m	3 m
Single drum static compaction roller 3-t	65 dB**	8 m	3 m
Terrex TS14 30-t motor scraper	65 dB**	8 m	3 m
Use of handheld power tools	65 dB	8 m	3 m
Grader	62 dB**	6 m	2 m
Idling delivery truck, dump truck, moxy, tractor	62 dB	6 m	2 m

* It is generally not possible to effectively screen driven piling because the noise source will be significantly higher than a 2-3 m high barrier for most of the activity.
** Reference noise level is for a moving noise source.

Most of the proposed activities will be outside of the unmitigated compliance distances displayed in Table 2 and will not require barriers to comply. All construction activities will be outside of the mitigated compliance distances due to their location within the Project Area.

The proposed construction works will therefore consistently comply with the AUP permitted construction noise limits by:

- Undertaking the noisiest construction work (vibratory pile driving, mulching, chipping, bored piling, and chainsaw work) between 7:30 am and 6:00 pm on Monday to Saturday.
- Operating all machinery and heavy vehicles associated with deliveries and concrete pours between 6:30 am and 7:30 am at least 130 m from any occupied building, or at least 50 m away with acoustic screening
- Using barriers for any work within the unmitigated compliance distances displayed in Table 2.
- Undertaking all chipping and mulching at least 60 m from any occupied building.
- Undertaking all construction work in accordance with a CNVMP that is certified by Auckland Council. The CNVMP will set out the procedures and mitigation required to ensure the project limits are being complied with and that adverse construction noise and vibration effects on the neighbours are minimised.

A summary of the barriers required for compliance between 7:30 am and 6:00 pm is displayed in Table 3. This information will be included in the project CNVMP.

Table 3: Construction noise barrier requirements for compliance 7:30 am – 6:00 pm

Construction activity	Unmitigated compliance distance	Receivers within the unmitigated compliance distances where an acoustically effective barrier will be required for compliance
Vibratory pile driving	106 m	None. Vibratory piling will only be used for pedestrian and vehicle bridges at least 350 m from any neighbouring dwelling.
Mulcher / chipper	60 m	None. A mulcher or woodchipper will not be used within 60 of any occupied building
Bored piling with a 20-t excavator	38 m	None. Bored piling will only be used to construct the WTP and WWTP which will be at least 500 m from any neighbouring dwelling
Demolition of existing dwellings with a 20-t excavator	38 m	None
Petrol chainsaw felling trees (based on 33% on-time)	34 m	None
D6, D7, or D8 bulldozer working in small area	27 m	Receivers A and Q
Padfoot vibratory compaction roller 15-t – 20-t	27 m	Receivers A and Q
Drilling with a 12-t excavator	24 m	None
Plate compactor	22 m	None
All other construction activities	–	None

It is unlikely that multiple activities will be undertaken in the same area at once because the works will be staged, but the CNVMP will outline a process for dealing with cumulative noise to avoid non-compliance.

The highest construction noise levels for any Receiver will be between 60 dB and 70 dB $L_{Aeq(15\ min)}$. These levels will be generated intermittently between 7:30 am and 6:00 pm on Monday to Saturday while earthworks are completed in the nearest part of the Project Area. When the works progress and move further away, the noise levels will generally range from 50 dB to 60 dB $L_{Aeq(15\ min)}$. There will also be long periods when little or no noise is generated. High noise levels will not be generated continuously or for long periods.

The L_{Amax} noise levels from the proposed construction activities will generally be 10-15 dB higher than the L_{Aeq} noise levels and will comply with the permitted L_{Amax} noise limits if our recommended mitigation measures are adopted.

The unmitigated setback areas for early morning activities and the setbacks for works during the day are illustrated in Figure 4 for Receivers A and Q (the only Receivers that may require screening during the day), and in Appendix B for the entire Project Area.

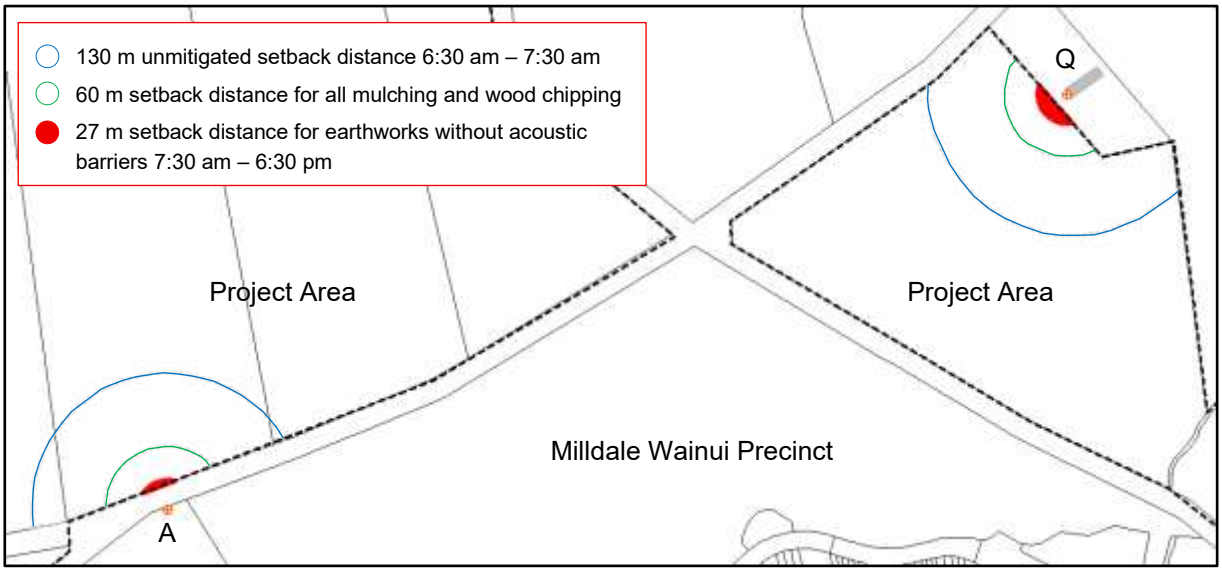


Figure 4: Setback areas for Receivers A and Q

7.5 Construction vibration levels

The highest construction vibration levels at the nearest Receivers will be generated during excavation, compaction, and heavy vehicle movements near to the boundary. The levels will depend on the separation distance, the size of the plant and how it is used, the ground conditions, and the response of the structure.

Table 4 presents typical vibration levels for the relevant construction activities. These are derived from previous measurements using a geophone buried in the ground. Measuring these activities from a dwelling may provide slightly lower results due to the loss of energy when the vibration transfers from the ground into the foundations.

Table 4: Typical construction vibration levels

Construction activity	Distance	Typical vibration level (PPV)
Vibratory compaction with a 15-t – 20-t roller	10 m	3-4 mm/s
Vibratory compaction with a 5-t – 7-t roller	10 m	2-3 mm/s
Compaction with a large static roller	10 m	1 mm/s
Cut and fill works, loading trucks, and tracking slowly with a 20-t excavator	10 m	1 mm/s
Heavy vehicle or tractor pass-by on even ground	10 m	<1 mm/s

The proposed works will consistently comply with the permitted construction vibration limits for amenity and for avoiding cosmetic building damage without requiring any specific mitigation. This is due to the distance between any vibration-generating activities on site and the nearest dwellings.

7.6 Potential construction noise and vibration effects

The proposed acoustic screening, setback distances, and construction hours will ensure that the AUP permitted construction noise standards are complied with. The proposed communication with the neighbours and CNVMP will minimise the potential effects.

The potential effects typically associated with construction noise during the day are displayed in

Table 5. The noise effects indoors are based on windows being closed and a noise level reduction of 20 dB through the façades. This is a typical reduction for older buildings with thinner glass and less air-tight joinery than modern buildings. The façades of modern or upgraded buildings will typically provide a greater reduction of approximately 25 dB.

People will generally be able to seek respite indoors during periods of high noise when construction work is near the site boundary. For most of the project, the noise effects will be no greater than those shown for noise levels up to 65 dB L_{Aeq} and there will be periods when there is little or no construction noise.

Table 5: Temporary daytime construction noise effects

Noise level at 1 m from the façade ($L_{Aeq\ (15\ min)}$)	Potential noise effects outside the building	Potential noise effects inside the nearest room of the building	Compliance with AUP permitted construction noise limits
≤ 55 dB	Noise may be noticeable outside, but it is unlikely to cause annoyance or interfere with residential activities	Up to 32 dB L_{Aeq} inside. May not be noticeable and is unlikely to cause annoyance	Compliant with AUP limits 7:00 am to 7:30 am
55-65 dB	Conversation may require raised voices	Up to 42 dB L_{Aeq} inside. Noise may be audible inside the building, but it is unlikely to cause annoyance or interfere with residential activities	Compliant with AUP limits 7:30 am to 6:00 pm
65-70 dB	Conversation will require raised voices. People are unlikely to spend time outside	Up to 47 dB L_{Aeq} inside. Noise may be noticeable inside the building and could affect concentration, but it is unlikely to interfere with residential activities	Compliant with AUP limits 7:30 am to 6:00 pm

Construction vibration may be perceptible intermittently when heavy machinery is used within approximately 50 m of a dwelling, but it will not exceed 2 mm/s PPV. The Receivers will be advised before works begin that vibration may be noticeable but standards for both amenity and avoiding building damage will be complied with.

Noise levels up to 70 dB L_{Aeq} and noticeable vibration are expected for short periods during the daytime while heavy machinery operates near to the site boundary. However, construction noise and vibration generated by the Project will be significantly lower than the AUP permitted standards for long-term construction projects for most of the construction period.

Noise will only be generated occasionally between 6:30 am and 7:30 am when early morning deliveries or concrete pours are required. It will not be necessary to operate concrete trucks or unload machinery near to the boundary at these times. Truck movements will control the construction noise levels at the nearest Receivers. The construction noise emissions will comply with the AUP permitted limits and will not cause sleep disturbance or serious annoyance.

We do not expect construction noise and vibration to cause unreasonable disturbance on any neighbouring site if our recommendations in Section 9.0 are adopted.

8.0 Operational noise assessment

The operational noise sources that require assessment against the AUP permitted noise limits are the proposed commercial node and the WTP and WWTP.

We understand the likely activities in the commercial node will be retail, and food and beverage outlets. Additionally, the Applicant proposes a condition which applies the AUP residential noise limits under E25.6.2 *Maximum noise levels in residential zones* at all residential lots within the Project Area.

The proposed condition effectively adopts the noise standards that would apply if the land were zoned residential, resulting in noise limits that are 5 dB lower that the permitted standards in the FUZ. This will provide for a better level of residential amenity in the Project Area than the FUZ permitted standards and will ensure that noise emissions from commercial activities in the Project Area do not exceed a reasonable level. We therefore consider that the proposed noise limits are appropriate.

The following sections set out our assessment of the proposed WTP and WWTP in accordance with the AUP permitted standards.

8.1 AUP noise standards

The WWTP and WTP will be within the Rural – Rural Production Zone (**RPZ**). The nearest Receivers, including sites within the Project Area, are within the RPZ or the Future Urban Zone (**FUZ**). The relevant AUP permitted noise limits are under standard E25.6.3, as follows:

- Monday to Saturday: 55 dB L_{Aeq} from 7:00 am to 10:00 pm; 45 dB L_{Aeq} and 75 dB L_{Amax} at all other times.
- Sunday: 55 dB L_{Aeq} from 9:00 am to 6:00 pm; 45 dB L_{Aeq} and 75 dB L_{Amax} at all other times.

The permitted noise limits apply within the notional boundary of any dwelling in the RPZ or FUZ. Standard E25.6.1.1 requires all operational noise to be measured and assessed in accordance with NZS 6801:2008 and NZS 6802:2008.

8.2 Recommended noise limits for plant

The permitted noise standards in the RPZ and FUZ are not necessarily designed for the character of noise typically generated by the constant operation of mechanical plant such as pumps, blowers, and fans. Noise levels up to 45 dB L_{Aeq} from these sources may be clearly audible as a consistent hum at night when ambient noise levels are low. This could result in adverse noise effects even though the noise levels comply with the relevant AUP limits for the zone.

To avoid such effects, we recommend that any noise generated by the permanently installed plant used for the operation of the WWTP and WTP should comply with the following limits at all notional boundaries on all days:

a. 7:00 am to 10:00 pm: 45 dB L_{Aeq}.

b. 10:00 pm to 7:00 am : 35 dB L_{Aeq} and 65 dB L_{Amax}.

Compliance with these limits will ensure that noise from the WWTP and WTP is inaudible inside dwellings, including those within the Project Area. The noise is unlikely to be audible outside during daytime hours in all but the calmest of meteorological conditions, and it will not cause annoyance or sleep disturbance at night.

8.3 Noise sources

The operational noise sources associated with the WWTP and WTP are listed below. Manufacturers L_{Aeq} noise level data at 1 m and operating times are provided. All noise except the anoxic mixer and trucks will be housed inside the treatment station buildings.

8.3.1 WWTP noise sources

- 3 x blowers: 79 dB L_{Aeq} (two blowers operating 24/7).
- 1 x compressor: 69 dB L_{Aeq} (2 hrs/day).
- 1 x odour fan: 69 dB L_{Aeq} (24/7).
- 1 x centrifuge: 77 dB L_{Aeq} (6 hrs/day, daytime only).
- 2 x headworks screens: 70 dB L_{Aeq} (intermittent 10 mins at any time of day).
- 2 x pumps: 67 dB L_{Aeq} (24/7).
- 5 x pumps: 55 dB L_{Aeq} (24/7).
- Anoxic mixer: 55 dB L_{Aeq} (24/7).
- Truck movements: 3 per week (daytime only).
- 2 x pumps: 70 dB L_{Aeq} (in a duty/standby arrangement 24/7).

8.3.2 WTP noise sources

- 4 x pumps: 67 dBA L_{Aeq} (24/7).
- 3 x pumps: 65 dBA L_{Aeq} (2 hrs/day).
- 3 x blowers: 79 dB L_{Aeq} (1 hr/day).
- 2 x compressor: 69 dB L_{Aeq} (2 hrs/day).
- 2 x pumps: 67 dB L_{Aeq} (24/7).
- 1 x pump: 55 dB L_{Aeq} (2 hrs/day).

- Truck movements: 1 per week (daytime only).

8.4 Noise mitigation

Our modelling of the operational noise emissions includes the following mitigation measures:

- All plant except the anoxic mixer will be located inside the treatment station buildings.
- There will be no truck movements on the site at night.

8.5 Noise level predictions

We have calculated operational noise levels at the nearest Receivers based on a worst-case scenario of all plant operating simultaneously and two truck movements within the same 15-minute period during the day.

To derive a Noise Rating Level for comparison with the AUP permitted noise limits, the noise must be assessed for duration and special audible characteristics, and adjustments made in accordance with NZS 6802:2008 where applicable. Our assessments of duration and special audible characteristics are outlined below:

- Duration: the plant can operate continuously on any day, so the noise emissions do not qualify for any adjustment. No duration adjustments are permitted at night. No adjustments for duration have been made.
- Special audible characteristics: Any plant that could produce noise with tonal characteristics will be located inside the treatment buildings. The noise will be mitigated by the building envelope and is unlikely to be audible at the nearest notional boundaries. We have not therefore applied any adjustment for special audible characteristics.

The predicted operational Noise Rating Levels at the nearest notional boundaries are displayed in Table 6.

Table 6: Predicted operational Noise Rating Levels

Location	Predicted Noise Rating Levels daytime	Predicted Noise Rating Levels night-time
Receiver J The nearest Receiver to the west	23 dB $L_{Aeq(15\ min)}$	20 dB $L_{Aeq(15\ min)}$
Receiver O The nearest Receiver to the north	26 dB $L_{Aeq(15\ min)}$	23 dB $L_{Aeq(15\ min)}$
Receiver P The nearest Receiver to the southwest	28 dB $L_{Aeq(15\ min)}$	25 dB $L_{Aeq(15\ min)}$

Location	Predicted Noise Rating Levels daytime	Predicted Noise Rating Levels night-time
Receiver T The nearest Receiver within the Project Area	35 dB $L_{Aeq(15\ min)}$	33 dB $L_{Aeq(15\ min)}$

The predicted Noise Rating Levels comply with both the AUP permitted L_{Aeq} noise limits (55 dB L_{Aeq} / 45 dB L_{Aeq}) and our recommended operational noise L_{Aeq} limits (45 dB L_{Aeq} / 35 dB L_{Aeq}) at all surrounding sites, including those within the Project Area.

The L_{Amax} noise levels are unlikely to be more than 10 dB higher than the L_{Aeq} noise levels and will readily comply with the AUP permitted limit of 75 dB L_{Amax} and our recommended limit of 65 dB L_{Amax}.

8.6 Potential operational noise effects

The operational noise emissions will comply with our recommended limits of 45 dB L_{Aeq} during the day and 35 dB L_{Aeq} and 65 dB L_{Amax} at night, which are lower than the AUP permitted standards for permitted activities in rural zones.

Compliance with these limits will ensure that noise from the WWTP and WTP is inaudible inside neighbouring dwellings, including those within the Project Area. The noise is also unlikely to be audible outside at the notional boundaries.

We consider that noise generated by the WWTP and WTP will not cause annoyance or disruption to commercial or residential activities on any neighbouring site.

9.0 Recommendations

We recommend the following mitigation measures are adopted in conditions for the Project:

1. A Construction Noise and Vibration Management Plan (CNVMP) covering the site clearance, earthworks, and civil works must be prepared by a suitably qualified person and submitted to Auckland Council for certification at least ten days before any construction works authorised by the approval begin.

   The objectives of the CNVMP must be to:

   a. Set out the procedures to identify and adopt the best practicable options for minimising adverse construction noise and vibration effects on neighbours.

   b. Define the procedures to be followed to ensure that the project construction noise and vibration limits are complied with.

   The CNVMP must address the requirements of Annex E of NZS 6803:1999 *Acoustics – Construction Noise* as a minimum and must be prepared in accordance with the

Association of Australasian Acoustical Consultants Guideline for interpreting and applying NZS 6803:1999.

Construction works must not begin until certification has been received in writing from Auckland Council. All construction works on the site must be carried out in accordance with the certified CNVMP.

2. The occupants of all dwellings within 100 m of the site boundary must be advised of the construction project at least five days before any construction works authorised by the approval begin. The advice must be provided in writing and must include the following information:
    a. A general description of the construction works including the duration of the project and the working hours on site.
    b. A contact name and phone number for any questions or complaints during the project.
3. All construction works authorised by the approval must only take place between 6:30 am and 6:00 pm, Monday to Saturday, with no works undertaken at any time on Sundays or public holidays.
4. Machinery and concrete trucks must only be operated outside the following set back distances between 6:30 am and 7:30 am:
    a) At least 130 m from any occupied dwelling when unmitigated.
    b) At least 45 m from any occupied dwelling when acoustically screened in accordance with the requirements of the CNVMP.
5. Vibratory pile driving, mulching, chipping, bored piling, and chainsaw work must only take place between 7:30 am and 6:00 pm on Monday to Saturday.
6. Chipping and mulching must not take place within 60 m of any occupied building.
7. The setback distances and / or time limitations in Conditions [4] to [6] may be varied subject to all of the following criteria being met:
    a) The results of noise measurements of plant on the site demonstrate that the variations will not result in the project noise limits being exceeded.
    b) Auckland Council has provided written confirmation that the proposed variations based on item (a) are acceptable.
    c) The variations are documented in the project CNVMP.
8. Noise Rating Levels generated by permanent fixed plant associated with the operation of the Wastewater Treatment Plant and Water Treatment Plant must comply with the following limits when measured and assessed at any notional boundary in accordance with NZS 6801:2008 and NZS 6802:2008:
    a) 7:00 am to 10:00 pm on all days: 45 dB L_{Aeq}
    b) 10:00 pm to 7:00 am on all days: 35 dB L_{Aeq} and 65 dB L_{Amax}.

10.0 Conclusion

Styles Group has assessed the potential noise and vibration effects of the proposed Stages 14-17 of the Milldale Development.

Construction noise and vibration will comply with the AUP permitted limits. This will be achieved by undertaking all noisy activities between 6:30 am and 6:00 pm on Monday to Saturday, applying minimum setback distances, restricting the noisiest activities until after 7:30 am, and using temporary construction noise barriers. The potential noise and vibration effects will be mitigated by communicating with the neighbours before the works begin and undertaking all construction works in accordance with a CNVMP that is certified by Auckland Council.

Construction noise will be noticeable outside the neighbouring dwellings and may dominate the noise environment during the day while the nearest earthworks are completed. Vibration may also be noticeable during the nearest works. However, this will be for a short duration, and the noise and vibration effects will not exceed those enabled by the AUP for long-term construction projects. The construction noise and vibration levels at any occupied dwelling will be significantly lower than the permitted standards during most of the project.

Noise from the proposed operation of the WWTP and WTP will comply with the AUP noise limits for permitted activities in the RPZ. To avoid potential adverse noise effects, we recommend that any noise associated with the WWTP and WTP should comply with lower limits at the notional boundaries of all neighbouring dwellings, including those within the Project Area. The recommended limits are:

- 7:00 am to 10:00 pm: 45 dB L_{Aeq}.
- 10:00 pm to 7:00 am : 35 dB L_{Aeq} and 65 dB L_{Amax}.

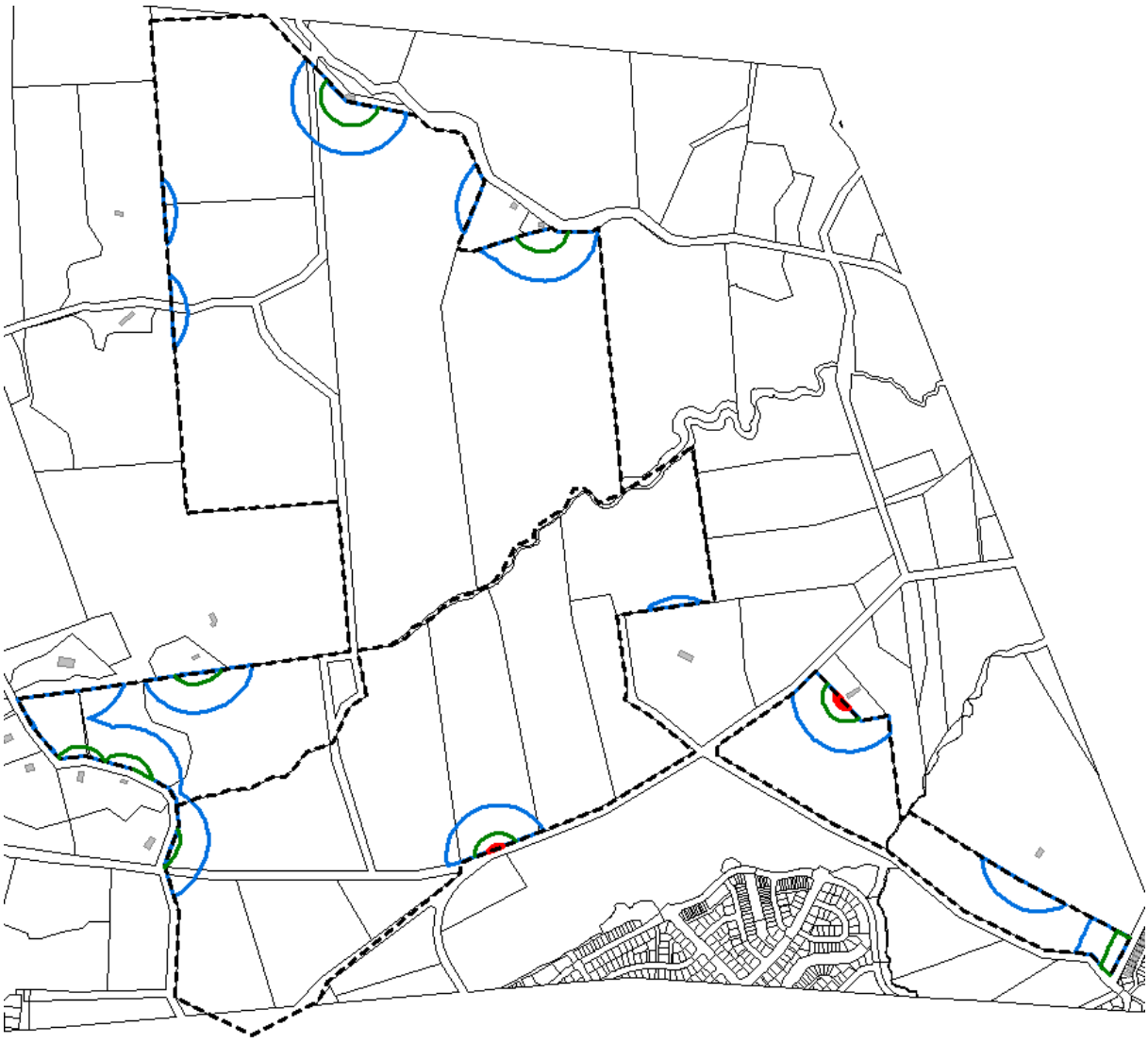
Compliance with these limits will ensure that the constant noise from the WWTP and WTP is inaudible inside all dwellings. The noise is unlikely to be audible outside during daytime hours, and it will not cause annoyance or sleep disturbance at night. Our predicted operational Noise Rating Levels demonstrate that the recommended noise limits will be complied with.

We consider overall that noise and vibration generated by the proposed development will be reasonable and will not cause annoyance or disruption to residential or rural activities on any neighbouring site if our recommendations are adopted.

Appendix A Glossary

Noise	Noise is unwanted, harmful, or inharmonious (discordant) sound which serves little or no purpose for the exposed persons. Sound is wave motion within matter, be it gaseous, liquid, or solid. Noise usually includes vibration as well as sound. The Resource Management Act 1991 defines noise as 'includes vibration'.
dB (decibel)	The basic measurement unit of sound. The decibel is a logarithmic scale that allows a wide range of values to be compressed into a more comprehensible range, typically 0 dB to 120 dB. Noise levels in decibels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dB, and another similar machine is placed beside it, the level will increase to 53 dB and not 100 dB.
A-weighting	A frequency filter applied to the full audio range (20 Hz to 20 kHz) to approximate the response of the human ear at lower sound pressure levels.
Ambient noise	The total of all noise within a given environment including sounds from sources near and far.
$L_{Aeq(t)}$ (dB)	The A-weighted equivalent sound pressure level with the same energy content as the measured varying acoustic signal over a sample period (t). The preferred metric for sound levels that vary over time because it considers the total sound energy over the period of interest.
L_{AFmax} (dB)	The maximum A-weighted sound pressure level recorded during the measurement period using a fast time-weighting response.
L_{WA} (dB)	Sound power level (L_{WA}) is the acoustical energy emitted by a sound source. It is an absolute value and is not affected by distance or the environment. The L_{WA} is used in computer noise modelling to calculate the sound pressure level (e.g. L_{Aeq}) at a given distance.
Noise Rating Level	A noise level derived in accordance with NZS 6802:2008 *Acoustics – Environmental noise*.
Notional boundary	A line 20 metres from any side of a residential unit or other building used for a noise sensitive activity or the legal boundary where this is closer to the building.
PPV	Peak particle velocity, measured in mm/s. The standard metric for the measurement of ground borne vibration in New Zealand. The instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position.
CNVMP	A Construction Noise and Vibration Management Plan is a document developed by a suitably qualified person to set out the procedures for a contractor to manage and mitigate construction noise and vibration effects.

Appendix B Construction noise mitigation map



Setback distances (refer to Sections 6.0, 7.3, and 7.4)

- Unmitigated setback distance for construction activities 6:30 am – 7:30 am
- Setback distance for all wood chipping and mulching 7:30 am – 6:00 pm
- Unmitigated setback distance all earthworks 7:30 am – 6:00 pm