Styles Group
Acoustics & Vibration Consultants

ACOUSTICS

MILLDALE STAGES 10-13
PROPOSED EARTHWORKS AND CIVIL WORKS

PREPARED FOR

Fulton Hogan Land Development

DATE

26 February 2025

Assessment prepared by Styles Group for Fulton Hogan Land Development.

Rev:	Date:	Comment:	Version:	Prepared by:	Reviewed by:
1	26/02/25	Issued for consent	Final	Jamie Exeter, MASNZ Principal Styles Group	Kelly Leemeyer, MASNZ Senior Consultant Styles Group

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Appendices

Executive summary

Fulton Hogan Land Development has engaged Styles Group to assess the potential noise and vibration effects of the proposed activities associated with Stages 10-13 of the Milldale Development, including bulk earthworks and the construction and operation of a temporary water booster pumping station within a residential zone.

This report has been prepared to accompany a resource consent application to the Environmental Protection Agency under the Fast-Track Approvals Act 2024. It includes:

- Proposed mitigation measures.
- An assessment of the worst-case construction noise and vibration levels and operational noise levels against the relevant Auckland Unitary Plan permitted standards.
- An assessment of the potential noise and vibration effects on the existing environment.

The following mitigation measures are proposed to ensure compliance with the Auckland Unitary Plan construction noise and vibration limits for permitted activities and to minimise potential effects:

- Any machinery and heavy vehicles operated between 7:00 AM and 7:30 AM on Monday to Saturday will be at least 130 m from any occupied building.
- All other construction work will be undertaken between 7:30 AM and 6:00 PM on Monday to Saturday (when higher permitted noise limits apply).
- There will be no construction work on Sundays or public holidays.
- Temporary construction noise barriers will be used when working near occupied dwellings.
- There will be proactive communication with the neighbours before the work begins.

Operational noise emissions from the proposed pumping station will comply with the Auckland Unitary Plan noise limits for permitted activities in residential zones. The noise emissions will be mitigated by:

- Locating all noise-generating plant inside the pumping station building.
- Designing the building to meet minimum sound reduction specifications.
- Constructing an acoustically effective fence on the boundaries of the adjoining lots.

The key findings of this report are:

- Construction noise and vibration emissions can be mitigated to comply with the relevant limits for permitted activities.
- Construction noise and vibration are not a reason for consent.
- Construction noise will be noticeable outside the neighbouring dwellings when the nearest earthworks are undertaken, but significantly lower than the permitted limits for most of the project.
- Construction vibration may be perceptible within the nearest dwellings when the nearest earthworks are undertaken but will be imperceptible for most of the project.
- Construction noise and vibration will not cause unreasonable disturbance at any neighbouring site.
- Operational noise emissions can be mitigated to comply with the limits for permitted activities.
- Operational noise is not a reason for consent.
- With robust design of the pump station building and an acoustically effective fence along the western boundary of the site, the sound of water pumps operating inside the building is unlikely to be audible on adjacent lots during the day and will not cause annoyance or disrupt sleep at night.
- The operational noise will not cause unreasonable disturbance at any neighbouring site.

We have recommended conditions of consent based on our findings.

1.0 Introduction

This report has been prepared in support of the application by Fulton Hogan Land Development (**FHLD**) to the Environmental Protection Authority under the Fast-Track Approvals Act 2024 for resource consent for the development of Stages 10-13 of the Milldale Development.

FHLD has engaged Styles Group to assess the potential noise and vibration effects associated with the proposed development.

The purpose of this report is to:

- Determine the potential construction noise and vibration levels at the nearest occupied dwellings (the **receivers**) based on typical and worst-case scenarios.
- Determine the potential noise levels at the nearest residentially zoned sites from the operation of the pump station.
- Assess the noise emissions in terms of the permitted standards of the Auckland Unitary Plan (the **AUP**) and identify where consent is required for infringements.
- Recommend noise and vibration mitigation measures and consent conditions.
- Describe the potential noise effects of the proposal in the context of the existing environment and the provisions of the AUP.

Our assessment is based on the methodologies, plant, timeframes, and other information provided to us by the relevant experts in the project team.

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 where applicable:

- NZS 6803:1999 *Acoustics – Construction noise*.
- NZS 6801:2008 *Acoustics – Measurement of environmental sound*.
- NZS 6802:2008 *Acoustics – Environmental noise*.

This report does not assess the potential construction noise effects on any neighbouring sites owned by the applicant.

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

2.0 Statement of qualifications and experience

This section outlines the qualifications and professional experience of both the author and the reviewer of this report.

2.1 Author – Jamie Exeter

I am a Principal at Styles Group. Styles Group is an acoustics consultancy specialising in environmental noise and vibration, building acoustics, and underwater noise. I have been employed at Styles Group since January 2008.

I hold a Diploma of Audio Engineering from the School of Audio Engineer, which I completed in 2004. I am a professional Member of the Acoustical Society of New Zealand (MASNZ) and served as an elected council member from 2012 until 2018.

I have 20 years of experience in acoustics, with over 17 years specialising in measuring, predicting, and assessing environmental noise and vibration in accordance with District Plans and the Resource Management Act.

I have contributed to a significant number of construction projects including large scale residential developments and many of New Zealand's largest infrastructure projects. I regularly undertake peer review work for Local Government throughout New Zealand. I have provided expert evidence and advice for District Plan changes and reviews for a large number of private and public sector clients. I have written and presented guidelines on the measurement and assessment of environmental noise and construction noise and vibration to council staff and project teams throughout New Zealand.

I am one of three consultants in a working group currently drafting guidelines on the measurement and assessment of construction noise in New Zealand on behalf of the Association of Australasian Acoustical Consultants to address issues and ambiguities in NZS 6803:1999 *Acoustics – Construction Noise*.

I confirm that, in my capacity as author of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

2.2 Reviewer – Kelly Leemeyer

I am a Senior Consultant at Styles Group. I have been employed at Styles Group since November 2013.

I hold the qualifications of a Bachelor of Science Degree with a major in Geology and a specialisation in Geophysics from the University of Auckland and a Post Graduate Certificate in Planning from Massey University. I am a professional Member of the Acoustical Society of New Zealand.

I have 11 years of experience as an acoustics consultant specialising in measuring, predicting, and assessing environmental noise and vibration in accordance with District Plans and the Resource Management Act.

My experience relevant to this project includes the preparation and review of a significant number of construction noise and vibration assessments and construction noise and vibration management plans for projects throughout New Zealand. I have extensive experience in assessing the potential noise effects of applications similar to the proposal.

I confirm that, in my capacity as reviewer of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

3.0 The proposed development

FHLD propose to subdivide and develop the site for medium density residential use. The proposal includes the development of 623 residential lots, 27 residential super lots, jointly owned access lots, roads, and reserves to vest, all associated works, landscaping, and infrastructure, and a temporary water booster pumping station.

The development of Stages 10-13 will require land modification and bulk earthworks across the site.

A full description of the proposal is provided in the application Assessment of Environmental Effects (**AEE**).

4.0 Construction noise and vibration assessment

The proposed construction works include bulk earthworks, subdivision works, roading and infrastructure works, stream works, and other activities involving the use of heavy machinery and vehicles.

The machinery required to undertake these works are identified in Section 4.5. There are no high noise or vibration generating activities required i.e., no hydraulic breaking, vibratory piling, impact piling, or blasting.

The construction period will be approximately three earthworks' seasons.

All construction work will take place between 7:00 AM and 6:00 PM on Monday to Saturday. There will be no noisy construction work on Sundays or public holidays.

4.1 The construction site and nearest receivers

The site subject to the application is located within the Milldale development and referred to as the Milldale Stages 10-13 subdivision areas (the **site**). The site consists of land covered by LoT 9006 DP 602895; Lot 9007 DP 602895; Lot 3 DP 151229; Lot 1 DP 147739; Lot 1 DP 488814; Lot 2 DP 488814; Lot 3 DP 488814; and Lot 2 DP 147739. Stages 10-13 are located within the northern and western extents of the Milldale development and comprise the remaining undeveloped greenfield stages of Milldale.

Overall, the site covers a total area of approximately 71ha. The site is bordered by Wainui Road to the north, Lysnar Road to the north-east, and undeveloped land to the west. Previously consented Milldale stages are located south of the site including Stages 5-8 and the Milldale Town Centre.

Full descriptions of the site and surrounds are provided in the application AEE.

The nearest receivers to the proposed construction works are displayed in Table 1. The stated separation distances provided are from noise-generating plant on the site to the assessment point at 1 m from the façade of the dwelling (see Section 0).

Table 1: Nearest receivers and approximate separation distances

Address	Approximate separation distance
480 Wainui Rd	35 m
522 Wainui Rd	49 m
51 Cemetery Rd	64 m
68 Cemetery Rd	34 m
86 Cemetery Rd	44 m
96 Cemetery Rd	115 m
104 Cemetery Rd	33 m
137 Young Access	96 m
142 Young Access	16 m

4.2 AUP permitted construction noise standards

Standard 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 provided in E25.6.27.

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'.

With respect to the criteria for determining the permitted construction noise limits under E25.6.27:

- 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 is more than 20 weeks.
- The nearest neighbouring sites include activities sensitive to noise (dwellings).

The permitted construction noise limits at 1 m from the most exposed façade of any occupied dwelling are therefore:

- Monday to Saturday 7:00 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}.

4.3 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 the buildings.

4.3.1 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 in measuring vibration in low-rise structures shows that construction vibration typically meets the short-term criteria.

The DIN 4150–3:1999 frequency-dependent values for short-term vibration are illustrated in Figure 1 for reference. Dominant frequencies for construction vibration in dwellings are typically less than 50 Hz.

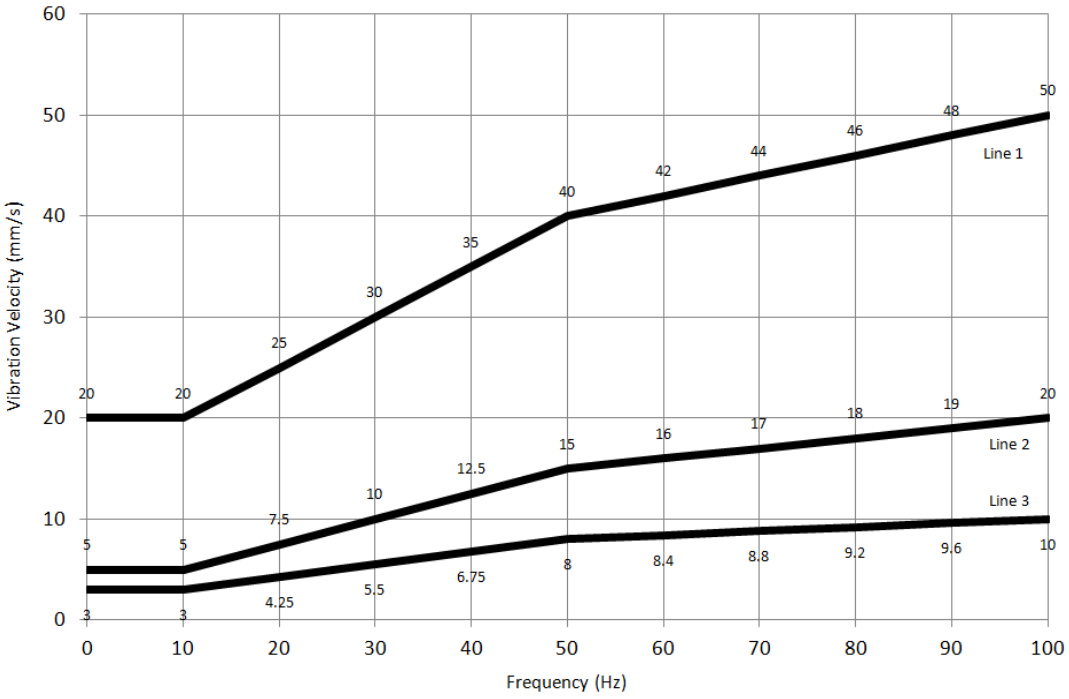

Figure 1: DIN 4150–3: 1999 guideline values for short-term vibration

4.3.2 Vibration amenity limit

The works will be during the daytime only 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.

4.4 Construction noise and vibration mitigation

The following measures will be adopted to minimise construction noise and vibration emissions and avoid unnecessary effects on the neighbouring sites.

1. The occupants of dwellings within 100 meters of the site (identified in Section 4.1) will receive written communication at least five days before earthworks begin. This communication will provide an overview of the works, approximate dates for the noisiest activities, and contact details for any questions or concerns.
2. Temporary construction noise 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 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.
3. Construction work will only occur between 7:00 AM and 6:00 PM on Monday to Saturday. There will be no noisy work at night or on Sundays and public holidays.
4. Any machinery and heavy vehicles operated on the site between 7:00 AM and 7:30 AM on Monday to Saturday will be at least 130 m from any occupied building. This will ensure the lower noise limits of 55 dB L_{Aeq} and 70 dB L_{Amax} at will be readily complied with.

4.5 Construction noise levels

We have calculated construction noise levels at the neighbouring sites based on reasonable worst-case scenarios and the references displayed in Table 2. Our references are based on measurement data. They 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 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.
- The mitigated compliance distances are based on construction noise barriers effectively screening the ground level of the building from the noise generating activity and reducing the noise levels 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)
Bored piling with a 20-t excavator	79 dB	38 m	12 m
Demolition of a building with a 20-t excavator	78 dB	34 m	11 m
D6, D7, or D8 bulldozer working in small area	76 dB*	27 m	9 m
Padfoot vibratory compaction roller 15t – 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
Drilling with a 6-t – 10-t excavator	72 dB	17 m	6 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

Construction activity	Unmitigated $L_{Aeq(15\ min)}$ noise level at 10 m	Unmitigated compliance distance	Mitigated compliance distance (with noise barrier)
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
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

* Reference noise level is for a moving noise source.

Most of the activities on site will be outside of the unmitigated compliance distances displayed in Table 2 and will not require acoustic screening. All construction activities will be outside of the mitigated compliance distances.

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

- Operating all machinery and heavy vehicles at least 130 m from any occupied building between 7:00 AM and 7:30 AM (this is the minimum unmitigated compliance distance for compliance with the early morning limits of 55 dB L_{Aeq} and 70 dB L_{Amax}).
- Undertaking all other construction work between 7:30 AM and 6:00 PM on Monday to Saturday (when higher permitted noise limits apply).
- Using the smallest plant practicable to complete the work.
- Using temporary construction noise barriers.
- Operating outside of the compliance distances displayed in Table 2.

The construction activities that may require acoustic screening for compliance between 7:30 AM and 6:00 PM (depending on their location) are summarised in Table 3 for reference.

Table 3: Acoustic barriers required for compliance between 7:30 AM and 6:00 PM

Construction activity	Unmitigated compliance distance	Receivers where a 2.4 m high acoustically effective barrier may be required for compliance
Bored piling with a 20-t excavator	38 m	• 480 Wainui Rd • 68 Cemetery Rd • 104 Cemetery Rd • 142 Young Access
Demolition of a building with a 20-t excavator	34 m	• 68 Cemetery Rd • 104 Cemetery Rd • 142 Young Access
D6, D7, or D8 bulldozer working in small area Padfoot vibratory compaction roller 15-t– 20-t	27 m	• 142 Young Access
Drilling with a 12-t excavator	24 m	• 142 Young Access
Plate compactor	22 m	• 142 Young Access
Cut and fill, clearing, and loading trucks with a 40-t – 50-t excavator Cat 825 static compactor 30-t Drilling with a 6-t – 10-t excavator	17 m	• 142 Young Access

The highest construction noise levels during the closest activities will be approximately 60 to 70 dB $L_{Aeq(15\ min)}$ at the neighbouring sites. When construction activities are more distant the noise levels will range from 50 to 60 dB $L_{Aeq(15\ min)}$. There will be periods when little or no noise is generated.

The predicted construction noise levels represent the peak 15-minute periods during the noisiest and closest activities. They are not averaged and 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 consistently comply with the permitted L_{Amax} noise limits.

4.6 Construction vibration levels

The highest construction vibration levels for the receivers identified in Table 1 will be generated during excavation, compaction, and heavy vehicle movements in the nearest areas of the site.

The vibration levels in the dwellings will depend on the separation distance, the size of the plant and how it is used, the ground conditions, and the response of the dwelling.

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 (see Table 1).

Construction vibration may be perceptible for the receivers identified in Table 1 when heavy construction machinery is used in the nearest area of the site, but it will not exceed 2 mm/s PPV. The highest vibration levels at these times will be generated intermittently over the day. The vibration is unlikely to be perceptible indoors once the works are 50 m away from the dwelling.

4.7 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 will minimise the potential effects.

The potential effects typically associated with construction noise 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 following vibration mitigation measures have been adopted by the applicant and offered as conditions of consent. In our experience, these will minimise effects on residential amenity.

- Limit perceptible vibration to daytime hours only.
- Let the residents know when to expect perceptible vibration.
- Inform the residents that the AUP limits for avoiding cosmetic building damage will be consistently complied with.
- Provide contact details for any questions or concerns.

Temporary construction noise and vibration effects are unavoidable during large-scale residential developments near occupied dwellings. Elevated noise levels and noticeable vibration are expected for short periods when heavy machinery operates near the site

boundary. However, noise and vibration will remain within the permitted limits set by the AUP for long-term construction projects and significantly lower during most of the proposed work.

We do not expect construction noise and vibration to cause unreasonable disturbance on any neighbouring site if our recommended conditions in section 6.0 are adopted.

5.0 Operational noise assessment

We understand a temporary water booster pumping station is required within Stage 13 until supply from the Orewa 3 Main is available. The pumping station will be constructed on Lot 474 and operated continuously for approximately ten years.

There will not be any occupied dwellings on the adjacent lots when the pump station is constructed, so this section only addresses the potential operational noise effects of the pumping station.

Further information on the pumping station can be found in the application document *Water Booster Pumping Station – Fast Track RC Memo*, Woods, 11 February 2025.

5.1 AUP noise standards

Lot 474 and the adjoining lots 472 and 473 are within the Residential – Mixed Housing Urban Zone. The AUP noise limits for permitted activities in the zone under standard E25.6.2 are:

- Monday to Saturday: 50 dB L_{Aeq} from 7:00 AM to 10:00 PM; 40 dB L_{Aeq} and 75 dB L_{Amax} at all other times.
- Sunday: 50 dB L_{Aeq} from 9:00 AM to 6:00 PM; 40 dB L_{Aeq} and 75 dB L_{Amax} at all other times.

The permitted limits apply at any point within the boundary of any other residentially zoned site. Standard E25.6.1.1 requires all operational noise to be measured and assessed in accordance with NZS 6801:2008 and NZS 6802:2008.

5.2 Noise sources

The operational noise sources include two 5.5 kW water pumps with variable speed controllers, and a larger fire water pump. These will all be housed within the pumping station building.

The two main pumps may operate simultaneously day or night, but neither will operate at the same time as the fire pump. The manufacturer noise data for the pumps are:

- 5.5 kW water pumps: 70 dB L_{Aeq} at 1 m (each),
- Variable speed controllers: 60 dB L_{Aeq} at 1 m (each),
- Fire water pump: 75 dB L_{Aeq} at 1 m.

The variable speed controllers will operate intermittently and may produce noise with a distinct tonal quality.

5.3 Noise mitigation

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

- The pumping station building will have composite reductions of at least 35 dB through the western façade, 30 dB through the northern and southern façades, 25 dB through the eastern façade, and 30 dB through the roof. This is achievable by including the following mitigation measures in the design (or acoustic performance equivalents):
    i. Using precast concrete and blockwork walls.
    ii. No ventilation points on the western façade.
    iii. All ventilation points located on the eastern façade with acoustic louvres, or on the northern or southern facades with high-performance acoustic louvres.
    iv. Solid acoustic rated access doors with perimeter and threshold seals.
    v. Long-run roofing on 16 mm structural sarking, R1.8 batts, and 13 mm high-density plasterboard (Noiseline).
- Vibration isolation for the water pumps.
- A 1.8 m high acoustically effective fence above the 1.35 m high retaining wall on the western boundary of the site (a total barrier height of approximately 3.15 m relative to the finished floor level of the pump station building).

Our modelling of the breakout noise from the building is based on the minimum reductions. Adopting the above design would result in a greater reduction than we have modelled. The final design of the building is not available at this stage, so we have recommended a condition of consent requiring minimum reductions through the facade and roof constructions.

5.4 Noise level predictions

We have calculated operational noise levels at the nearest residentially zoned lots based the typical scenario of the two smaller pumps operating, and the worst-case scenario of the larger pump operating. Predicted noise levels based on the minimum reductions through the pump station building are displayed in Table 6.

Table 6: Predicted operational noise levels

Location	Noise level with two water pumps and the variable speed controllers operating simultaneously	Predicted noise level with fire water pump operating
Lot 472		
Within the boundary:	25 dB $L_{Aeq(15\ min)}$	27 dB $L_{Aeq(15\ min)}$
At the upper-level façade:	29 dB $L_{Aeq(15\ min)}$	31 dB $L_{Aeq(15\ min)}$
Lot 473		
Within the boundary:	28 dB $L_{Aeq(15\ min)}$	30 dB $L_{Aeq(15\ min)}$
At the upper-level façade:	29 dB $L_{Aeq(15\ min)}$	31 dB $L_{Aeq(15\ min)}$

The predicted levels are the highest $L_{Aeq(15\ min)}$ noise levels that will be generated under each scenario. These have been used to derive a Noise Rating Level for comparison with the AUP permitted noise standards by making any applicable adjustments for duration and special audible characteristics under NZS 6802:2008.

The water pumps can operate continuously on any day, so the noise emissions do not qualify for any duration adjustment.

Variable speed controllers typically produce noise with a distinctive “whine” that can cause additional annoyance. However, we have not applied any adjustment for special audible characteristics because the noise from the controllers will be heavily mitigated and is unlikely to be audible at the neighbouring lots.

The highest Noise Rating Level will be no more than 31 dB L_{Aeq} at lot 473. This complies with the AUP permitted noise limits of 50 dB L_{Aeq} during the day and 40 dB L_{Aeq} at night – by margins of 19 dB and 9 dB, respectively.

If the sound were to include an audible whine at the neighbouring lots, the Noise Rating Levels would be 5 dB higher, but still compliant with the permitted limits by at least 14 dB during the day and 4 dB at night.

The L_{Amax} noise levels are unlikely to be more than 10 dB higher than the L_{Aeq} noise levels and will comply with the permitted limit of 75 dB L_{Amax} by a significant margin.

5.5 Potential noise effects

The operational noise emissions will comply with the AUP noise limits for permitted activities in the zone by a considerable margin with the proposed mitigation in place.

The sound of the water pumps operating is unlikely to be audible at the adjacent lots during the day and will not cause annoyance or sleep disturbance at night.

We do not expect the operational noise levels to cause unreasonable disturbance on any neighbouring site.

6.0 Recommended conditions

We recommend the following conditions for the project:

1. The consent holder must advise the occupants of all dwellings within 100 m of the site boundary of the project at least five days before earthworks begin. The advice must be provided in writing and must include the following information:
   i. A general description of the construction works including the duration of the project and the working hours on site.
   ii. The approximate dates and durations of the activities that will generate the highest levels of construction noise and vibration for them.
   iii. A contact name and phone number to advise of any sensitive times for high noise levels and for any questions or complaints during the project.
2. All construction works authorised by this consent must only take place between 7:00 AM and 6:00 PM, Monday to Saturday, with no works undertaken at any time on Sundays or public holidays. Heavy plant must not be operated within 130 m of any occupied dwelling before 7:30 AM. This condition does not prevent quiet activities from taking place on site outside of standard construction hours, providing they are generally inaudible outside the neighbouring dwellings (e.g., toolbox meetings on site).
3. Temporary construction noise barriers must be used to screen any construction work undertaken within the unmitigated compliance distances displayed in the following table. The barriers must be at least 2.4 m high. They must have a surface mass of at least 7 kg/m^2 or be constructed from proprietary construction noise panels.

Construction activity	Unmitigated compliance distance from an occupied dwelling
• Bored piling with a 20-t excavator or rig	38 m
• Demolition with a 20-t excavator	34 m
• Bulldozer • 15 – 20-t vibratory compactor	27 m
• Drilling with a 12-t excavator or rig	24 m
• Plate compactor	22 m

Construction activity	Unmitigated compliance distance from an occupied dwelling
• 40 –50-t excavator • 30-t static compactor • Drilling with a 6-t – 10-t excavator or rig	17 m

4. The pumping station building must be designed and constructed to achieve composite sound level reductions of at least 35 dB through the western façade, 30 dB through the northern and southern façades, 25 dB through the eastern façade, and 30 dB through the roof. Compliance with the minimum specifications must be confirmed by a suitably qualified and experienced person at the detailed design stage of the project. The final design and the input of an appropriately qualified person must be provided to Auckland Council in writing on request.

5. The consent holder must construct an acoustically effective fence along the western boundary of lot 474 that adjoins lots 472 and 473. The fence must be solid and have a minimum surface mass of 10 kg/m^2. The fence must be no less than 1.8 m high above the retaining wall. It must be maintained as an acoustically effective barrier for as long as the water boosting pumping station is operated.

7.0 Conclusion

Styles Group has assessed the potential noise effects of the proposed activity for Stages 10-13 of the Milldale Development.

Construction noise and vibration will consistently comply with the AUP permitted limits. This will be achieved by undertaking all noisy activities between 7:00 AM and 6:00 PM on Monday to Saturday, applying minimum setback distances, and using temporary construction noise barriers. The potential noise and vibration effects will be mitigated by communicating with the neighbours before the works begin.

Construction noise will be noticeable outside the neighbouring dwellings and may dominate the noise environment during the day while the nearest earthworks are completed. However, this will be for a short duration and the noise 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 limits for most of the project.

Noise from the proposed operation of the temporary pumping station will comply with the AUP noise limits for permitted activities in the Residential – Mixed Housing Urban Zone.

With the proposed robust design of the pump station building and an acoustically effective fence along the western boundary of the site, the sound of the water pumps operating is

unlikely to be audible on adjacent lots during the day and will not cause annoyance or disrupt sleep at night.

Noise emissions from the proposed activities will not cause unreasonable disturbance on any neighbouring site if our recommended conditions are adopted.

Appendix A Glossary

Noise	A sound which serves little or no purpose for the exposed persons and is commonly described as ‘unwanted sound’. The definition of noise includes vibration under the Resource Management Act.
dB (decibel)	The basic measurement unit of sound. The logarithmic unit used to describe the ratio between the measured sound pressure level and a reference level of 20 micropascals (0 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.
$L_{Aeq(t)}$ (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 time period of interest.
L_{AFmax} (dB)	The maximum A-weighted sound pressure level recorded during the measurement period using a fast time-weighting response.
PPV (mm/s)	Peak particle velocity is the metric commonly used for measuring construction vibration in New Zealand. It is the instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position.