Watercare Services Limited

QUEEN STREET WASTEWATER DIVERSION PROGRAMME: MAYORAL DRIVE ALIGNMENT PROJECT

CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

21 MAY 2025

PUBLIC

QUEEN STREET WASTEWATER DIVERSION PROGRAMME: MAYORAL DRIVE ALIGNMENT

CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

Watercare Services Limited

WSP
Auckland
Level 3 The Westhaven
100 Beaumont St
Auckland 1010, New Zealand
+64 9 355 9500
wsp.com/nz

REV	DATE	DETAILS
0	24/11/2023	Draft issue for comment
1	19/12/2024	Update for alignment change
2	14/05/2025	Update for shaft location changes
3	21/05/2025	Update from Client feedback

	NAME	DATE	SIGNATURE
Prepared by:	George van Hout	21/05/2025	
Reviewed by:	Kezia Lloyd-Marsh	21/05/2025	
Approved by:	Kezia Lloyd-Marsh	21/05/2025	

TABLE OF CONTENTS

ABBREVIATIONS AND DEFINITIONS

Abbreviation	Definition
AT	Auckland Transport
Auckland Council	The 'Council'
AUP	Auckland Unitary Plan (Operative in Part)
BPO	Best Practicable Option
CNVA	Construction Noise and Vibration Assessment
CNVMP	Construction Noise and Vibration Management Plan
CSA	Construction Support Area
EOP	Engineered Overflow Points
NSR	Noise and Vibration Sensitive Receptor(s)
The Project	The new wastewater pipeline between Part 3 – Part 4 Connector Tunnel within 329 Queen Street and P1MH1 within Vincent Street
Watercare	Watercare Services Limited
WSP	WSP New Zealand Limited

GLOSSARY

Term	Definition/Description
A-weighting, dBA	A frequency weighting designed to reflect the relative loudness perceived by the human ear. It de-emphasises frequencies in which the ear is less sensitive and is commonly used to measure environmental and industrial noise, ensuring readings are more representative of human auditory perception.
Decibel (dB)	The decibel (dB) is a logarithmic scale that allows a wide range of sound pressures to be represented in a more comprehensible range, typically 0 dB to 120 dB. The decibel is ten times the logarithm of the ratio of sound energy (i.e., power squared, or pressure squared relative to a reference level squared). The reference level for sound pressure is typically 20 µPa which is the approximate threshold of human hearing.
Façade Level	A noise level measured/assessed at one metre in front of a sound reflecting object such as a building façade and including the contribution of the sound reflection.
Free-Field Level	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5 metres.
Equivalent Continuous Sound Pressure Level, $L_{eq,T}$	Many sounds, such as road traffic noise or construction noise, vary repeatedly in level over a given time period. $L_{eq,T}$ is the equivalent continuous sound level over a given time period (T). It is often referred to as the 'average' level.
Maximum Sound Pressure Level, L_{max}	The absolute maximum sound level recorded over the measurement period.
Peak Particle Velocity (PPV)	The peak speed in a particular direction a particle travels at the measurement location resulting from vibration.
Sound Power Level, L_w or SWL	A measure of the total acoustic energy emitted by a source. Expressed in decibels (dB), it represents the intrinsic acoustic output of a source and is independent of distance from the source or the specific conditions of the surrounding space.
Sound Pressure Level, L_p or SPL	The sound pressure level of a source, in dB, varies with distance from the noise source and with the environment in which it is located. Sound pressure simply put is a deviation over atmospheric/ambient pressure due to sound energy from a source or reflection propagating through a medium over time.

EXECUTIVE SUMMARY

WSP New Zealand Limited (WSP) has been engaged by Watercare Services Limited to assess the construction noise and vibration effects in relation to the Mayoral Drive Alignment of the Queen Street Wastewater Diversion programme of works.

The Mayoral Drive alignment involves the installation of a new wastewater pipe between the P4MH3 shaft within 329 Queen Street and the P1MH1 shaft within Vincent Street, along with connections to 'engineered overflow points' ('EOPs') and manholes.

Noise and vibration criteria have been developed based on the Auckland Unitary Plan (AUP). Noise from construction works within the roading corridor is exempt from the construction noise limits, provided that a Construction Noise and Vibration Management Plan (CNVMP) is developed with the measures being implemented. While a CNVMP will be adopted by the contractor, we have assessed noise regardless of the location of the works under this Application.

The construction methodology for the installation of the wastewater pipework has been provided by Fulton Hogan Limited and the WSP design team. This methodology has been used to develop the phases of construction and equipment used as part of the Project.

Physical mitigation that is proposed by the contractor are solid site hoardings around the construction support areas ('CSA's) within Mayoral Drive and Vincent Street. However, as many of the surrounding buildings are multi-story, the screens are unlikely to be effective for receptors above ground level.

Managerial mitigation measures are also being adopted by the contractor. These include operating a plate compactor (as opposed to a vibratory roller) near the Historic Heritage Overlay, and advising adjacent buildings prior to high noise and vibration generating works.

Based on the construction methodology and proposed mitigation, the following properties are predicted to exceed the AUP noise limits from construction works outside the road corridor during daytime construction works:

- 321 Queen Street
- 323-327 Queen Street
- 329 Queen Street

The following properties are predicted to exceed the 60 dB $L_{Aeq,30min}$ night time noise limit from dewatering activities both inside and outside of the road corridor:

- 3 Greys Avenue
- 71 Greys Avenue
- 100 Mayoral Drive
- 299 Mayoral Drive
- 321 Queen Street
- 323-327 Queen Street
- 329 Queen Street

The exceedances from night time dewatering can be mitigated by specific placement of equipment and localised barriers/enclosures.

Overall, the predicted noise levels are conservative as it is assumed all equipment is operating concurrently and at ground level. Where equipment is not operating concurrently, located below ground level (i.e. bottom of a shaft), or for a shorter period of time, the predicted noise levels will be lower than those presented in this report. All practicable options of mitigation are also proposed to be adopted including plant selection, plant location, hours of operation, and noise mitigation.

The predicted noise levels for any stage/phase are assessed over a worst-case 30-minute period. This level of activity is unlikely to occur all day or occur continuously throughout the stage/phase. Therefore, noise levels for most of the time will be lower than those presented in the report.

Considering the implementation of physical and managerial mitigation, the adoption of a CNVMP, and levels throughout a day/phase (rather than the worst-case 30-minute level), the noise effects are predicted to be reasonable.

No properties are predicted to exceed the Section E25.6.30(1)(a) or (b) vibration limits. Therefore, vibration effects are predicted to be acceptable.

We have therefore not identified any parties that receive obvious or unreasonable levels of noise and vibration based on this analysis, and as such, there are no affected parties.

1 INTRODUCTION

Watercare is proposing to upgrade the existing wastewater network of the upper (southern) catchment of Auckland City Centre. The current network has insufficient capacity to meet future needs based on increased development in the area. The wider programme of works has been split into separate parts for the purpose of design, consenting and construction; the consenting and construction packages of the Queen Street Wastewater programme are shown in Figure 1-1.

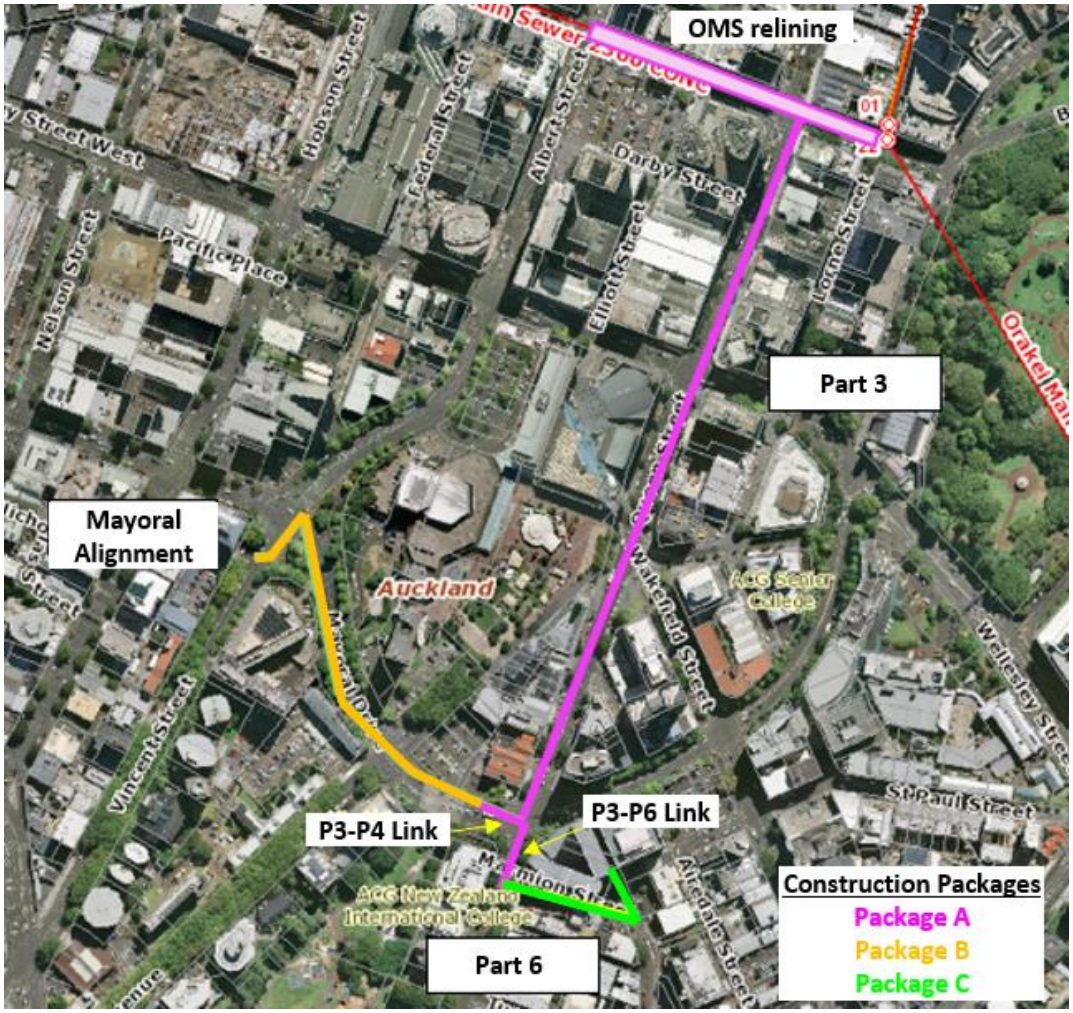


Figure 1-1: Queen Street Wastewater Diversion Programme

The Mayoral Alignment (Package B in Figure 1-1) involves a new wastewater pipe within or adjacent to the road reserve of Mayoral Drive. The works proposed under this consent ('the Project') include a 375mm – 700mm diameter wastewater pipeline between the P4MH3 shaft within 329 Queen Street and the P1MH1 shaft within Vincent Street, along with connections to 'engineered overflow points' ('EOPs') and manholes.

1.1 PURPOSE OF THIS REPORT

The purpose of this report is to provide an assessment of construction noise and vibration in relation to the Mayoral Drive alignment project only.

Works involved with the other Parts of the Queen Street Wastewater Diversions Programme are outside the scope of this report.

Noise and vibration within the Greys Ave construction compound are captured within the existing consent for the Part 3 Alignment (BUN60422974) and the Part 3 – Part 4 Connector Tunnel (BUN60425924) projects.

1.2 INFORMATION SOURCES

This report is based on discussions with the consenting team and contractor, along with the following documentation:

- Alignment drawings titled *Queen Street Wastewater Diversions Project; Mayoral Alignment and Cross Connections; updated alignment*, drawing number 2014250.XX, issue 1, prepared by Watercare Services Limited, and dated 26 March 2025.
- Construction methodology titled *Construction Methodology; Queen Street Wastewater Diversions – Package B*, revision 5, document number QSSD-CS-XXXX, dated 15 February 2025.

2 DESCRIPTION OF EXISTING ENVIRONMENT

The project is located within Auckland City Centre, on a section of Mayoral Drive between Queen Street and Vincent Street/Cook Street, along with a short extension within Vincent Street (see Figure 2-1 for approximate project area). In addition, the project works will also occur within a surface carpark at 34-38 Greys Avenue and 329 Queen Street. The CSA site will contain both a section of the proposed wastewater pipeline and the CSA for the Queen Street programme[1].

Figure 2-1: Mayoral Drive Alignment project area in orange

The land use surrounding the works generally consists of multi-storey commercial buildings and visitor accommodation. The Auckland Civic Precinct is located to the north of Mayoral Drive and contains a range of landmarks including Auckland Town Hall, Aotea Square, Aotea Centre, and the former Civic Administration building, which has been recently renovated and converted into apartments. The former police headquarters building is located at the Project terminus on Vincent Street. This building is currently disused and vacant.

2.1 ZONING AND OVERLAYS

The majority of the construction works are located within the road corridor. A new shaft and trenchless construction will also occur within the Greys Ave carpark, zoned *Business – City Centre Zone*. All surrounding buildings adjacent to the sites are within the Business – City Centre Zone. Some adjacent buildings are also protected by the Historic Heritage overlay of the AUP.

[1] The CSA at 34-38 Greys Avenue and 329 Queen Street has been established under the 'Part 3' consent and retained for the Mayoral Drive alignment construction works.

The zoning of the alignment and surrounding areas are illustrated in Figure 2-2.

The City Centre Residential Precinct (red box in Figure 2-2) provides for higher levels of amenity in areas within the Business – City Centre Zone. The more stringent night time limits are applied to Noise and Vibration Sensitive Receptor(s) (NSR) in this area.

Figure 2-2: Proposed Project area (orange), zoning, and overlays

2.2 AMBIENT NOISE ENVIRONMENT

The existing ambient noise environment around the site includes noise emissions from activities on adjacent sites, road traffic noise, pedestrian noise, noise from activities within the street or recreation areas (Myers Park or Aotea Square) and other environmental noise.

To quantify the ambient noise environment, ambient noise measurements were undertaken along the Project area on Wednesday, 15 November 2023, from 0730 to 1600 hours. Noise measurements were in general accordance with NZS 6801:2008[2].

Weather observations taken whilst on site noted low wind speeds (< 4 m/s) and dry, overcast (8 octa) conditions. Given the nature of the site and surroundings, none of the weather conditions

[2] NZS 6801: 2008 *Acoustics – Measurement of Environmental Sound*

observed during the survey period are considered to have adverse effects on the validity of the measurement results. The traffic was flowing freely with no road lane restrictions and no events occurring within Myers Park or Aotea Square.

Figure 2-3 presents the location of the noise measurements, and the measured noise levels are provided Table 2-1.

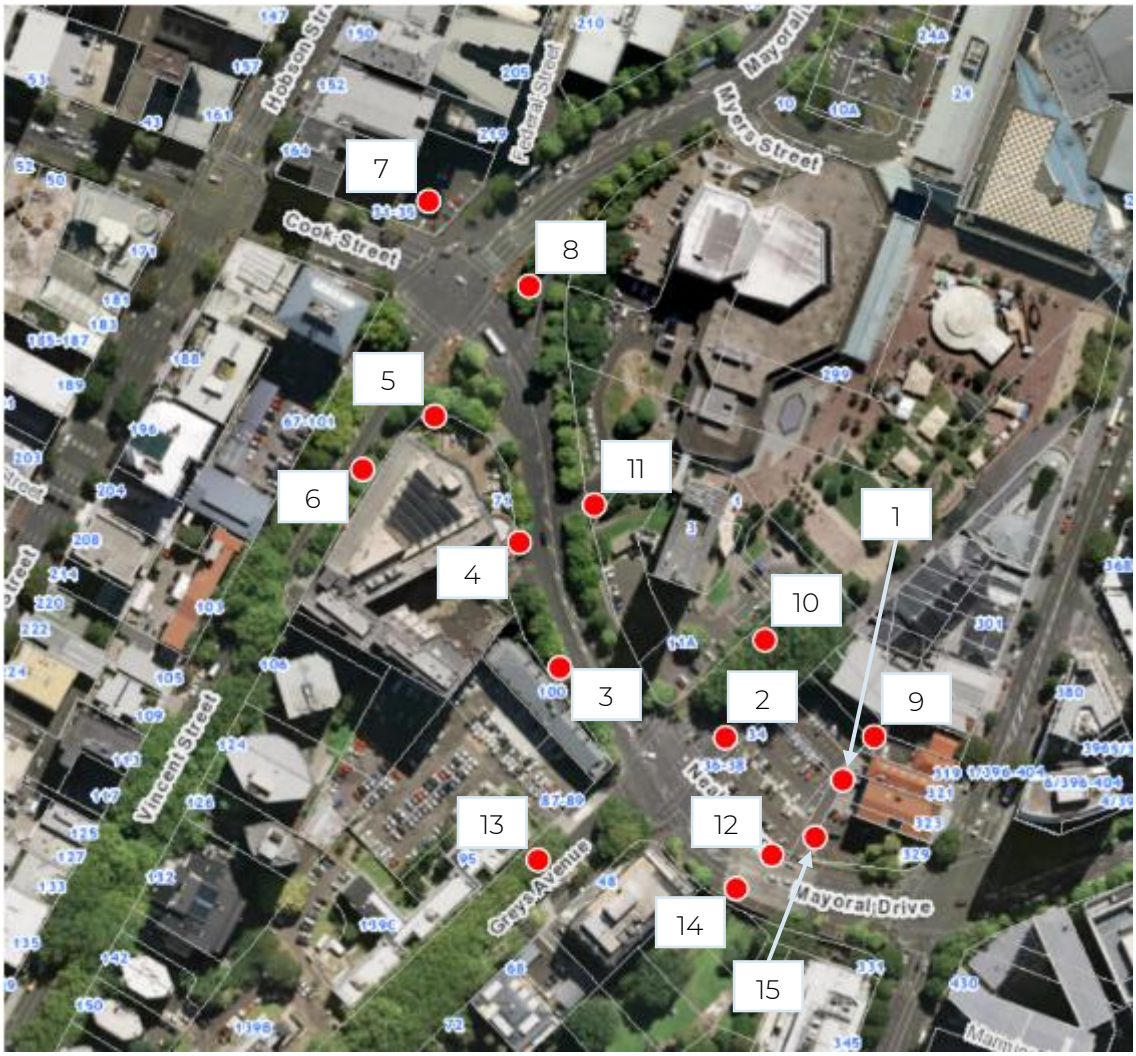


Figure 2-3: Ambient noise environment measurement locations

Table 2-1: Ambient noise environment measurement results

POSITION	START TIME	DURATION (MM:SS)	$L_{Aeq,T}$ (dB)	L_{AFmax} (dB)
1	9:42:40 am	15:00	56	75
	2:37:19 pm	15:00	54	66
2	9:24:45 am	15:00	60	80
	1:28:59 pm	15:00	61	76
3	1:04:29 pm	06:24	63	72
	3:20:15 pm	15:00	64	83
4	7:43:06 am	15:00	62	83
	12:18:22 pm	15:00	62	77
5	8:01:44 am	15:00	60	75
	11:58:03 am	15:00	62	85
6	8:28:28 am	15:00	59	80
	11:40:51 am	15:00	59	72
7	8:52:00 am	05:07	59	66
	12:37:13 pm	05:07	57	64
8	9:01:29 am	05:24	59	71
	12:48:27 pm	05:11	62	84
9	10:00:28 am	15:00	57	70
	2:53:27 pm	15:00	57	74
10	9:15:50 am	05:02	56	71
	1:21:57 pm	05:01	58	72
11	12:55:21 pm	05:01	62	73
12	10:26:40 am	05:08	64	82
	1:46:26 pm	05:03	66	83
13	1:13:37 pm	05:04	58	72
14	3:12:16 pm	05:05	64	77
15	10:16:48 am	05:20	55	70

In addition to the ambient noise measurements, noise and vibration measurements of the equipment on other stages of the Queen Street Wastewater Diversions programme (Part 3) have been undertaken. The measured equipment levels have been used in this analysis, as the same contractor will be used for the Mayoral Drive Alignment section of these works.

2.3 NOISE AND VIBRATION SENSITIVE RECEPTORS

The land use around the Project is a mixture of retail, commercial, hospitality, civic, and residential, representing a highly developed urban environment. Land uses of the nearest noise sensitive receptors (NSRs) to the Project Area (orange) are indicated in Figure 2-4.

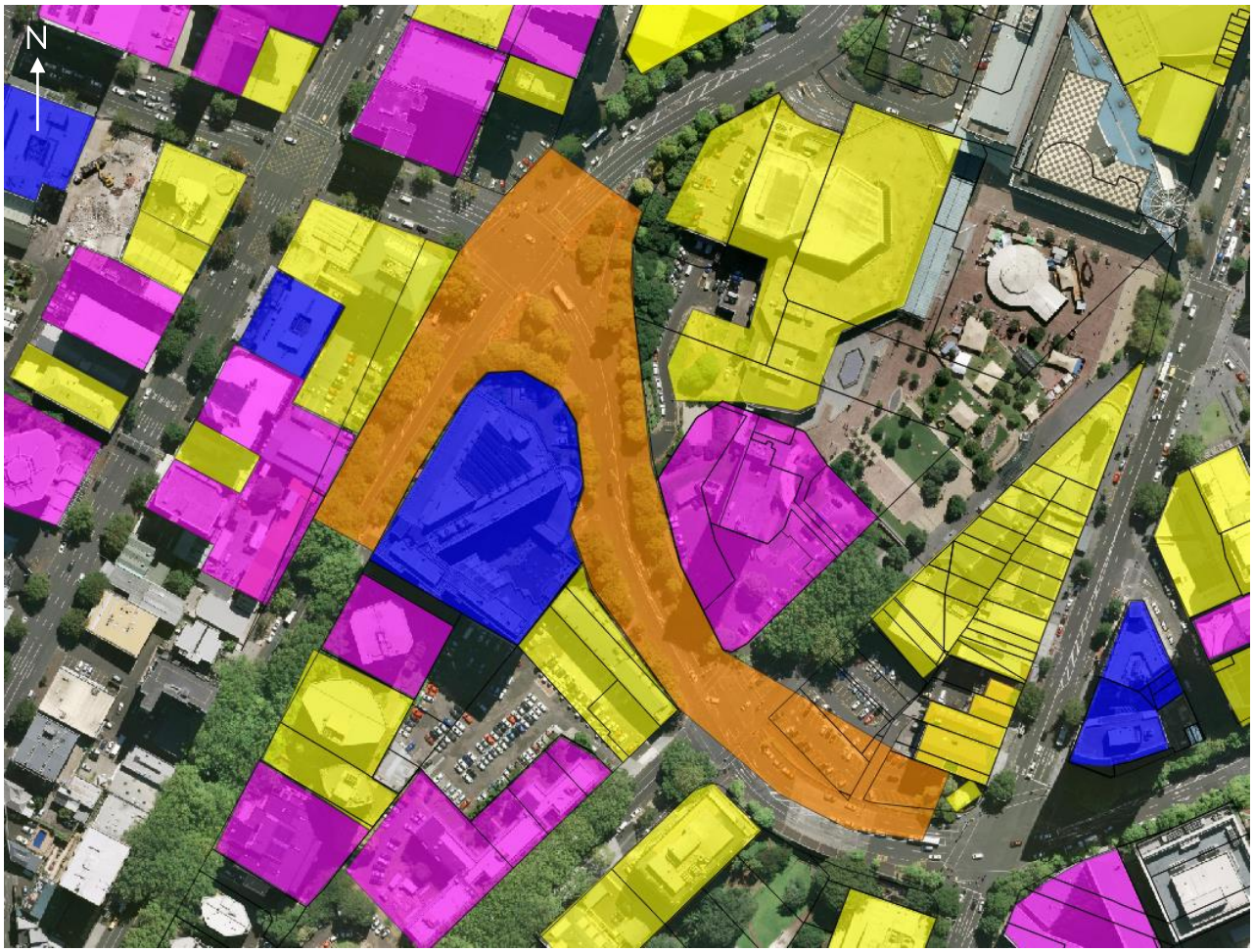


Figure 2-4: Adjacent noise sensitive receptor building types – commercial (yellow), hotels (blue), apartments (pink)

The Project is also located adjacent to buildings within the Historic Heritage Overlay of the AUP. Specifically, these properties are:

- 323 – 327 Queen Street
- 3 Greys Avenue
- 95 Greys Avenue
- 168 Hobson Street

These properties are likely to be more sensitive to vibration and therefore specific management procedures may need to be adopted by the contractor to minimise vibration impacts. These management procedures will be captured in a Construction Noise and Vibration Management Plan (CNVMP).

However, we note that 3 Greys Ave was recently substantially rebuilt and converted into an apartment building. Therefore, while this is within the Historic Heritage overlay, it is unlikely to be a sensitive vibration structure.

3 NATURE OF WORK (ACTIVITIES) SUBJECT TO ASSESSMENT

The following is a summary of the construction activities to which the resource consent relates. For more details on the nature of the works proposed, refer to the Construction Methodology (**Appendix C of the Application**). The Construction Methodology has been based on a likely scenario and has been developed to provide a baseline assessment.

The Project will be constructed using a combination of trenchless pilot bore and open-cut trenching excavation, with shafts utilised along the alignment to launch and receive the pilot boring machine. An overview of the proposed construction activities is shown below as Figure 3-1.

To ensure flexibility in the consenting process, a consenting envelope approach has been adopted for all shaft dimensions and the construction compounds. The dimensions specified within the consent allow for changes through the detailed design phase.

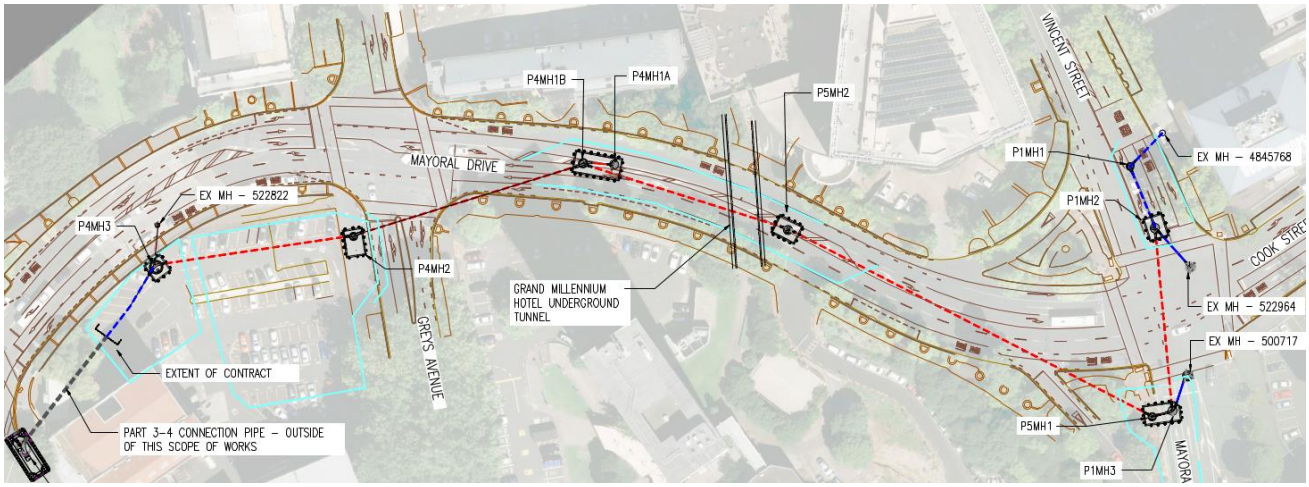


Figure 3-1: Overview of main indicative construction works (red lines are trenchless pipelines, blue are trenched pipelines)

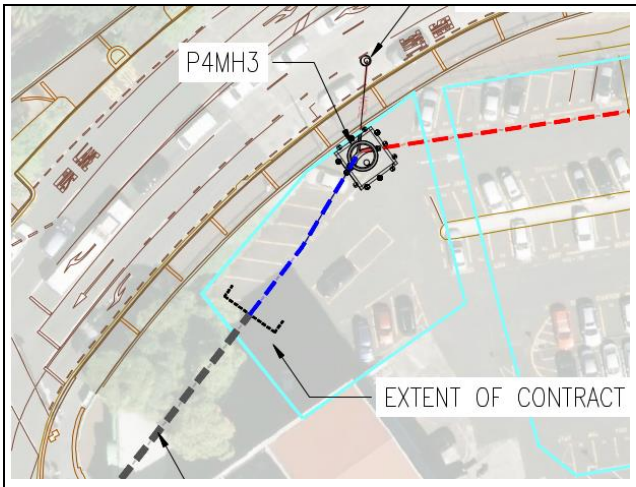
Table 3-1 provides a high-level overview of the different construction activities and stages, which are provided in greater detail within the Construction Methodology.

Table 3-1: Overview of the different construction activities and stages

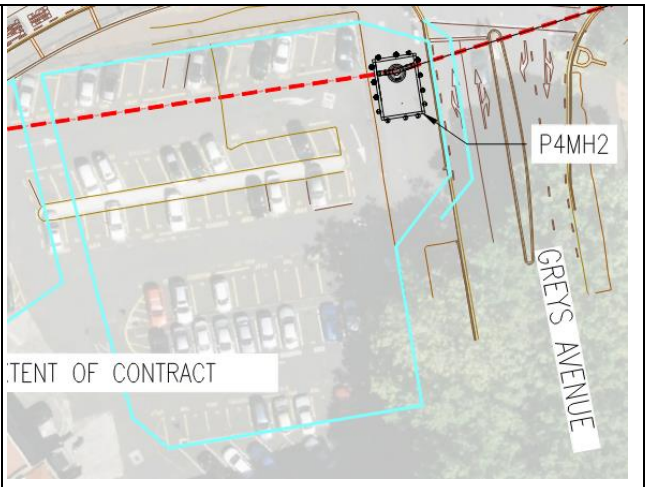
Network Utility Relocations	The existing network utilities within and around the proposed shafts will need to be relocated. The exact utilities to be diverted are yet to be confirmed, but will likely include potable water, electricity, wastewater, stormwater and communications. Open-cut progressive trenching will be utilised to relocate any utilities that are required to be relocated. New utilities will be constructed around the proposed shaft locations, and the existing utilities will be removed during shaft construction. Dewatering of the trenches may be required.

Temporary Construction Shafts	Most manhole locations on this alignment will be used as launch/reception pits for the trenchless construction method (axis/pilot bore). Six construction shafts are proposed along the Mayoral Drive alignment. The trenchless method requires shafts with maximum internal dimensions of 5.5 m x 12 m and a maximum depth of 9 m. The shafts are expected to be constructed using a 'post and panel' type methodology (subject to geotechnical investigations and shaft temporary works design). Refer to Section 3.1 of the Construction Methodology (Appendix C of the Application) for the steps to construct the temporary shafts.
Trenchless Tunnelling Works	It is proposed to construct the tunnelled sections between manholes P4MH3 (within Greys Avenue Carpark) and P1MH2 (within Vincent Street, opposite the intersection with Mayoral Drive) of the wastewater pipeline using a trenchless pilot-guided boring methodology. Refer to Section 3.2 of the Construction Methodology (Appendix C of the Application) for more detail of the trenchless tunnelling methodology.
Open Cut Construction Works	Open-cut construction is proposed for two short sections of the proposed pipeline between the shafts for P4MH3 and the P3-P4 Connector Tunnel within 329 Queen Street, and between P1MH1 and the shaft within Vincent Street. Open-cut construction is also proposed for network tie-ins and connections to existing EOPs. Refer to Section 4 of the Construction Methodology (Appendix C of the Application) for more detail of the trenchless tunnelling methodology.
Construction Support Areas	To support the proposed construction activities, a primary CSA will be used within the public carpark at 38 Greys Avenue and 329 Queen Street. This CSA is already set up as part of the approved Part 3 Alignment and will also be utilised for the Part 3 – Part 4 Connector Tunnel consents. The CSA may be reconfigured to respond to the works proposed for the Project. The CSA contains site offices and welfare facilities, along with some limited site laydown and materials storage areas. The indicative site layout for the Greys Avenue CSA is shown below in Figure 3-2 which reflects the set up for Part 3 construction. Three secondary construction compounds (compounds) will be established within the road corridor of Mayoral Drive and Vincent Street to allow for the construction of shafts and to undertake tunnelling works. In addition, the Greys Avenue CSA will be extended into the footpath at Greys Avenue to accommodate the construction of P4MH2. These compounds are expected to be in place for 6 to 8 months. Temporary concrete or steel barriers with hoardings will be constructed around the perimeter of each, with access gates one or both ends. The indicative compound boundaries around the possible shaft envelopes are shown in Figure 3-2 and Figure 3-3.

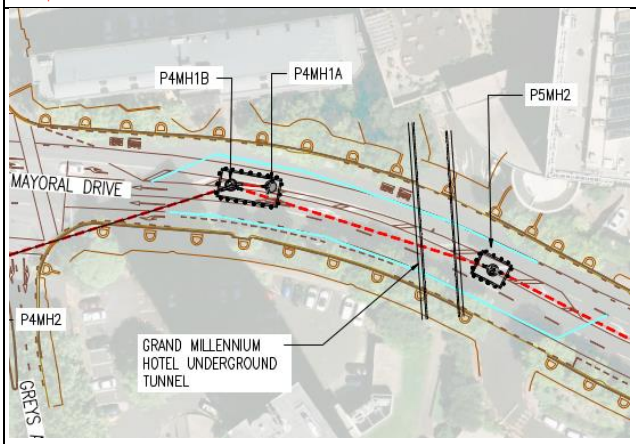
Figure 3-2: Indicative Greys Ave CSA layout (looking north-west towards Greys Ave)



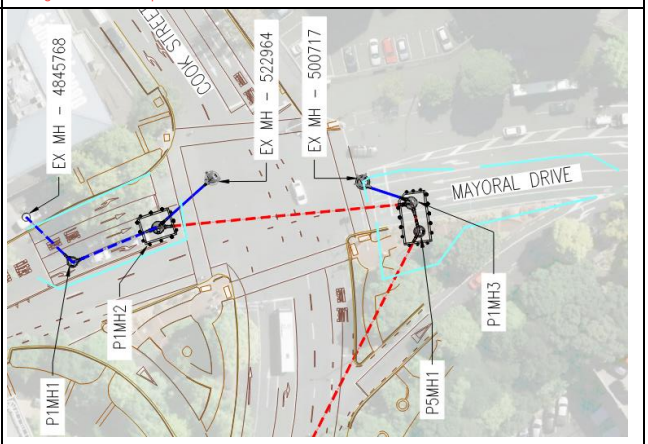
Indicative compound around P4MH3 within Greys Ave Carpark



Indicative compound on Greys Ave outside the CSA in the Greys Ave carpark



Indicative compound on Mayoral Drive outside 299 Queen Street, G05/1 Greys Ave



Two compounds at Cook St/Mayoral Drive/Vincent St intersection

Figure 3-3: Indicative compound locations used as part of the Project (extent shown in light blue)

3.1 CONSTRUCTION HOURS AND DURATION

The anticipated construction hours are noted in Table 3-2.

Table 3-2: Construction hours

WORKS	CONSTRUCTION HOURS
Network Utilities Relocation	Monday to Saturday – 0700hrs to 1800hrs
Shaft Construction	Monday to Saturday – 0700hrs to 1800hrs
Tunnelling works	Monday to Saturday – 0700hrs to 1900hrs
Open Trenching	Monday to Saturday – 0700hrs to 1800hrs

Sunday and night work will only be carried out if required by traffic management or Watercare operational restrictions such as for tie-ins/connections to existing pipe work.

Where dewatering is required, this will occur 24-hours a day.

An indicative construction programme is provided in **Appendix C** of the Application. It is currently expected that works will commence in Q4 2025, with the works being completed in Q3 2026 (expected duration of 9 months or 40-45 weeks).

4 PERFORMANCE STANDARDS

Section 16 of the Resource Management Act (RMA) requires occupiers of land to avoid unreasonable noise:

> *'Every occupier of land (including any premises and any coastal marine area), and every person carrying out an activity in, on, or under a water body or the coastal marine area, shall adopt the best practicable option to ensure that the emission of noise from that land or water does not exceed a reasonable level.'*

Guidance as to what a reasonable level of noise and vibration when assessed at NSRs is taken from *Chapter E25 – Noise and Vibration* of the AUP. This chapter sets out noise and vibration standards for permitted activities. Where the AUP noise and/or vibration standards are exceeded, then resource consent is required as a restricted discretionary activity.

4.1 CONSTRUCTION NOISE CRITERIA

This section outlines guidance as to what constitutes a reasonable level of construction noise for this Project.

Construction occurs within and outside of the road zone for this project. Therefore, AUP Standards E25.6.28 (for noise outside of the road zone) and E25.6.29 (for noise within the road zone) apply. These standards are reproduced in Appendix A – AUP Standards of this CNVA.

The following construction works occur outside of the road zone:

- Construction of P4MH2 and P4MH3
- Trenchless construction between P4MH2 and P4MH3
- Open trench works from P4MH3 to the temporary shaft constructed as part of the P3-P3 link project (shaft consented separately).

All other works occur solely within the road zone.

4.1.1 NOISE LIMITS OUTSIDE OF THE ROAD ZONE

The relevant noise standards that apply to construction works that occur outside of the road zone from Table E26.6.28.2 of the AUP are reproduced in Table 4-1.

Table 4-1: AUP construction noise limits in the Business – City Centre Zone

TIME	$L_{Aeq,30\ min}$ (dB)	L_{AFmax} (dB)
Monday to Friday 6.30am – 10.30pm	75	90
Saturday 7am-11pm	80	90
All other times (night time)	60	75
All other times in the City Centre Residential Precinct and the Learning Precinct	55	75

All works (other than dewatering) will occur during the day as such a 75 dB $L_{Aeq,30min}$ / 90 dB L_{AFmax} noise limit applies. Dewatering is proposed at night, and as such a 60 dB $L_{Aeq,30min}$ / 75 dB L_{AFmax} noise limit applies to this activity.

4.1.2 WORKS WITHIN THE ROAD ZONE

Noise during the day is exempt from achieving the Table E25.6.28.2 limits if it cannot practicably be made to comply with the limits due to the works and proximity of receivers (E25.6.29(3)(b), and a CNVMP is provided to Council a minimum of 5 days prior to works starting (E25.6.29(3)(d). An access permit will also be provided by Auckland Transport for these works (E25.6.29(3)(c).

AUP Standard E25.6.29(2)(a) requires that works between 10pm and 7am comply with the AUP Table E25.6.28.2 unless the works are for 3 nights or less.

Dewatering could occur for up to 6 months. Therefore, night-time dewatering would need to comply with the "at all other times" noise limits in Table 4-1 of this CNVA to be a permitted activity regardless of location.

However, under Section 16 of the RMA, there is still a requirement for construction noise to not exceed a reasonable level. There is also a requirement for the CNVMP to indicate the area impacted by the works (refer to Section 4.3 of this CNVA).

4.1.3 REGENERATED NOISE

Regenerated noise from a trenchless boring machine is typically assessed only when it operates during the night-time period, as this is when receptors are generally more sensitive, the background levels are lower, and sleep disturbance can cause health impacts (either if the boring machine operates 24-hours a day or only during the night-time period).

For this Project, the trenchless boring machine will only operate between 0700 and 1900 hours, Monday to Saturday, which is during a less sensitive time (during daytime hours only), in comparison to night time hours.

New Zealand Standard NZS 2107[3] presents recommended internal noise levels with the aim of providing *a healthy, comfortable and productive environment for the occupants and users,* which apply to spaces which are unoccupied but ready for occupancy. It is noted that the occupied noise levels are typically higher than the recommended limits in NZS 2107 when considering the operation/activity within spaces.

Based on the recommended internal noise levels in NZS 2107, the proposed criteria for regenerated noise are presented in Table 4-2.

Table 4-2: Recommended internal noise levels from regenerated noise from trenchless pipe construction

SPACE	RECOMMENDED INTERNAL NOISE LEVEL FOR REGENERATED NOISE FROM TRENCHLESS BORING ACTIVITIES
Office, retail, or hospitality	45 dB $L_{Aeq,T}$
Residential sleeping or living area in the inner city (including hotels)	35 dB $L_{Aeq,T}$

[3] NZS 2107:2016 *Acoustics – Recommended design sound levels and reverberation times for building interiors*

4.2 CONSTRUCTION VIBRATION CRITERIA

This section outlines guidance as to what constitutes a reasonable level of vibration.

4.2.1 AUCKLAND UNITARY PLAN

Section E25.6.30 of the AUP outlines the relevant vibration limits. This requires work within the road zone and outside of the road zone to achieve the vibration limits in DIN 4150:1999[4].

Construction works also need to achieve the vibration amenity criteria in AUP Table E25.6.30.1, reproduced in Table 4-3, as far as practicable. These vibration levels should not be used to restrict construction works. They should be used as a trigger for notification of high-vibratory works.

Table 4-3: AUP Table E25.6.30.1 vibration limits

RECEIVER	PERIOD	MAXIMUM PEAK PARTICLE VELOCITY (PPV) LIMIT, MM/S
Occupied activity sensitive to noise	Night-time 10pm to 7am	0.3
	Daytime 7am to 10pm	2.0
Other occupied buildings	At all times	2.0

There is an exemption from compliance with AUP Table E25.6.30.1 for works within the road zone, as outlined in AUP Standard 25.6.29(4A). This exemption applies if a works access permit is provided to Auckland Council prior to commencement of the works, and a CNVMP.

4.2.2 GERMAN STANDARD DIN 4150-3:1999

The German Standard DIN 4150-3 is an internationally recognised standard used to assess the effects of vibration on structures. The Standard is widely used throughout New Zealand and is referenced by many District Plans (or similar) including the AUP.

The vibration limits in DIN 4150-3 relate to avoiding cosmetic damage to buildings. DIN 4150-3 states:

'Experience has shown that if these values are complied with, damage will not occur. Exceeding the values in table 3 slightly does not necessarily lead to damage.'

The vibration limits outlined in DIN 4150-3 apply at the plane of the highest floor of various types of buildings. Structural damage is unlikely to occur in both residential and commercial structures at less than 50 mm/s and for in-ground structures and infrastructure services at less than 100 mm/s.

The short-term vibration limits outlined in Table 3 of DIN 4150-3 are outlined in Table 4-4.

[4] DIN 4150:1999 *Structural Vibration – Part 3: Effects of Vibration on Structures*

Table 4-4: DIN 4150-3 short-term guideline vibration limits

LINE	TYPE OF STRUCTURE	GUIDELINE VALUES FOR VELOCITY, V_i, IN MM/S			
		VIBRATION AT THE FOUNDATION AT A FREQUENCY OF			VIBRATION AT HORIZONTAL PLANE OF HIGHEST FLOOR AT ALL FREQUENCIES
		1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz*	
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use.	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 or 2 and have intrinsic values (e.g., buildings under a preservation order).	3	3 to 8	8 to 10	8
*At frequencies above 100Hz, the values given in this column may be used as minimum values.					

The DIN 4150-3 vibration criteria apply at the corner of the floor of the storey of interest for a multi-storey building, or within 500mm of ground level at the foundation of a single storey building.

4.3 AUCKLAND UNITARY PLAN – CNVMP REQUIREMENTS

As the Project is located within the road corridor and Standard E25.6.29 of the AUP applies, a CNVMP is required. The requirements of a CNVMP are provided in Appendix A – AUP Standards of this CNVA.

The CNVMP is required to include:

- Details of the community consultation to be undertaken to advise the occupiers of properties located within 100m of the proposed works. These details are to include:
  - the area affected by the work;
  - why the work is required to be undertaken at night (where relevant);
  - the times and days when the noise and vibration is likely to be generated;
  - a contact name and number of the works supervisor who can be contacted if any issues arise; and
  - how noise and vibration complaints will be managed and responded to;
- A description of the works and its duration, anticipated equipment to be used, the processes to be undertaken and the predicted noise and vibration levels; and
- Identification of the best practicable options that will be undertaken to mitigate and minimise any noise and vibration being produced that is likely to exceed the relevant noise and/or vibration criteria.

4.4 ACOUSTIC IMPACT TERMINOLOGY

We have used the following terminology when considering the impacts on adjacent properties.

Table 4-5: Noise and/or vibration impact terminology

ACOUSTIC IMPACT TERMINOLOGY	DESCRIPTION
Acceptable	The predicted noise or vibration level is at or below the AUP criteria.
Reasonable	The predicted noise or vibration level is above the AUP criteria, but due to timing, assessment location, hours of operation, receiver, or other factors, the level of noise or vibration impact on the receiver is low.
Obvious	The predicted noise or vibration level is above the AUP criteria and is likely to have a low or medium impact on adjacent receptors. Noise-sensitive activities are likely to be disturbed.
Unreasonable	The noise or vibration level is likely to have a high impact on adjacent receptors. All but the least sensitive activities are likely to be disturbed.

5 ASSESSMENT METHODOLOGY

This section details the assessment works naming guide, assessment methodology, assumptions and limitations used within this assessment.

5.1 CONSTRUCTION METHODOLOGY AND STAGING

This assessment has been based on the construction methodology document developed by Fulton Hogan (provided in Appendix C of the Application).

The construction methodology has been rationalised into three construction stages:

1 Network utility relocation

2 Shaft construction and trenchless pipe installation

3 Open trench pipe installation

These stages have been broken into phases.

Details of the three stages and their phases are presented in Table 5-1 to Table 5-3.

Table 5-1: Network utility relocation construction works

PHASE	ACTIVITY	EQUIPMENT
1	Saw cut and remove existing pavement including concrete breaking if required.	— Concrete saw — 8T excavator — Excavator-mounted concrete breaker — Mobile generator
2	Expose, identify, and support existing utilities. All spoil loaded onto trucks and disposed of off-site.	— 8T excavator — 6-wheeler truck — Vacuum truck
3	Trench bedding, backfill and compaction Or Place concrete protection slabs or similar around the utility to be protected.	— Plate compactor — 8T excavator — 6-wheeler truck or Hiab — Concrete truck
4*	Install new pit(s) over new ducts (if required)	— 8T excavator — 6-wheeler truck or Hiab
5	Reinstate with Asphalt.	— 6-wheeler truck or Hiab — Concrete truck and pump — Bitumen Truck
6*	Carry out pressure and bacteria tests where required for potable water relocation.	— 6-wheeler truck — Hiab
7*	Complete connections to existing watermain where required for potable water relocation.	— 8T excavator — Hiab — Concrete truck and pump
8*	Backfill and reinstate connection points where required for potable water relocation.	— 8T excavator — 6-wheeler truck — Concrete truck and pump — Plate compactor
*	Phase to occur if required.	

Table 5-2: Temporary shaft construction and trenchless pipe installation

PHASE	ACTIVITY	EQUIPMENT/PLANT
1	The shaft extent will be saw cut and an excavator will be used to remove pavement layers and other shallow-level obstructions. Six-wheeler trucks will be used to remove spoil off site.	— Concrete cutter — 35Tt excavator — Six-wheeler trucks — Excavator-mounted concrete breaker
2	An auger attachment on a 35T excavator or piling rig (GEAX EK-60) will be used to drill 600 mm diameter holes. Six-wheeler trucks will be used to remove spoil off site. Steel H-beams will be set into each with sand or concrete backfill.	— Excavator with auger piling attachment or GEAX EK60 piling rig — 20T Excavator — Six-wheeler trucks — 35T mobile crane — Concrete Truck/pump
3	The shaft will be excavated from the top using an excavator at surface level to a depth of approximately one metre below the pipe invert. Six-wheeler trucks will be used to remove spoil off site. Steel road plates or timber lagging will be installed between H-beams as the excavation advances.	— 40T excavator — Six-wheeler trucks — Ventilation fan — 60 kVA silenced generator
4	The shaft base will be lined out with aggregate or blinding concrete to provide a solid and level working platform.	— Concrete truck/pump — Plate compactor — Six-wheeler — 40T excavator — Ventilation fan — 60 kVA generator
5	If dewatering is required, a submersible pump will be used to remove water from the excavation. The water will be pumped into a clarifying tank for treatment before discharging. The pumps will run continuously while the shaft is open and will be powered by a diesel generator or grid power. *This activity has been assumed as part of Phases 3 to 7 and assessed as Phase 5 for night time dewatering.*	— Submersible pump — 60 kVA silenced generator — Clarifying tank
6	Set up power pack, pump, and water tank on the surface adjacent to relevant shaft. Lift pilot bore rig into pit and survey into position.	— Hiab/crane truck — 20T Excavator — Six-wheeler trucks — Tool truck — Ventilation fan — 60 kVA generator
7	Drill pilot hole to receiving shaft. Install cutting reamer in the receiving shaft and backreaming/cutting back to the launch shaft. Trenchless installation of pipe from launch shaft to receiving shaft. A vacuum truck will be used to remove spoil to be disposed of offsite. Clean up and flush the drill slurry out of the pipe. Inspect and test pipe. *Note, all equipment for this phase is allowed for at both the launch and receiving shafts.*	— Hiab/crane truck — Six-wheeler trucks — Power pack container — Pilot boring machine — Vacuum truck — Tool truck — Ventilation fan — 60 kVA generator
8	Following the completion of tunnelling works, an in situ concrete manhole will be formed and poured within the shaft using a concrete pump.	— Hiab/crane truck — 40T excavator — Concrete truck/pump — Six-wheeler trucks — 20T excavator — Plate compactor — Vibratory roller

Table 5-3: Open cut pipe installation

PHASE	ACTIVITY	EQUIPMENT/PLANT
1	The trench extent will be saw cut and a 14-35T excavator will be used to remove pavement layers and other shallow-level obstructions. Excavated material will be cut to waste with six-wheeler trucks used to remove material. The trench will then be excavated to the required depth, and trench shields and boxes will be installed. If existing services cross the trench, shoring will be undertaken using H-piles installed either side with timber members installed between.	— Concrete saw — 35T excavator — Six-wheeler trucks — Vacuum truck
2	If dewatering is required, a submersible pump will be used to remove water from the excavation. The water will be pumped into a clarifying tank for treatment before discharging. The pumps will run continuously while the shaft is open and will be powered by a diesel generator or grid power. This activity has been assumed as part of phases 1 – 4 and assessed as phase 1A for night time dewatering.	— Submersible pump — 60 kVA silenced generator — Clarifying tank
3	Pipe bedding material will be carted to site directly from source in 6 or 8 wheeled trucks, spread by an excavator and compacted in layers with a 300 – 800 kg plate compactor. An excavator will lift pipe lengths into the trench.	— 35T excavator — Six/Eight-wheel trucks — Plate compactor — Concrete truck/Pump
4	Form and pour concrete manhole base using concrete pump truck or excavator. Alternative precast manhole bases may be used. Lift in precast manhole risers using HIAB or excavator Form and pour connection corbels on outside of precast riser using concrete pump truck and pump.	— 35T excavator — Six/Eight-wheel trucks — Hiab/crane truck — Concrete truck/Pump
5	Side haunching, overlay bedding and hard fill to pavement level. 6 or 8 wheel trucks will bring material direct from source and compacted using 600 – 800kg plate compactors. Alternatively low-strength concrete may be used around manholes. Road surface will be reinstated.	— 35T excavator — Six/Eight-wheel trucks — Concrete truck/Pump — Plate compactor — Vibratory roller

5.2 CONSTRUCTION EQUIPMENT AND MITIGATION

5.2.1 CONSTRUCTION EQUIPMENT

Appendix B – Construction Equipment of this CNVA, provides a list of the expected equipment to be used during each construction stage and phase, the assessed sound power of that equipment, and the percentage of time in use over a worst-case 30-minute period.

The equipment selection and associated sound power levels are based on BS 5228-1[5], NZS 6803[6], or previous measurements undertaken by WSP of similar equipment (including those from noise and vibration monitoring at Part 3 of the Queen Street Wastewater programme).

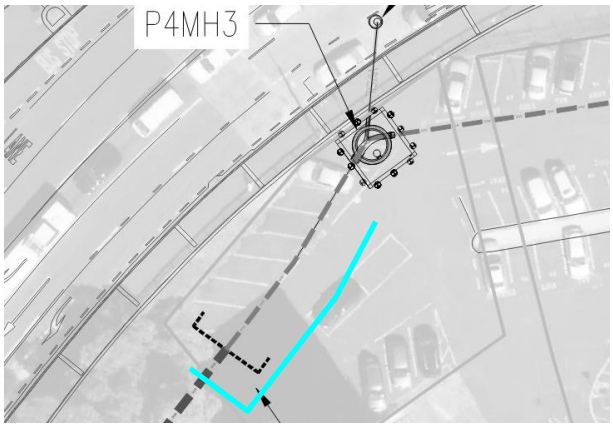
Appendix B – Construction Equipment of this CNVA also presents the vibration levels for specific high-vibration equipment taken from the NZTA Construction Noise and Vibration Guide[7], BS 5228-2[8], or previous measurements undertaken by WSP of similar equipment.

Light construction works (such as light handheld tools, manual digging, line painting etc.) are also expected to occur on site. These activities are not expected to produce excessive noise or vibration levels and have therefore not been included unless otherwise specified.

5.2.2 PHYSICAL SITE MITIGATION

The contractor is proposing to use temporary acoustic site hoardings around the compounds, and for open-cut works.

The site hoardings are shown in cyan in Figure 5-1. Note that the locations are approximate and may change due to site requirements, AT restrictions, or other non-acoustic factors.

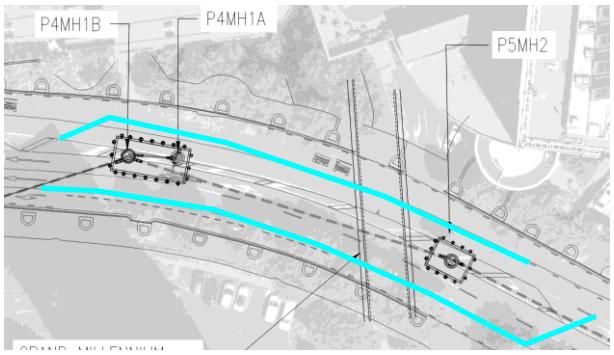
Site hoardings for Secondary Compounds	Site Hoardings for Open Cut
Greys Ave Extended CSA 	*Greys Ave CSA* 
Mayoral Drive Compound	*Vincent Street Open Cut Works*

5 BS 5228-1:2009 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*

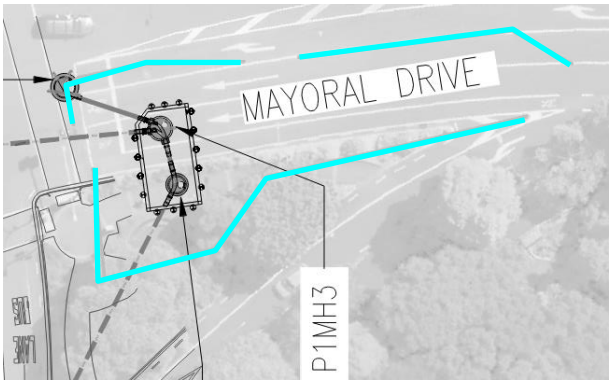
6 NZS 6803:1999 *Acoustics – Construction noise*

7 Waka Kotahi NZ Transport Agency's *State Highway Construction and Maintenance Noise Vibration Guide*, version 1.1, dated August 2019

8 BS 5228-2:2009 *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*



Mayoral-Cook Compound



Vincent Street Compound

Figure 5-1: Proposed acoustic hoardings (cyan) for compounds and open cut works

The site hoardings are to be constructed to a height of no less than 2.0 metres, with a surface mass of 10 kg/m^2 (such as 18 mm plywood) and have no gaps or cracks. Further specifications for these barriers are found in Section 9.2.1.

5.2.3 LOCATION OF DEWATERING EQUIPMENT

The dewatering generator for works for P4MH3, P4MH2, and open trenching works within the Greys Ave CSA is proposed to operate only within the area highlighted in red in Figure 5-2.

Greys Ave Expanded CSA

Figure 5-2: Location of dewatering generator at Greys Ave CSA

5.2.4 MANAGERIAL MITIGATION

Managerial mitigation measures will be adopted by the contractor to further help reduce the noise and vibration and the impacts of any exceedances.

The following managerial mitigation measures have been adopted by the contractor to reduce the impacts of noise and vibration:

- Placing noise and vibration-generating equipment as far as practicable from adjacent NSR.
- Not operating vibratory rollers within the Greys Ave CSA and as part of the P4MH3 works/rehabilitation.
- Not operating high-vibration equipment listed in Table 6-4 within the setback distance to adjacent NSRs.

Further information on managerial mitigation measures is provided in Section 9.

A framework CNVMP is included as part of this Application. A condition of consent is recommended that the final CNVMP is certified by Auckland Council prior to works commencing.

5.3 NOISE PREDICTION METHODOLOGY

Noise propagation between the source equipment and one metre from the façade of all adjacent NSRs has been assessed in accordance with the method provided in NZS 6803 and ISO 9613-2[9]

[9] *ISO 9613-2:1996 Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation* (ISO 9613-2).

SoundPLAN Version 8.2 3D computational noise modelling software has been used to develop a noise prediction model. The developed construction stages and phases have been analysed with the model and presented to support the acoustic assessment. The model prediction considers attenuation due to distance, terrain, absorption by the atmosphere and ground, and reflections from building facades (including the receiver façade). The assessment assumes worst-case theoretical downwind conditions in all directions from all sources, which provides a conservative approach for this assessment.

Table 5-4 presents the noise modelling parameters adopted for this assessment.

Table 5-4: Noise modelling parameters

PROPERTY	VALUE	SOURCE
Calculation method	NZS 6803 for construction noise ISO 9613-2 for propagation	-
Terrain contours	0.25 m vertical heights	Auckland Council GeoMaps
Buildings	Outlines of building footprints Heights set to 3 m for each storey	Auckland Council GeoMaps, Heights: Google Street View.
Land parcels	Property land and road extent	Auckland Council GeoMaps
Ground Absorption Coefficient	0.1 – acoustically hard ground	Google Street View
Number of Reflections	3	-
Assessment location	1.0 metres from any façade at any level	NZS 6803

It is assumed that all shafts may be constructed concurrently, and trenchless pipe installation may occur concurrently at any shaft. The predicted noise levels are the sum of the shaft construction and/or trenchless activities occurring at all shafts at the NSR.

The L_{AFmax} was calculated using the maximum noise level generated by any piece during any phase when undertaken at the closest point from the site to the receptor building. This approach provides a worst-case assessment of noise levels.

5.4 REGENERATED NOISE

Regenerated noise predictions from vibration generated by a trenchless boring machine received in adjacent buildings are based on the propagation model outlined in Amick[10] with building coupling losses and floor resonances provided in the Federal Transport Agency *Transit Noise and Vibration Impact Assessment Manual*.

The following has been assumed:

- Competent soil conditions (compacted clay, exposed rock).
- Masonry buildings on spread footings.
- Noise levels assessed at ground levels.

[10] *A frequency-dependent soil propagation model* (Amick) PROC SPIE conference on current developments in vibration control for optomechanical systems, 1999.

— Typical residential (furnished room with carpet) or office/retail/hospitality environment (furnished room with carpet and ceiling tiles).

5.5 VIBRATION PREDICTION METHODOLOGY

Appendix B – Construction Equipment of this CNVA, presents the vibration levels for specific high-vibration equipment. Vibration propagation between the source equipment and receiving locations has been predicted based on the methodology outlined in the NZTA Construction Noise Vibration Guide. The same assumptions for regenerated noise apply to the vibration prediction methodology.

5.6 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations apply to this construction noise and vibration assessment:

— Construction activity locations are based on the documentation received to date.

— An assessment period of 30-minutes has been applied.

— It is conservatively assumed that all equipment will operate within a worst-case 30-minute period for each construction stage. For the majority of construction works, not all equipment will operate, or operate for a shorter time period.

— There is always a level of uncertainty in predicting noise from construction activities. Numerous variables including variations in the specific models of equipment, the exact location of each item on site, and how the operator uses the equipment, will affect the accuracy of the noise predicted.

— It is assumed that dewatering would be required 24-hours a day, and as such, we have assessed dewatering works at night.

— It is assumed that no night works (apart from dewatering) are required, or if night works are required, they are due to AT requirements.

— The evaluation and assessment have been conducted under the assumption that the equipment or plant will not exceed the levels outlined Appendix B – Construction Equipment of this CNVA. It is the contractor's responsibility to ensure that all equipment and/or plant on site is equivalent to or less than the assumed sound power levels.

6 PREDICTED LEVELS

This section provides the predicted noise and vibration levels for the proposed works.

6.1 PREDICTED NOISE LEVELS

The setback distances to achieve the required noise criteria and the predicted noise levels for the construction stages and phases are presented in this section.

6.1.1 NOISE SETBACK LEVELS

Table 6-1 presents a list of equipment used for the project, its associated sound power level, and the predicted noise level at increasing distances from the equipment operation. Additionally, the setback distance is provided at which the 75 dB $L_{Aeq,30min}$ noise limit (between 0630 and 2230 hours) may be achieved. The predicted distances and noise levels assume each individual piece of equipment is operating separately, no noise mitigation is adopted, and the equipment operates for the entire 30-minute assessment period.

Table 6-1: Proposed equipment, sound power levels, and setback distance without mitigation

SOURCE	SOUND POWER LEVEL (dB L_{WA})	PREDICTED NOISE LEVEL AT DISTANCE (dB $L_{Aeq,30min}$)				SETBACK DISTANCE IN METRES TO ACHIEVE 75 dB $L_{Aeq,30min}$
		5 m	10 m	15 m	20 m	
Airvac/Hydrovac	108	89	83	79	77	24
Concrete Saw	113	94	88	84	82	43
Concrete truck and pump	103	84	78	74	72	13
90T Crane	105	86	80	76	74	17
Submersible pump*	95*	74	68	64	62	6
8T excavator	102	83	77	73	71	12
20T Excavator	105	86	80	76	74	17
40T Excavator	107	88	82	78	76	22
Excavator Movax/Vibro	121	102	96	92	90	110
GEAX EK60	107	88	82	78	76	22
Excavator mounted breaker	121	102	96	92	90	110
Hiab	107	88	82	78	76	22
60 kVa Generator	90	68	62	58	56	3
Plate Compactor	108	89	83	79	77	24
Pilot Boring Machine	82	63	57	53	51	2
Power Pack	103	84	78	74	72	13
6-Wheeler Truck	107	88	82	78	76	22
Tool Truck	107	88	82	78	76	22
Ventilation Fan	105	87	81	77	75	17
Vibratory Roller	103	84	78	74	72	13
* Pump located underground so noise level received will be significantly less than this analysis.						

6.1.2 CONSTRUCTION STAGING AVERAGE NOISE LEVELS ($L_{AEQ,30MIN}$)

This section presents the NSRs that are predicted to infringe on the noise criteria for each of the stages and phases outlined in Table 5-1 to Table 5-3 based on the prediction methodology outlined in Section 5 and mitigation outlined in Section 5.2.2.

The predicted noise level at the closest NSRs to the works is presented in Appendix C – Predicted Noise Levels of this CNVA assuming all works regardless of location, occur (i.e. inside and outside of the road zone).

Table 6-2 outlines the NSRs that are predicted to receive noise levels in excess of the 75 dB $L_{Aeq,30min}$ AUP construction noise limit, which have been coded to show:

- Pink indicates NSRs that are predicted to receive noise from works inside and outside the road corridor cumulatively that are greater than 75 dB $L_{Aeq,30min}$ noise limit. However, are lower than 75 dB $L_{Aeq,30min}$ from works outside of the road reserve (i.e. trenchless construction and open trenching around P4MH2 and P4MH3).
- Red indicates NSRs where the predicted noise levels from both works inside and outside of the road corridor are greater than the 75 dB $L_{Aeq,30min}$ noise limit.

Note that construction works within the road reserve are exempt from the AUP construction noise limits. Therefore, NSRs which are highlighted pink are a permitted activity as per Standard E26.5.29 of the AUP.

NSRs that are highlighted red show NSRs which receive noise levels greater than 75 dB $L_{Aeq,30min}$ from construction works outside of the road reserve.

Figure 6-1 provides the NSRs which are predicted to exceed the criteria from any stage of construction works. They have been colour-coded to show whether, during any stage, they exceed from works either within the road only (pink) or for any works outside of the road zone (red).

Table 6-2: NSRs predicted to exceed the AUP noise limit

STAGE OF WORKS	NSR SUBJECT TO EXCEEDANCES OF NOISE STANDARDS							
	PHASE 1	PHASE 2	PHASE 3	PHASE 4	PHASE 5	PHASE 6	PHASE 7	PHASE 8
Network Utility Relocation	205/209 Federal St 219 Federal St 3 Greys Ave 71 Greys Ave 152 Hobson St 100 Mayoral Dr 299 Queen St 321 Queen St 323-327 Queen St	3 Greys Ave 71 Greys Ave 100 Mayoral Dr		71 Greys Ave 100 Mayoral Dr			3 Greys Ave 71 Greys Ave 100 Mayoral Dr	
Temporary Shaft and Trenchless Construction	3 Greys Ave 71 Greys Ave 100 Mayoral Dr 299 Queen St 321 Queen St 323-327 Queen St 329 Queen St	219 Federal St 3 Greys Ave 71 Greys Ave 100 Mayoral Dr 299 Queen St 321 Queen St 323-327 Queen St 329 Queen St	3 Greys Ave 71 Greys Ave 100 Mayoral Dr 323-327 Queen St 329 Queen St	219 Federal St 3 Greys Ave 71 Greys Ave 100 Mayoral Dr 299 Queen St 321 Queen St 323-327 Queen St 329 Queen St	n/a*	3 Greys Ave 71 Greys Ave 100 Mayoral Dr 299 Queen St 321 Queen St 323-327 Queen St 329 Queen St	219 Federal St 3 Greys Ave 71 Greys Ave 100 Mayoral Dr 299 Queen St 321 Queen St 323-327 Queen St 329 Queen St	3 Greys Ave 71 Greys Ave 100 Mayoral Dr 299 Queen St 321 Queen St 323-327 Queen St 329 Queen St
Open Cut Construction	219 Federal St 71 Greys Ave 299 Queen St 323-327 Queen St 329 Queen St	n/a*	71 Greys Ave 323-327 Queen St 329 Queen St			n/a		
*Noise limit of 55/60 dB $L_{Aeq,30min}$ applies due to dewatering at night.								

Figure 6-1: NSRs which are predicted to exceed the noise criteria from works within the road zone (pink) and outside of the road zone (red) at any stage/phase

6.1.3 MAXIMUM NOISE LEVELS (L_{AFMAX})

The maximum sound level (L_{AFmax}) is the highest A-weighted noise level measured during a given time period. It is generated by single events such as the dropping of spoil into an empty truck, impact of an excavator bucket on asphalt to break it up, and the like. The predicted maximum noise level at each receptor based on the worst-case equipment is presented in Appendix C of this CNVA.

The following properties are predicted to exceed the maximum noise limit of 90 dB L_{AFmax} :

- 71 Greys Avenue (3 dB exceedance)
- 100 Mayoral Drive (2 dB exceedance)
- 323-327 Queen Street (4 dB exceedance)

323-327 Queen Street is the only NSR that receives maximum noise levels greater than 90 dB L_{AFmax} from works outside of the road corridor.

6.1.4 REGENERATED NOISE

Table 6-3 provides the setback distance (The slope distance between the tunnel boring machine and adjacent buildings) where the internal regenerated noise criterion is predicted to be achieved, with the assumptions in Section 5.4.

Table 6-3: Predicted setback distance for regenerated noise from trenchless pipe installation

REGENERATED NOISE CRITERIA	SETBACK DISTANCE
45 dB $L_{Aeq,T}$	7 metres
35 dB $L_{Aeq,T}$	15 metres

There are no properties within the setback distance. Therefore, regenerated noise is not predicted to cause adverse effects.

6.2 PREDICTED VIBRATION LEVELS

The setback distances to achieve the required vibration criteria and the predicted vibration levels for the construction stages and phases are presented in this section.

6.2.1 VIBRATION SETBACK DISTANCES

The key vibration-generating activities are excavators breaking ground, piling or drilling of holes, pipe jacking, and compaction.

Table 6-4 outlines the setback distance of each piece of high-vibration equipment used to achieve the various vibration limits. The setback distance is the distance from any vibration-generating equipment at which the vibration limits are reached. Any building within the setback distance is predicted to exceed the vibration criteria.

Table 6-4: Vibration setback distance to achieve the vibration criteria

EQUIPMENT	VIBRATION LEVEL OF EQUIPMENT (MM/S PPV)	SETBACK DISTANCE TO ACHIEVE VIBRATION CRITERIA (METRES)			
		20 mm/s	5 mm/s	3 mm/s	2 mm/s*
Excavator breaking ground	1.9 at 10 m	0.2	2	5	10
Plate Compactor	2.0 at 10 m	0.2	1	5	6
Vibratory compaction roller	3.6 at 10 m	1.0	6	15	25
Pipe jacking	1.5 at 10 m	0.1	1.1	4	7
CFA piling, auguring, small or similar	0.5 at 10 m	0.1	0.2	0.5	1
Excavator with breaker attaching breaking road surface	4 at 10 m	0.6	7	16	28
*AUP vibration amenity limit					

The 20 mm/s PPV criteria apply at any commercial building, or structures that are commercial in nature (high-rise concrete or steel residential buildings for instance). The 5 mm/s PPV applies to single, or two-storey detached or semi-detached residential dwellings (or similar structural buildings).

Heritage buildings are subject to more onerous vibration limits because of their structural sensitivity to vibration and their intrinsic value. We have considered that the 3 mm/s PPV limit applies to all buildings within the Historic Heritage overlay of the AUP. The exception to this is the Civic Administration Building which we understand is a new building and therefore can be considered as a commercial structure.

6.2.2 CONSTRUCTION VIBRATION LEVELS

Based on the setback vibration levels outlined in Table 6-4, there are no NSRs within the DIN 4150-3 or AUP amenity vibration level setback distances. Therefore, vibration is a permitted activity.

7 PROPOSED ACTIVITY/S AND TRIGGERED RULES

The following sections provides an indication of the AUP Chapter E25 rules which are predicted to be exceeded.

7.1 NOISE

Noise generated from construction activity during the daytime within the road zone is exempt from achieving the AUP construction noise limits if a CNVMP is adopted, as outlined in Section E25.6.29 of the AUP.

A CNVMP will be adopted (with a Framework CNVMP provided as part of this application). Therefore, noise generated by construction works in the road zone during the day is a permitted activity.

The following NSRs exceed the 75 dB $L_{Aeq,30min}$ daytime construction noise criteria from works outside of the road zone:

- 321 Queen Street (7 dB exceedance)
- 323-327 Queen St (11 dB exceedance)
- 329 Queen St (4 dB exceedance)

Based on the above, resource consent is required for noise under activity Rule E25.4.1 (A2) as a restricted discretionary activity, as the permitted activity standard cannot be met.

7.2 VIBRATION

The vibration limits outlined in Section E25.6.30(1)(a) are required to be achieved regardless of location and whether a CNVMP is adopted.

There are no NSRs predicted to exceed the AUP Section E25.6.30(1)(a) vibration limits.

Vibration generated within the road corridor is exempt from achieving the vibration limits outlined in Section E25.6.30(1)(b), where a CNVMP is adopted.

There are no NSRs predicted to exceed the AUP Section E25.6.30(b) vibration limits from works outside of the road corridor.

Based on the above, the vibration is a permitted activity.

8 EFFECTS ASSESSMENT

This section provides an assessment of the construction noise and vibration generated by the proposed activities.

8.1 CONSTRUCTION NOISE EFFECTS

Noise from construction works will likely be noticeable in the surrounding area during high-noise activities, particularly at the closest NSRs.

While barriers are proposed around the compounds to manage noise, multi-story buildings will overlook the construction sites. Therefore, barriers will not provide any appreciable noise reduction for receptors above ground or first floor.

It has been assumed that all equipment in each stage and phase operates for a worst-case 30-minute assessment period. It is unlikely that all equipment will operate for all assessment periods during each day and over the stage/phase. Therefore, for much of the construction period, noise levels will be lower than what has been predicted and provided in this assessment.

Construction effects are based on the use and occupation of the building. Commercial/industrial buildings are generally less sensitive to noise than residential or visitor accommodation. Commercial/industrial buildings are also generally unoccupied during the night, and as such would not have any noise effects.

8.1.1 NIGHT WORKS

No properties are predicted to exceed the 60 dB $L_{Aeq,30min}$ criteria during dewatering works (the only night works on this project), as all equipment outside of the road zone can operate away from receptors.

The current generators used on other parts of the Queen Street Wastewater Diversions Programme recharge a series of internal batteries . These batteries power the dewatering pumps. The generator does not work constantly, only to recharge the batteries when the power goes down. Therefore, the generator will cycle on and off during the night time. Therefore, the predicted noise levels would only occur when the generator is recharging the batteries, and not during the entire night period.

Therefore, noise during the night time is acceptable and a permitted activity..

8.1.2 DAYTIME WORKS

Many of the construction activities that lead to a predicted exceedance of the AUP E25.6.28 construction noise criteria occur within the road corridor. However, these are exempt from the noise limits if a CNVMP is adopted. Therefore, this level of noise could be generated as a permitted activity.

As described above, the predictions assume all equipment operates for a worst-case 30-minute assessment period. It is unlikely that all equipment will be used all the time for all day, every day. While there are predicted infringements during a worst-case scenario, we have taken into account fluctuations in the noise levels during the day, and across the stages/phases when concluding noise effects.

The above analysis assumes that all equipment is located at the surface. Where machinery is located below ground level, the equipment will benefit from acoustic screening from the shaft itself. For example, a plate compactor working at the bottom of a shaft.

Open-cut areas are relatively short in length (<10 m). Therefore, the predicted infringements would only occur for a short duration (days or weeks rather than months).

The noise levels presented in Appendix C – Predicted Noise Levels of this CNVA, are the worst-case levels on the most exposed façade of each NSR. This level of noise is not received over the entire exposed façade, or at facades facing away from the construction works. For example, the noise level will decrease up the height of the building as the receptor location distance increases from the source.

Adverse noise effects will only occur where a building is occupied by NSRs. Therefore, if buildings are unoccupied (e.g. apartments during the day when people are at work or offices during the weekends), there are no noise effects. Consideration will be given to working outside hours when buildings are occupied; however, this will not be possible for all buildings (as some are multi-use or will have some NSRs within the buildings at all times).

The predicted noise levels are assessed at one metre from the façade of the building and at 1.5 metres above each floor level in the building. For internal spaces above the ground level (where the façade is sealed and has no decks), an assessment location 1 metre from the façade does not provide a good indication of effects. For these spaces, people would experience construction noise from inside the building, which provides a more relevant assessment location.

Table 8-1 has been developed based on current guidance and professional experience. This assumes a conservative 25 dB reduction provided by a closed window. Note that the AUP has façade noise reduction requirements for buildings within the Central City Zone, including specific low-frequency noise control. This may mean façades provide a higher level of separation than 25 dB and as such the effects are likely lower than those presented in the table below.

Table 8-1: Construction noise: internal subjective effects

EXTERNAL NOISE LEVEL, 1M FROM THE FACADE	EFFECTS WITH WINDOWS CLOSED
≥90 dB $L_{Aeq,T}$	This level is unlikely to be tolerated for any extent of time indoors.
80 dB $L_{Aeq,T}$	Disruption is likely for quiet activities. Likely to require the volume on TV or radio to be turned up to be intelligible over background noise.
75 dB $L_{Aeq,T}$	Noise from construction is likely just perceptible over background noise. May be disruptive for quiet activities such as reading. Not likely to disrupt less sensitive activities such as watching TV; however, these may require more concentration.
70 dB $L_{Aeq,T}$	Little disruption. Noise is likely to be perceptible over background noise during quiet activities (such as reading). Unlikely to disrupt less sensitive activities such as watching TV.
65 dB $L_{Aeq,T}$	Unlikely to disrupt activity. May be audible within the building if quiet activities are occurring

For many NSRs, noise from construction may be just perceptible over background noise, but will not cause disruption, even to sensitive activities.

The NSRs outlined in Table 6-2 may require the volume on TVs radios, etc. to be turned up to be audible over background noise. A higher level of concentration for sensitive tasks may be required at times when the worst-case noise scenario is realised.

However, communication with adjacent building occupants prior to works, and constant communication throughout the works, will mean the occupants will understand when the works occur and what they will potentially experience as effects. This will be outlined in a CNVMP.

With the adoption of all practicable physical mitigation measures, the assessment of noise described above, and the implementation of a CNVMP, noise effects from construction are predicted to be **reasonable**.

8.2 CONSTRUCTION VIBRATION EFFECTS

Vibration from the proposed construction activities is predicted to be below the vibration criteria outlined in Section E25.6.30(1)(a) and E25.6.30(1)(b) of the AUP for works outside of the road zone. The vibration limits within Section E25.6.30(1)(a) are also achieved for works within the road zone.

The following NSRs are predicted to be within the 2 mm/s PPV setback distances (E25.630(1)(b) criteria, which only applies to works outside of the road zone) when construction works are within the road zone:

- 100 Mayoral Drive
- 71-87 Mayoral Drive (Grand Millennium)
- 67-101 Vincent Street

It should be noted that NSRs that are predicted to be beyond the 2 mm/s PPV setback distance may still perceive vibration. However, it will be at a level that is unlikely to cause any impact to the building structure.

Considering the assessment of vibration described above, the implementation of a CNVMP including all proposed and practicable mitigation measures, and the AUP construction vibration rules for works within the road corridor; the vibration effects from the Project are predicted to be acceptable to reasonable.

Vibration impacts are predicted to be **acceptable**.

9 MITIGATION MEASURES

The construction noise and vibration assessment has determined that mitigation measures are required to reduce the noise and/or vibration impacts on NSRs.

This section provides details of the specific mitigation measures that shall be applied to the construction works.

Additionally, as noted in the RMA, mitigation measures should be adopted in any case to protect against unreasonable levels of noise and vibration where practically possible.

9.1 GENERAL MITIGATION MEASURES

As the Project is located within the road corridor and Standard E25.6.29 of the AUP applies, a CNVMP is required. The CNVMP shall be developed in accordance with E25.6.29(5) of the AUP and shall be followed and updated by the contractor for the duration of the project.

As a minimum, the CNVMP shall include the following:

- How the community consultation is to be undertaken to advise the NSRs within 100m of the proposed works of all the following:
  - The proposed works and how they may be affected;
  - The times and days when elevated noise and vibration is likely to be generated;
  - Why the work is required to be undertaken at night (where relevant);
  - How NSRs communicate any enquiries or complaints about construction noise including contact name and details of the project manager/noise liaison officer;
  - How noise and vibration complaints will be managed and responded to;
- A description of the works and its duration, anticipated equipment to be used, the processes to be undertaken and the predicted noise and vibration levels;
- The procedure to identify the best practicable options of mitigation for each stage/phase to mitigate and minimise any noise and vibration being produced

9.2 PHYSICAL MITIGATION MEASURES

9.2.1 ACOUSTIC SITE HOARDINGS

Site hoardings are only effective as noise mitigation where they block the line of sight from the plant to the receptor. In many cases, the surrounding buildings are multi-storey and therefore, when assessing noise at 1 metre from the façade of the building, physical mitigation will have a limited impact.

However, physical mitigation measures are recommended as they can effectively reduce the impact on receptors who traverse along the footpath adjacent to the construction sites.

Site hoardings are proposed to be installed around the construction sites, as outlined in Section5.2.2. The acoustic site hoardings shall achieve the following minimum specifications.

- Height: >2.0 m
- Surface mass: >10 kg/m^2
- The hoardings shall be constructed and maintained such that there are no gaps or cracks in the fence.
- Where timber is used, the palings shall be overlapped by a minimum of 25 mm, or a board and batten system implemented. A sleeper rail will be required to seal the bottom of the fence to the ground. For timber, 25 mm pine (or equivalent) is to be used to resist warping.

While not required, where practicable, localised movable acoustic barriers shall be used around high noise-generating equipment when in use, such as a concrete saw. The movable site hoardings shall achieve the minimum specifications listed above but may be 2 m in height.

9.2.2 SELECTION OF EQUIPMENT

Equipment is to be selected with the generated noise level in mind. This includes:

- Vehicles with audible reversing warning sirens will be fitted with broadband reversing beepers.
- Generators and/or water pumps are to be selected that have acoustic enclosures to reduce the noise radiated by these units. The noise reduction that the acoustic enclosures provide over standard units depends on the manufacturer. Where generators are required, these shall be installed on site as far as practicable from sensitive receptors.
- Use of electric equipment over petrol/diesel alternatives including saws, hand power tools, chainsaws, and the like.
- Selection of equipment that is an appropriate power for the use (i.e., not using more powerful equipment than needed.

9.3 MANAGERIAL MITIGATION MEASURES

9.3.1 GENERAL

The following managerial mitigation measures are to be adopted by the contractor as far as reasonably practicable:

- Site-specific training shall be given to site personnel including management and workers involved in construction activities or equipment operators that have the potential to generate noise and vibration effects.
- Equipment outlined within Appendix B – Construction Equipment of this CNVA is to be operated only between Monday to Friday and Saturday periods as dictated by Table 3-2.
- All machinery to be used on site will be acoustically tested to determine the sound power level of the machinery and compared to the sound power levels within Table 6-1 of this CNVA. Where the tested sound power level is greater, either this machinery shall be fitted with acoustic noise reduction measures (mufflers), or additional noise modelling should be undertaken to determine whether further mitigation is required to attenuate noise to adjacent properties to achieve desired noise levels.
- No unnecessary idling of equipment on site (such as trucks and excavators) when not in use.

9.3.2 WORKS OUTSIDE THE TYPICAL CONSTRUCTION HOURS

If equipment generating notable noise relative to the AUP noise limits within Table 4-1 is required for connection or tie-in works outside the construction hours (such as concrete cutting or breaking, metallic grinding/cutting, or use of an air/hydro-vac or excavator), this shall occur prior to 10:30 pm as far as reasonably practicable to minimise sleep disturbance for the adjacent accommodation/residential buildings.

10 IDENTIFICATION OF AFFECTED PARTIES – NOISE AND VIBRATION

Affected Parties are those which receive noise or vibration levels above the AUP criteria, and the exceedances are likely to have an obvious or unreasonable impact on adjacent receptors when considering the actual noise level received, the proposed mitigation measures, and the duration of the works (including the time each day the exceedance may occur, the total days the exceedances are to occur for and duration of the overall construction).

This section identifies any potentially affected parties when considering the above.

10.1 NOISE

While NSRs are predicted to be exposed to noise levels above the noise limits in Table 4-1 of this CNVA, the effects associated with the infringements are reasonable. This is due to the likelihood and duration of the exceedances, and the level of noise mitigation that has or can practicably be installed. Further, the best practicable mitigation measures are to be incorporated by the contractor to reduce the noise impacts.

Based on the implementation of a CNVMP by the contractor with the mitigation measures outlined in Section 9, no NSRs are identified as affected by noise from these works.

10.2 VIBRATION

There are no buildings which are predicted to receive vibration levels higher than the vibration limits in Section E25.6.30 of the AUP. Therefore, there are no NSRs identified as affected by these works.

11 CONCLUSIONS AND RECOMMENDATIONS

WSP has been engaged by Watercare to assess the noise and vibration impacts from the Mayoral Drive Alignment as part of the Queen Street Wastewater Diversion Programme. This report provides an assessment of the construction noise and vibration in relation to the Mayoral Drive Alignment of the Programme.

Noise and vibration criteria have been developed based on the criteria in Chapter E25 of the AUP. Noise from construction works within the roading corridor is exempt between 7am to 10pm from the AUP construction noise limits, provided that a CNVMP is developed. However, for completeness, noise from this activity has been predicted. Works outside of the roading corridor, and night-time dewatering works have been assessed against the applicable noise standards.

The construction methodology (Appendix C of the Application) for the Mayoral Drive Alignment of the Project has been provided by Fulton Hogan, the proposed contractor. This methodology has been used to develop the phases of construction and the equipment used.

Based on the construction methodology and proposed mitigation, three NSRs are predicted to exceed the noise limits within the AUP from construction works outside the road corridor during the day.

Based on the construction methodology and proposed mitigation, one NSR is predicted to exceed the noise limits within the AUP from dewatering works during the night time.

No NSRs are predicted to exceed the Section E25.6.30(1)(a) or (b) vibration limits with the proposed mitigation.

Physical and managerial mitigation measures are to be adopted in a CNVMP to manage the impacts of these exceedances.

With the adoption of the conditions of consent below, the best practicable option of mitigation is to be used by the contractor. Therefore, the effects associated with the construction of the shafts and installation of the wastewater pipe are predicted to be reasonable. This CNVA has not identified any parties impacted by noise or vibration to an obvious or unreasonable level.

11.1 RECOMMENDATIONS

The following conditions of consent are recommended:

1. A CNVMP shall be implemented, in line with Section E25.6.29(5) and Section E26.8.8 of the AUP, and Annex E2 of NZS 6803:1999. This is to include:
    a. Construction methodology and proposed equipment by the contractor.
    b. Updated noise predictions based on the final construction methodology.
    c. Outline mandatory mitigation measures to reduce the effects of noise on adjacent noise sensitive receptors.

d Outline practicable physical and managerial mitigation measures to reduce the effects of noise on adjacent noise-sensitive receptors, site mitigation for equipment on site, and community liaison methodology.

e If equipment is shown to exceed the vibration limits, undertake monitoring to confirm on-site levels and whether any vibration monitoring is required.

12 LIMITATIONS

This report ('Report') has been prepared by WSP exclusively for Watercare Services Limited ('Client') in relation to the assessment of noise and vibration effects for the Mayoral Drive Alignment of the Queen Street Wastewater Diversion Programme of Works, for consenting purposes ('Purpose') and in accordance with the task order number TO-WSP-65 task name Queen Street Wastewater Diversions – Rescoping, dated 03.12.2025. The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

In preparing the Report, WSP has relied upon data, surveys, analyses, designs, plans and other information ('Client Data') provided by or on behalf of the Client. Except as otherwise stated in the Report, WSP has not verified the accuracy or completeness of the Client Data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this Report are based in whole or part on the Client Data, those conclusions are contingent upon the accuracy and completeness of the Client Data. WSP will not be liable in relation to incorrect conclusions or findings in the Report should any Client Data be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

APPENDIX A – AUP STANDARDS

E25.6.28. Construction noise Levels in the Business – City Centre Zone and the Business – Metropolitan Centre Zone

Construction activities in the Business – City Centre Zone and the Business –Metropolitan Centre Zone must comply with Standard E25.6.27(1) above for any receiver not in a Business – City Centre Zone or a Business –Metropolitan Centre Zone and must not exceed the levels in Table E25.6.28.1 Construction noise levels for construction less than 15 consecutive calendar days duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone and Table E25.6.28.2 Construction noise levels for the construction of 15 consecutive calendar days or more duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone when measured for any 30 minute period 1m from the façade of any building in the Business – City Centre Zone or the Business – Metropolitan Centre Zone that is occupied during the work.

Where external measurement of construction noise is impractical or inappropriate, the upper limits for the noise measured inside the building will be 20dB less than the relevant levels.

Table E25.6.28.2 Construction noise levels for construction of 1 5consecutive calendar days or more duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone

Construction of 15 consecutive calendar days or more (total duration of works)		
Time	*$L_{Aeq,30\ min}$ (dB)*	*L_{AFmax} (dB)*
Monday to Friday 6.30am – 10.30pm	*75*	*90*
Saturday 7am-11pm	*80*	*90*
Sunday 9am-7pm	*65*	*85*
All other times (night time)	*60*	*75*
All other times in the City Centre Residential Precinct and the Learning Precinct	*55*	*75*

E25.6.29. Construction noise and vibration levels for work within the road

(1) Noise from any construction, maintenance and demolition activities in the road must comply with the relevant noise levels in the following relevant table:

(a) 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; or

(b) Table E25.6.27.2 Construction noise levels for noise affecting any other activity; or

(c) Table E25.6.28.1 Construction noise levels for construction less than 15consecutive calendar days duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone; or

(d) Table E25.6.28.2 Construction noise levels for construction of 15 consecutive calendar days or more duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone

(1A) Vibration from any construction, maintenance and demolition activities in the road must comply with the relevant vibration levels in the following relevant table or standard: (a) the limits set out in E25.6.30(1)

(a) German Industrial Standard DIN 4150-3 (1999): Structural vibration – Part 3 Effects of vibration on structures; and

(b) Table E25.6.30.1 Vibration limits in buildings.

(2) The noise levels specified in Standard E25.6.29(1) above do not apply to unplanned repair or maintenance works or planned works in the road between the hours of 10pm and 7am where:

(a) the number of nights where the noise generated by the works exceeds the relevant noise levels in the following tables:

(i) 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; or

(ii) Table E25.6.27.2 Construction noise levels for noise affecting any other activity; or

(iii) Table E25.6.28.1 Construction noise levels for construction less than 15 consecutive calendar days duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone; or

(iv) Table E25.6.28.2 Construction noise levels for construction of 15 consecutive calendar days or more duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone;

at any one receiver is 3 nights or less; and

(b) the works cannot practicably be carried out during the day or because the road controlling authority requires this work to be done at night time; or

(c) because of the nature of the works the noise produced cannot be practicably be made to comply with the relevant noise levels of the following tables:

(i) *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; or*

(ii) *Table E25.6.27.2 Construction noise levels for noise affecting any other activity; or*

(iii) *Table E25.6.28.1 Construction noise levels for construction less than 15 consecutive calendar days duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone; or*

(iv) *Table E25.6.28.2 Construction noise levels for construction of 15 consecutive calendar days or more duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone; or*

(d) *for planned works, a copy of the works access permit issued by Auckland Transport or approval from the New Zealand Transport Agency is provided to the Council five days prior to work commencing; or*

(e) *for minor planned works a construction noise and vibration management plan is provided to the Council no less than five days prior to the works commencing in accordance with the applicable provisions of Standard E25.6.29(5) below.*

(3) *The noise levels specified in Standard E25.6.29(1) above do not apply to unplanned repair or maintenance works or planned works in the road corridor between the hours of 7am and 10pm where:*

(a) *the number of days where the noise generated by the works exceeds the relevant noise levels in the following tables:*

(i) *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; or*

(ii) *Table E25.6.27.2 Construction noise levels for noise affecting any other activity; or*

(iii) *Table E25.6.28.1 Construction noise levels for construction less than 15 consecutive calendar days duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone; or*

(iv) *Table E25.6.28.2 Construction noise levels for construction of 15 consecutive calendar days or more duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone;*

at any one receiver is 10 days or less; or

(b) *because of the nature of the works and the proximity of receivers the noise generated cannot be practicably made to comply with the relevant noise levels of the following tables:*

(i) *Table E26.6.27.1 Construction noise limits for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone;*

(ii) *Table E25.6.27.2 Construction noise levels for noise affecting any other activity; or*

(iii) *Table E25.6.28.1 Construction noise levels for construction less than 15 consecutive calendar days duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone; or*

(iv) *Table E25.6.28.2 Construction Noise levels for construction of 15 consecutive calendar days or more duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone; or*

l *for planned works, a copy of the works access permit issued by Auckland Transport or approval from the New Zealand Transport Agency is provided to the Council five days prior to work commencing; or*

(c) *for planned works, a copy of the works access permit issued by Auckland Transport or approval from the New Zealand Transport Agency is provided to the Council five days prior to works commencing; or*

(d) *for planned works where the works will take more than 8 hours to complete a construction noise and vibration management plan is provided to the Council no less than five days prior to the works commencing in accordance with the applicable provisions of Standard E25.6.29(5) below.*

(4A) The vibration levels specified in E25.6.29(1A)(b) do not apply to works within the road where:

(a) *for planned works, a copy of the works access permit issued by Auckland Transport or approval from the New Zealand Transport Agency is provided to the Council five days prior to work commencing; and*

(b) *a construction noise and vibration management plan is provided to the Council no less than five days prior to the works commencing in accordance with the applicable provisions of Standard E25.6.29.(5) below.*

(5) A construction noise and vibration management plan must be prepared by a suitably qualified and experienced person and include the following:

(a) *details of the community consultation to be undertaken to advise the occupiers of properties located within 100m of the proposed works of all of the following:*

(i) *the area affected by the work;*

(ii) *why the work is required to be undertaken at night (where relevant);*

(iii) *the times and days when the noise and vibration is likely to be generated;*

(iv) *a contact name and number of the works supervisor who can be contacted if any issues arise; and*

(v) *how noise and vibration complaints will be managed and responded to;*

(b) *a description of the works and its duration, anticipated equipment to be used, the processes to be undertaken and the predicted noise and vibration levels; and*

(c) *identification of the best practicable options that will be undertaken to mitigate and minimise any noise and vibration being produced that is likely to exceed the relevant levels of the following tables:*

(i) 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; or

(ii) Table E25.6.27.2 Construction noise levels for noise affecting any other activity; or

(iii) Table E25.6.28.1 Construction noise levels for construction less than 15 consecutive calendar days duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone; or

(iv) Table E25.6.28.2 Construction noise levels for construction of 15 consecutive calendar days or more duration in the Business – City Centre Zone and the Business – Metropolitan Centre Zone; or (v) Table E25.6.30.1 Vibration limits in buildings.

(6) For the purpose of Standards E25.6.29(1) to E25.6.29(4A) above:

(a) planned work means work that has been planned to take place at least seven days before the work commences;

(b) the measurement and assessment of all construction noise must be in accordance with New Zealand Standard NZS 6803:1999 Acoustics – Construction noise, and

(c) the measurement of all vibration must be in accordance with E25.6.30 Vibration.

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 by 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 500 mm of ground level at the foundation of a single-storey building.*

Table E25.6.30.1 Vibration limits in buildings

RECEIVER	*PERIOD*	*MAXIMUM PEAK PARTICLE VELOCITY (PPV) LIMIT, MM/S*
Occupied activity sensitive to noise	*Night-time 10pm to 7am*	*0.3*
	Daytime 7am to 10pm	*2.0*
Other occupied buildings	*At all times*	*2.0*

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.*

APPENDIX B – CONSTRUCTION EQUIPMENT

Construction equipment, sound power levels, and percent on-time – Network Utility Relocation

PHASE	EQUIPMENT	SWL (dB L_{wA})	SWL (dB L_{wAmax})	% ON TIME
1	Concrete saw	113	-	50
	Excavator-mounted concrete breaker	120	-	25
	8T excavator	102	120	100
	Mobile generator	103	-	100
2	8T excavator	102	120	100
	6-wheeler truck	107	120	50
	Vacuum Truck	108	115	100
3	8T excavator	102	120	100
	Plate compactor	108	-	100
	Concrete truck	103	-	50
	6-wheeler truck/Hiab	107	120	50
4	8T excavator	102	120	100
	6-wheeler truck/Hiab	107	120	50
5	6-wheeler truck/Hiab	107	120	50
	Concrete truck and pump	103	-	100
	Bitumen truck	95	-	50
6	6-wheeler truck	107	120	50
	Hiab	107	120	50
7	8T excavator	102	120	100
	Hiab	107	120	50
	Concrete truck and pump	103	-	100
8	8T excavator	102	120	100
	6-wheeler truck	107	120	50
	Concrete truck and pump	103	-	100
	Plate compactor	108	-	100

Construction equipment, sound power levels, and percent on-time – Shaft Construction and Trenchless Pipe Installation

PHASE	EQUIPMENT	SWL (dB L_{wA})	SWL (dB L_{wAmax})	% ON TIME
1	Concrete cutter	113	-	50
	Excavator-mounted concrete breaker	120	-	25
	35T excavator	107	120	100
	6-wheeler truck	107	120	50
2	Excavator with auger piling attachment or GEAX EK60 piling rig	107	-	100
	20T excavator	105	120	100
	6-wheeler truck	107	120	50
	35T Mobile Crane	105	-	80
	Concrete truck and pump	103	-	100
3	40T excavator	107	120	100
	6-wheeler truck	107	120	50
	Ventilation fan	100	-	100
	Submersible dewatering pump	96	-	100
	Clarifying tanks	90	-	100
	Silenced Generator	90	-	100
4	40T excavator	107	120	100
	6-wheeler truck	107	120	50
	Plate Compactor	108	-	100
	Concrete truck and pump	103	-	100
	Ventilation fan	100	-	100
	Submersible dewatering pump	96	-	100
	Clarifying tanks	90	-	100
	Silenced Generator	90	-	100
5	Submersible dewatering pump	96*	-	100
	Clarifying tanks	90	-	100
	Silenced Generator	90	-	100
6	HIAB	105		75
	20T excavator	107	120	100
	6-wheeler truck	107	120	50
	Tool Truck	100	-	100
	Ventilation fan	100	-	100
7	HIAB	105		75
	20T Excavator	105	120	100
	Pilot Boring Machine	82	-	100
	Power Pack	103	-	100
	6-wheeler truck	107	-	50
	Tool Truck	100	-	100
	Vacuum Truck	108	-	100
	Ventilation fan	100	-	100
	Submersible dewatering pump	96	-	100
	Silenced Generator	90	-	100
8	40T Excavator	107	120	100

	20T Excavator	107	120	100
	6-wheeler truck	107	120	50
	Concrete truck and pump	103	-	100
	90T Crane	105	-	80
	Vibratory roller	103	-	100
	Plate Compactor	108	-	100
*Dewatering pump to be located underground no negligible noise emissions from this equipment				

Construction equipment, sound power levels, and percent on-time – Open Cut Pipe and Manhole Installation

PHASE	EQUIPMENT	SWL (dB L_{wA})	SWL (dB L_{wAmax})	% ON TIME
1	Concrete saw	113	-	50
	35T excavator	107	120	100
	6-wheeler truck	107	120	50
	Vacuum Truck	108	-	100
2	Submersible dewatering pump	96*	-	100
	Clarifying tank	90	-	100
	Silenced Generator	90	-	100
3	35T excavator	107	120	100
	6/8-wheeler truck	107	120	50
	Concrete truck and pump	103	-	100
	Plate Compactor	108	-	100
	Ventilation fan	100	-	100
	Submersible dewatering pump	96	-	100
	Clarifying tank	90	-	100
	Silenced Generator	90	-	100
4	35T excavator	107	120	100
	6/8-wheeler truck	107	120	50
	HIAB	107		75
	Concrete truck and pump	103	-	100
	Ventilation fan	100	-	100
	Submersible dewatering pump	96	-	100
	Clarifying tank	90	-	100
	Silenced Generator	90	-	100
5	35T excavator	107	120	100
	6/8-wheeler truck	107	120	50
	Concrete truck and pump	103	-	100
	Plate Compactor	108	-	100
	Vibratory Roller	103	-	100
*Dewatering pump to be located underground no negligible noise emissions from this equipment				

Vibration equipment/plant and associated PPV

EQUIPMENT/PLANT	PPV (MM/S)
Excavator breaking ground	1.9 at 10 m
Plate compactor	2.0 at 10 m
Vibratory compaction roller	3.6 at 10 m
Pipejacking	1.5 at 10 m
CFA piling, auguring, drilling of holes, or similar	0.5 at 10 m
Excavator with breaker attaching breaking road surface	4 at 10 m

APPENDIX C – PREDICTED NOISE LEVELS

The following predicted noise levels tables have been coded to show:

- Pink indicates NSRs that are predicted to receive noise from works inside and outside the road corridor cumulatively that are greater than 75 dB $L_{Aeq,30min}$ noise limit. However, are lower than 75 dB $L_{Aeq,30min}$ from works outside of the road reserve (i.e. trenchless construction and open trenching around P4MH2 and P4MH3).
- Red indicates NSRs where the predicted noise levels from both works inside and outside of the road corridor are greater than the 75 dB $L_{Aeq,30min}$ noise limit.
- Noise levels outside of brackets is the cumulative noise from construction works inside and outside of the road zone.
- The number inside of the brackets is the noise from construction works outside of the road zone only.

Predicted noise levels for Stage 1 – Utility Diversion

NSR	PHASE (DB $L_{AEQ,30MIN}$)							
	1	2	3	4	5	6	7	8
Federal Street 205 -209	76	70	70	65	66	66	68	71
Federal Street 210	74	68	68	63	64	64	66	69
Federal Street 219	78	72	71	67	68	68	70	73
Greys Avenue 3	85	79	79	75	75	76	77	80
Greys Avenue 48	76	70	70	66	67	67	68	71
Greys Avenue 71	89	83	83	79	79	80	81	84
Hobson Street 152	77	71	70	66	67	67	69	71
Mayoral Drive 100	87	81	81	77	78	78	79	82
Queen Street 299	78	72	72	68	69	69	71	73
Queen Street 301	71	65	64	60	61	61	63	65
Queen Street 313	75	69	69	65	65	65	67	70
Queen Street 315	74	68	68	64	65	65	67	69
Queen Street 317	74	68	68	64	64	65	66	69
Queen Street 319	73	67	67	62	63	63	65	68
Queen Street 321	76	70	70	66	66	66	68	71
Queen Street 323-327	76	70	70	65	66	66	68	71
Queen Street 329	72	66	66	61	62	62	64	67
Queen Street 361	68	62	62	58	58	58	60	63
Queen Street 363	67	61	61	57	58	58	59	62
Queen Street 438	68	62	61	57	58	58	60	62

Predicted noise levels for Stage 2 – Shaft Construction and Trenchless Pipe Installation

NSR	PHASE (DB $L_{AEQ,30MIN}$)							
	1	2	3	4	5	6	7	8
Federal Street 205 -209	73(50)	75(52)	71(48)	74(51)	52(29)	73(50)	75(51)	73(50)
Federal Street 210	72(51)	74(53)	70(49)	73(52)	51(30)	72(50)	74(52)	72(50)
Federal Street 219	74(53)	76(55)	73(51)	76(54)	53(32)	74(53)	76(54)	74(53)
Greys Avenue 3	79(67)	81(69)	77(65)	80(68)	58(47)	79(67)	81(68)	79(67)
Greys Avenue 48	72(69)	74(71)	70(67)	73(70)	52(49)	71(69)	73(70)	71(69)
Greys Avenue 71	83(65)	85(67)	81(63)	84(66)	60(45)	83(65)	85(66)	83(65)
Hobson Street 152	73(53)	75(55)	71(52)	74(55)	52(32)	73(53)	74(55)	73(53)
Mayoral Drive 100	80(70)	82(73)	78(69)	81(72)	59(50)	80(70)	81(72)	80(70)
Queen Street 299	76(62)	78(65)	74(61)	77(64)	55(41)	75(62)	77(64)	75(62)
Queen Street 301	67(68)	69(70)	65(66)	68(69)	45(45)	67(67)	69(69)	67(67)
Queen Street 313	72(69)	74(71)	70(67)	73(70)	50(46)	71(69)	73(70)	71(69)
Queen Street 315	72(69)	74(71)	70(68)	73(71)	50(46)	72(69)	73(71)	72(69)
Queen Street 317	72(69)	74(71)	70(67)	73(70)	50(46)	71(69)	73(70)	71(69)
Queen Street 319	71(70)	73(72)	69(68)	72(71)	48(47)	70(70)	72(72)	70(70)
Queen Street 321	76(74)	78(77)	75(73)	78(76)	53(51)	76(74)	78(76)	76(74)
Queen Street 323-327	83(83)	85(85)	81(82)	84(85)	60(60)	82(83)	84(85)	82(83)
Queen Street 329	77(75)	80(78)	76(74)	79(77)	55(53)	77(75)	79(77)	77(75)
Queen Street 361	70(71)	72(73)	69(69)	72(72)	49(49)	70(70)	72(72)	70(70)
Queen Street 363	67(64)	69(67)	65(63)	68(66)	46(43)	67(64)	68(66)	67(64)
Queen Street 438	68(66)	70(68)	67(64)	70(67)	47(45)	68(66)	70(67)	68(66)

Predicted noise levels for Stage 3 – Open Cut Pipe Installation

NSR	PHASE (DB $L_{AEQ,30MIN}$)				
	1	2	3	4	5
Federal Street 205 -209	74(53)	51(29)	73(51)	71(50)	73(51)
Federal Street 210	72(55)	49(31)	71(53)	69(52)	71(53)
Federal Street 219	76(54)	52(30)	74(52)	73(51)	74(52)
Greys Avenue 3	69(66)	45(43)	67(65)	66(63)	67(65)
Greys Avenue 48	75(72)	51(48)	73(70)	72(69)	73(70)
Greys Avenue 71	81(67)	57(43)	79(65)	78(64)	79(65)
Hobson Street 152	75(53)	52(29)	74(51)	73(50)	74(51)
Mayoral Drive 100	70(70)	46(46)	68(68)	67(67)	68(68)
Queen Street 299	77(60)	53(36)	75(58)	74(57)	75(58)
Queen Street 301	64(62)	40(38)	62(60)	61(59)	62(60)
Queen Street 313	72(69)	48(45)	70(67)	69(66)	70(67)
Queen Street 315	69(68)	45(45)	67(67)	66(65)	67(67)
Queen Street 317	63(62)	39(38)	61(60)	60(59)	61(60)
Queen Street 319	62(61)	38(37)	60(59)	59(58)	60(59)
Queen Street 321	74(74)	50(50)	72(72)	71(71)	72(72)
Queen Street 323-327	88(86)	60(60)	86(84)	85(83)	86(84)
Queen Street 329	83(79)	59(56)	81(78)	80(76)	81(78)
Queen Street 361	76(76)	52(52)	74(74)	73(73)	74(74)
Queen Street 363	72(69)	48(45)	70(67)	69(66)	70(67)
Queen Street 438	71(71)	47(47)	69(69)	68(68)	69(69)

Predicted maximum noise level from any stage/phase of construction

NSR	WORST-CASE PREDICTED NOISE LEVELS, L_{AFmax}
Federal Street 205 -209	78
Federal Street 210	81
Federal Street 219	80
Greys Avenue 3	84
Greys Avenue 48	87
Greys Avenue 71	82
Hobson Street 152	93
Mayoral Drive 100	81
Queen Street 299	92
Queen Street 301	85
Queen Street 313 (facing)	81
Queen Street 315	82
Queen Street 317	82
Queen Street 319	82
Queen Street 321	83
Queen Street 323-327	88
Queen Street 329	94
Queen Street 361	89
Queen Street 363	81
Queen Street 438	78