MARSHALL DAY Acoustics

DOWNTOWN CARPARK RESOURCE CONSENT

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Project: **DOWNTOWN CARPARK**

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1.0 SUMMARY

Marshall Day Acoustics (MDA) has been engaged by RCP on behalf of Precinct Properties New Zealand Limited to advise on the Downtown Carpark Project. The project involves the demolition of the existing Downtown Carpark building (together with the Lower Hobson Street pedestrian bridge and Customs Street West vehicle ramp located within part of the road reserve) and redevelopment of the site to provide for a mixed-use precinct providing for commercial, residential, retail, food and beverage and civic uses. The redevelopment involves an excavated six-level basement, three podium buildings, two towers and six levels of shared basement, including new public spaces and a new laneway network to provide connectivity within the city centre. In addition, the proposed development involves modifications to the podia of existing adjacent buildings (HSBC and AON) to facilitate the new laneway network.

We note that a report addressing noise and vibration effects of demolition activities is attached in Appendix B and forms part of the resource consent application. This report needs to be read in conjunction with the demolition report in Appendix B.

This report provides an acoustic review of the proposed activities and assesses compliance against the Unitary Plan noise and vibration rules. This report is suitable for inclusion in a Resource Consent Application. The main considerations are:

- Construction noise effects are predicted to be reasonable if good practice mitigation and management measures are implemented
- Sheet piling noise is predicted to infringe the limits at four neighbouring buildings, with measures proposed to manage associated effects.
- Construction vibration is predicted to comply with the cosmetic damage limits at all neighbouring buildings
- Vibratory sheet piling is predicted to exceed the vibration amenity limit at the AON building. Vibratory sheet piling will only occur outside typically business hours when the building is mostly unoccupied. Based on this the effects are considered reasonable.
- Environmental (operational) noise emission is predicted to comply.
- Building envelope and internal sound insulation for residential apartments will be designed to comply with the appropriate criteria.

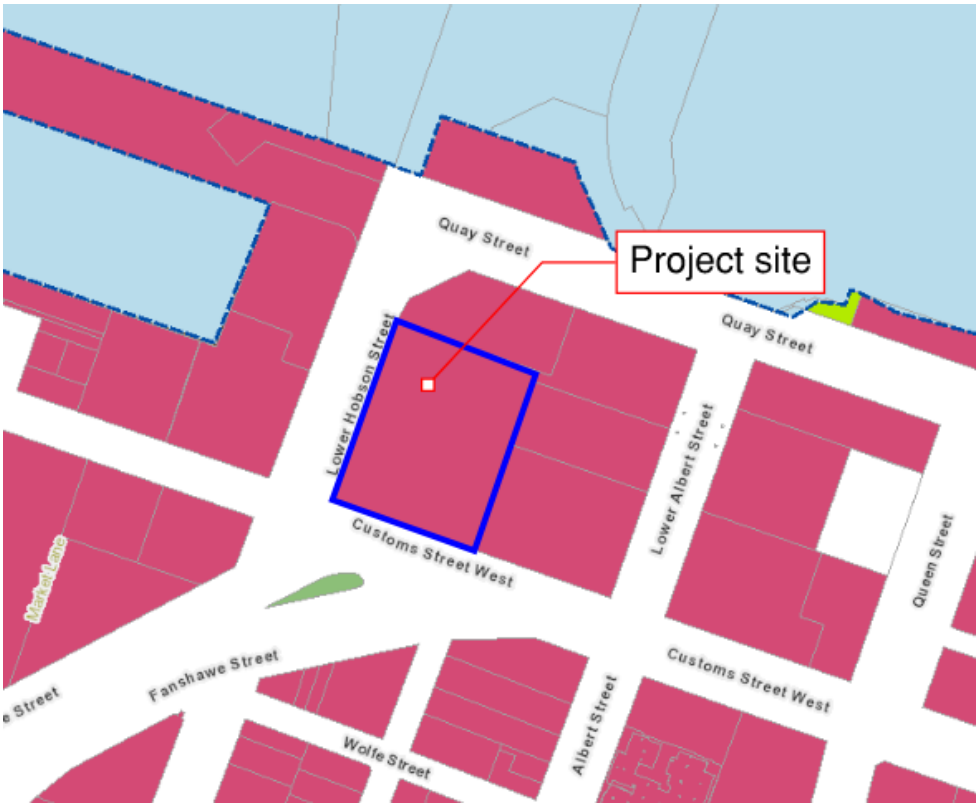
Appendix A contains a glossary of acoustic terminology.

2.0 PROJECT DESCRIPTION

2.1 The Site

An Auckland Unitary Plan (AUP) map is provided in Figure 1 showing the development site and surrounding zones. The site is zoned *Business - City Centre.* The sites adjacent to the development site are all the same zone.

Figure 1: AUP Map



The surrounding receivers are a mixture of commercial and hotel/apartment buildings. The nearest receivers, their use and sensitivities are described below.

M Social – 196 – 200 Quay Street

This is a hotel. The façade of the hotel facing the project site is mostly back of house spaces and corridors. These spaces are not acoustically sensitive. There are some offices and a conference room facing the project site on the ground and first floor. Typically, hotels rooms are less sensitive during the middle of the day e.g. 10am to 4pm.

HSBC Building – 188 Quay Street

This building is a typical commercial building with ground floor lobby, retail and food and beverage spaces with offices in the upper floors. The closest part of the building to the project site is a carpark. We have not assessed construction noise levels at the carpark as it's not a regularly occupied space.

Aon Building – 29 Customs Street West

This building is a typical commercial building with ground floor lobby, retail and food and beverage spaces with offices in the upper floors.

On the ground floor there is a Kindercare childcare centre which has an outdoor play area facing the project site. This outdoor play area is likely a sensitive area for noise. Their opening hours are 7:30am to 5.30pm Monday to Thursday and 7:30am to 5pm on Friday.

The Sebel - 85 Customs Street West

This building is hotel/apartments on the upper levels with ground floor retail/food and beverage.

204 Quay Street

This building is a mixture of offices and food and beverage spaces. The building has a Historic heritage Overlay in the Unitary Plan.

Schedule 14.1 (ID:01969) does not list any primary features. The heritage values are identified as historical (A), physical attributes (F) and aesthetic (G). The overlay excludes the interior of the building.

The HNZPT heritage listing states that the notable features are the fenestration and associated horizontal concrete "ledges" used as an ornament and the lettering on the façade. These features are unlikely to be vibration sensitive.

We have concluded that the heritage listing does not appear to be related to vibration sensitivity. Therefore, we have assessed the vibration sensitivity of this building as a commercial building.

2.2 Proposed Development

The project includes:

- Demolition of the existing carparking building and associated pedestrian bridge and vehicle ramps (addressed in a separate report)
- The removal of the concrete slab including foundations and services
- The excavation of a 5-level basement plus a plant level (6 Levels overall)
- Construction the following buildings:
  - Tower 1 – Commercial (51 Levels)
  - Tower 2 –Residential (41 Levels)
  - Three podium buildings including office spaces, retail and food and beverage units and a new public realm space known as the Urban Room (Te Urunga Hau).

3.0 NOISE AND VIBRATION PERFORMANCE STANDARDS

3.1 Construction Noise (Rule E25.6.28)

AUP Rule E25.6.28 sets construction noise limits for the City Centre zone. The relevant limits are reproduced in Table 1.

Table 1: Construction noise limits for construction duration of at least 15 days

Time	Noise Limit	
	Average ($L_{Aeq(30min)}$)	Maximum (L_{AFmax})
Monday to Friday 6.30am – 10:30pm	75 dB	90 dB
Saturday 7am-11pm	80 dB	90 dB
Sunday 9am – 7pm	65 dB	85 dB
All other times	60 dB	75 dB

Construction noise must be measured and assessed in accordance with the provisions of New Zealand Standard NZS 6803:1999 "*Acoustics - Construction Noise*". The noise limits apply at 1m from external façades of occupied buildings.

3.2 Vibration (Rule E25.6.30)

3.2.1 Cosmetic Building Damage

AUP rule E25.6.30 (1)(a) requires construction vibration to be measured and assessed in accordance with German Standard DIN 4150-3:1999 "*Structural vibration – Part 3: Effects of vibration on structures*". The short-term (transient)[1] vibration limits in Figure 2 apply at building foundations in any axis. The vibration limits in all other cases are summarised in Table 2.

The criteria relate to the avoidance of cosmetic building damage, such as cracking in paint or plasterwork. Cosmetic building damage effects are deemed 'minor damage' in the Standard and can generally be easily repaired. The cosmetic building damage thresholds are much lower those that would result in structural damage. The Standard states: "*Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur*."

Figure 2: Short-term (transient)[1] vibration at building foundations (DIN 4150-3 1999: Figure 1)

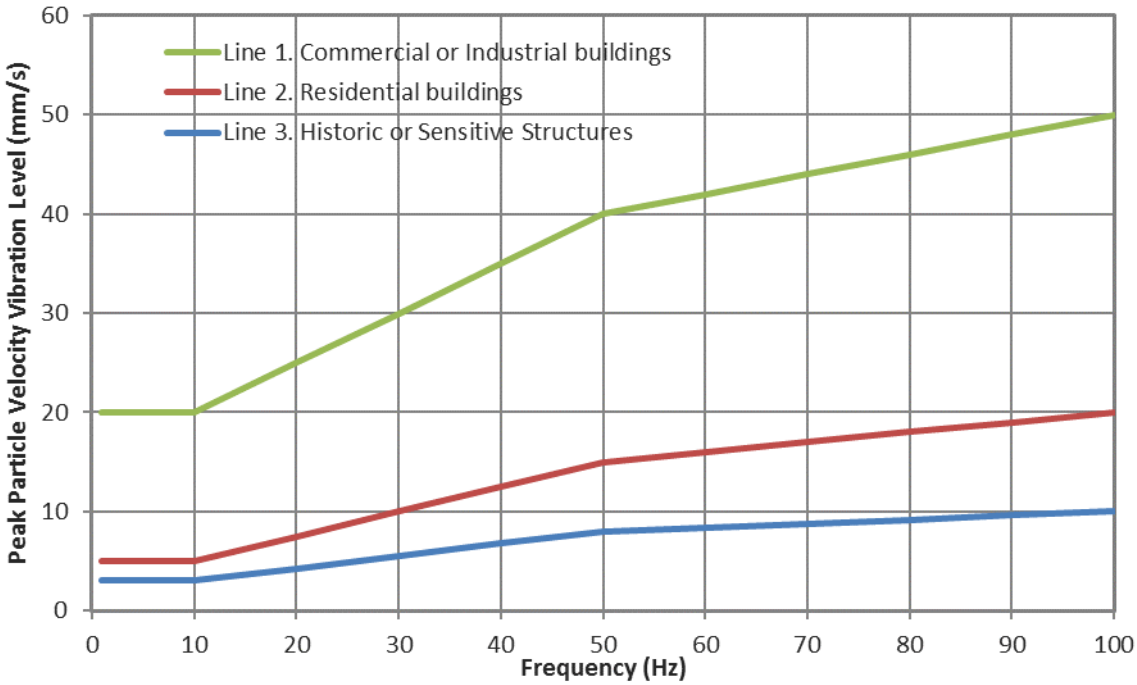


Table 2: Vibration at horizontal plane of highest floor (DIN 4150-3 1999: Tables 1 and 3)

Structure Type	Peak Particle Velocity Vibration Level (mm/s)	
	Short-term (transient)[1]	Long-term (continuous)[2, 3]
Line 1. Commercial or Industrial buildings	40	10
Line 2. Residential buildings	15	5
Line 3. Vibration Sensitive Structures	8	2.5

[1] Short-term (transient) vibration is "*vibration which does not occur often enough to cause structural fatigue and which does not produce resonance in the structure being evaluated*"

[2] Long-term (continuous) vibration is types not covered by the short-term vibration definition

[3] The long-term (continuous) criteria can apply at all floor levels, but levels are normally highest at the top floor

3.2.2 Building Amenity

AUP rule E25.6.30 (1)(b) requires construction vibration to comply with 2 mm/s PPV in any axis on the floor of interest. Where construction vibration is predicted to exceed this threshold for more than three days, the occupants of buildings within 50 m must be advised of the works no less than three days prior to the works commencing and the vibration level must not exceed 5 mm/s whilst occupied.

3.3 Operational Activities Noise Emissions (Rule E25.6.8)

Table 3 summarises the AUP noise limits between adjacent sites. These are to be measured or assessed as the incident level on the façade of any building on any other site.

Table 3: AUP Noise Limits at Surrounding Properties

Zones	Day & Time		Level[1]
Business - City Centre Zone To Business - City Centre Zone *Measured or assessed as the incident level on the façade of any building on any other site*	Monday to Sunday	7.00 am -11.00 pm	65 dB L_{Aeq}
		11.00 pm-7.00 am	60 dB L_{Aeq} 65 dB L_{eq} at 63 Hz 60 dB L_{eq} at 125 Hz 75 dB L_{Amax}

1 The 63Hz and 125Hz octave band limits do not apply to fixed mechanical plant

3.4 Internal Sound Levels (Rule E25.6.9 & E25.6.10)

The apartments must be designed so that the internal sound levels do not exceed the limits summarised in Table 4.

Rule E25.6.9 applies between units. Management of noise emissions between tenancies is the responsibility of the occupier/tenant. They must ensure that noise generated by their operation does not exceed the AUP noise limits within adjacent tenancies as per Rule E25.6.9. Additionally, we recommend that the Body Corporate imposes noise conditions on tenants which would reinforce the AUP rules.

Rule E25.6.10 requires the assumption that the noise level incident on the façade is based on the maximum permitted noise level of that which can be generated in the zone in Table 3 above.

Table 4: Internal Sound Levels

Room	Time	Internal Sound Levels
Bedrooms and sleeping areas	11.00 pm – 7.00 am	35 dB L_{Aeq} 45 dB $L_{eq\ at\ 63\ Hz}$ 40 dB $L_{eq\ at\ 125\ Hz}$
Other noise sensitive spaces	At all times	40 dB L_{Aeq}
In all units except those containing activities sensitive to noise (Rule E25.6.9)	At all times	50 dB L_{Aeq}

These internal noise levels can only be complied with when doors or windows are closed. It will be necessary for all apartments to be mechanically ventilated and/or cooled. AUP Rule E25.6.10 (3) f requires the mechanical systems to be controlled to a level of 35 dB L_{Aeq}.

We consider the noise level in Rule E25.6.10 (3) f not appropriate for living rooms. We recommend the following condition of consent:

1. *Mechanical services noise in noise sensitive spaces shall not exceed the following;*

   35 dB L_{Aeq} in bedrooms, and

   40 dB L_{Aeq} in living areas

   This shall be measured in accordance with AS/NZS 2107:2016 "Acoustics- Recommended design sound levels and reverberation times for building interiors" and at the minimum air flows required to achieve the design temperatures and air flows in Standard E25.6.10(3)(b)(i) and (ii).

Our recommended level of 40 dB L_{Aeq} in living areas aligns with NZS 2107:2016 "*Acoustics – Recommended design sound levels and reverberation times for building interiors*". This standard recommends internal noise levels of 35 to 45 dB L_{Aeq} in living areas. The noise effect of this change is considered negligible and aligns with the Port Noise Overlay requirements below.

3.5 Port Noise Overlay

The residential tower straddles the 58 dB L_{Aeq} and 60 dB L_{Aeq} City Centre Port Noise Overlay in the Unitary Plan. Rule D25.6.1 requires that activities sensitive to noise be designed to achieve the following internal noise levels based on the external noise in the overlay.

- Bedrooms 35 dB L_{Aeq}
- Other habitable rooms 40 dB L_{Aeq}

Rule D25.6.1(2) provides a spectrum for the façade noise level. Rule D25.1(3) notes that D25.1(2) applies in addition to any other noise insulation requirements. The other relevant noise insulation requirement is Rule E25.6.10 which is covered in Section 3.4.

Rule D25.6.1(4) sets out the requirements for mechanical ventilation like Rule E25.6.10(3). We recommend our amended condition of consent in Section 3.4 also apply to this rule.

We also note that D25.6.1(6) requires a restrictive no-complaint covenant in favour of Ports of Auckland Limited.

4.0 CONSTRUCTION NOISE AND VIBRATION

4.1.1 Construction Methodology

We understand that construction hours will generally be Monday to Friday 7am – 6pm and Saturdays 8am – 5pm. Construction hours may be extended to Monday to Friday 6.30am – 10.30pm and Saturdays 7am – 11pm to enable high noise works to occur outside sensitive hours of neighbouring buildings.

The high noise activities will occur mostly during foundations and excavation. The predicted duration for each phase is:

- Enabling works 6 months
- Piling, Foundations and excavation 9 months
- Basement works 14 months
- Building construction 40 months

Based on discussions with the design team, we have identified the following high noise demolition and construction activities. We focus on them as the primary indicators of the noise effects.

Enabling works, foundations and excavation

Prior to the perimeter and building piles being installed, the ground floor slab of the downtown carpark will be removed. This will be removed in a progressive matter as piling works moves across the site. We understand that the ground floor slab was constructed with a sub floor and is supported on plies. This means that demolition would involve concrete cutting, pulverizing and isolated breaking like the demolition of the upper floors (see Appendix B)

A diaphragm wall (d-wall) will be constructed around the northern and western perimeter of the site (see Appendix B). The southern and eastern perimeter of the site is proposed to have a sheet piled wall. To minimise noise and vibration from sheet piling, the following methodology is proposed.

- Sheet piles are pre-drilled during typical construction hours
- Sheet piles are pressed in without using the vibration function during typical construction hours
- Sheet piles vibrated to final depth outside typical business hours (Mon to Fri 5.30pm to 10.30pm and Sat 7am to 11pm)

Tonkin and Taylor have informed us that vibratory sheet piling will take approximately 3 weeks to complete. Following this, the foundation piling will commence across the site using bored piling rigs.

Once piling is completed, excavation will commence along with installation of ground anchors. During this phase, it may be necessary to remove inground foundations leftover from the demolition phase. This would be undertaken using a medium (8-10t) excavator with breaker attachment.

Building construction

The remainder of the construction period will involve typical commercial building construction methodologies, including as concrete works, cranage and hand tools.

4.2 Construction Noise & Vibration Mitigation and Management

The two most effective demolition noise mitigation measures to reduce noise level are screening (e.g. noise barriers) and alternative equipment selection. Management measures (e.g. communication/consultation, scheduling, training, and monitoring) are effective at minimising residual construction noise effects.

4.2.1 Breaker Shroud

We recommend that any concrete breaking be undertaken using a shroud, such as the Hushtec rock breaker noise control attachment. These breaker shrouds typically reduce noise levels by 5-7 decibels.

4.2.2 Concrete Cutting Enclosure

When concrete cutting is required within 25m of the façade of M Social at 196 – 200 Quay Street and within 50m of the Aon podium at 29 Customs Street West we recommend using an enclosure. Noise enclosures surround the source on more than one side and have a roof (an example is included as Figure B.3 in NZS 6803: 1999). As concrete cutting noise is dominated by high frequency sound, a well designed enclosure will provide 15 decibels or more of attenuation.

- Enclosures can be made from the noise curtains listed above, or the following proprietary options are available:
  - Echo Barrier ‘Cutting Station’ (www.supplyforce.co.nz)
  - Soundbuffer ‘Cutting Enclosure' (soundbuffer.co.nz)
  - Hushtec ‘Acoustic Tent’ (www.duraflex.co.nz)

If a custom enclosure is needed, a suitably qualified and experienced acoustic specialist, such as a Member of the Acoustical Society of New Zealand (MASNZ), will be involved in its design.

4.2.3 Noise Barriers

Ground level noise barriers are predicted to be ineffective as the surrounding receivers are all multi-level and will look over the barrier. Precinct has agreed with Kindercare to install noise barriers along the edge of their outdoor play areas on ground floor and level 2. To be effective these will need to block line of sight to the construction activities.

Where practicable, the following guidelines should be incorporated in the design and utilisation of temporary noise barriers:

- The panels should be constructed from materials with a minimum surface mass of 6.5 kg/m^2. Suitable panels include 12 mm plywood or the following proprietary 'noise curtains':
  - SealedAir 'WhisperFence 24dB' (www.sealedair.com)
  - Hushtec 'Premium Series Noise Barrier' (www.duraflex.co.nz)
  - Soundbuffer 'Performance Acoustic Curtain' (soundbuffer.co.nz)
  - Hoardfast 'Fast Wall Premium PVC partition panels' (www.ultimate-solutions.co.nz)
  - Safesmart 'Acoustic Curtain 6.5kg/m^2' (www.safesmartaccess.co.nz)
  - Alternatives should be approved by a suitably qualified acoustic specialist because some proprietary noise curtains have insufficient surface mass for general use
- The panels should be a minimum height of 2 m, and higher if practicable to block line-of-sight
- The panels should be abutted or overlapped to provide a continuous screen without gaps at the bottom or sides of the panels
- The panels should be positioned as close as practicable to the noisy demolition activity to block line-of-sight between the activity and noise sensitive receivers

Effective noise barriers typically reduce the received noise level by 10 decibels.

4.2.4 Construction Noise and Vibration Management Plan

We recommended that a Construction Noise and Vibration Management Plan (CNVMP) be prepared and implemented throughout the demolition and construction. We have prepared a draft CNVMP which is attached and includes:

- The performance standards that must, where practicable, be complied with
- Predicted noise and vibration levels for relevant equipment and/or activities
- Mitigation considerations to identify the BPO with respect to demolition noise and vibration
- Noise and vibration monitoring requirements, with triggers and feedback mechanisms
- Communication, consultation, and complaints response protocols

4.3 Construction Noise

4.3.1 Noise Levels

Table 5 presents the typical noise levels and setbacks from the activity required to achieve compliance for representative construction activities.

Table 5: Construction noise levels at 1m from a building façade (excluding screening)

Equipment	Sound Power Level (dB L_{Aeq})	Noise Level (dB L_{Aeq})				Setback (m)
		5 m	10 m	20 m	50 m	75 dB L_{Aeq}
Excavator (20t)	103	84	78	72	64	14
Mobile crane (35t)	98	79	73	67	58	8
Small excavator (2 - 5t) mounted concrete breaker*	106	87	81	75	66	20
Medium excavator (8-10t) mounted concrete breaker*	111	92	86	80	71	33
Concrete truck and pump	103	84	78	72	64	14
Mobile crane (35t)	98	79	73	67	59	14
D Wall and Bored piling	106	87	81	75	66	20
Sheet piling	116	97	91	85	76	52
Concrete cutting	115	96	90	84	75	48

* includes 5 dB from breaker shroud

We have predicted the highest representative noise levels at the adjacent buildings in Table 6. We predict compliance at all other buildings. These noise levels would only occur for a short period when works are closest. We have provided estimated durations of the exceedances based on the construction programme. During this time the infringements would range between the highest representative level and 75 dB L_{Aeq} as the work moves further away.

Table 6: Highest representative noise levels

Building Address	Predicted Noise Level, dB L_{Aeq}			Duration of infringement
	Dwall / Bored Piling	Sheet Piling	Concrete cutting (slab removal)	
M Social – 196 – 200 Quay Street	79	77	80[1] – 75	3.5 months
Aon Building – 29 Customs Street West – Tower	76	88	< 75[1]	6 weeks
Aon Building – 29 Customs Street West – Podium	79	94	< 75[1]	6 weeks
HSBC – 188 Quay Street – Tower	< 75	80	< 75[1]	3 weeks
The Sebel - 85 Customs Street West	< 75	80	< 75	3 weeks

[1] includes 15 dB of shielding from a concrete cutting enclosure

4.3.2 Construction Noise Effects

The effects generated by construction noise occur in the locations that people regularly occupy. For commercial buildings (such as M Social, HSBC and The Sebel) all spaces are internal to the building. The Kindercare at the Aon Building has an outdoor play area facing the Site, for this location we have assessed both internal and external noise effects.

We provide a discussion for each location below.

M Social – 196 – 200 Quay Street

The façade of the hotel facing the project site is mostly back of house spaces and corridors. Noise levels in the corridors are predicted to be 55 dB L_{Aeq} or less. This will be reasonable for this transient space with prior communication. Noise levels in the hotel rooms are predicted to be 40 dB L_{Aeq} or less. This will be acceptable for occupants during the day. If people are trying to sleep, there may be some disturbance.

Level 1 of M Social has a conference room facing the construction site. This space has no external windows and a double wall construction. Noise levels in this space are predicted to be 45 dB L_{Aeq} or less. With a speech amplification system there shouldn't be any issues addressing large groups. Group activities could procced without significant disturbance.

Aon Building – 29 Customs Street West – Podium Offices and Tower

Internal noise levels, from all activities except vibratory sheet piling, are predicted to be 50 dB L_{Aeq} or less in the offices facing the project site. This is typically acceptable in an office environment, and we note that this level is the same as the Unitary Plan requirement (E25.6.9) for noise transfer between tenancies. Concentration and communication would begin to be affected for people sensitive to noise.

Vibratory sheet piling will only occur outside typical business hours and it has been assumed that the building will generally be unoccupied. We haven't assessed the noise effects from sheet piling at this location as the building will be generally unoccupied.

HSBC – 188 Quay Street – Tower

All activities except for vibratory sheet piling are predicted to comply with the construction noise limits at this location.

Vibratory sheet piling will only occur outside typical business hours and it has been assumed that the building will generally be unoccupied at these times. We haven't assessed the noise effects from sheet piling at this location as the building will be generally unoccupied.

The Sebel - 85 Customs Street West

All activities except for vibratory sheet piling are predicted to comply with the construction noise limits at this location.

Vibratory sheet piling will occur in the evenings and Saturdays. We note that sheet piling noise levels are compliant with the Saturday noise limits between 7am and 11pm. This shows that construction noise levels of this magnitude are expected within the Business City Centre Zone.

During vibratory sheet piling, noise levels within the apartments will be 50 dB L_{Aeq} or less, for a period of approximately 3 weeks. When people are awake this will be acceptable for most occupants and communication would begin to be affected. This will be disturbing for people trying to sleep but this is a hotel generally for short stays only. We recommend that temporary noise barriers be installed close to the sheet pile. The barriers would need to be ~3m high to shield the top floors of the Sebel. This would enable noise levels to be 40 dB L_{Aeq} inside, which would be less disturbing and considered acceptable.

With effective communication, mitigation and management measures in place, we consider the effects to be reasonable.

Aon Building – 29 Customs Street West – Kindercare

Vibratory sheet piling is proposed to only occur outside the operational hours of Kindercare to avoid undesirable noise effects.

It has been agreed with Kindercare to install a noise barrier along the edge of the podium, which will reduce noise levels received within their outdoor play areas.

The outdoor play areas are located on the ground floor and second floor of the podium. The play areas extend back a good distance from the works, which will provide a range of noise levels cross the play area. We predict the following worst case bored piling noise levels in the outdoor play areas. We note that these levels will reduce as piling moves away from the eastern boundary.

Ground floor podium outdoor area: 60 – 70 dB L_{Aeq}

Level 2 podium outdoor area: 55 – 65 dB L_{Aeq}

- A noise level above 65 dB L_{Aeq} in the outdoor play area will limit communication to within a radius of a couple of meters even when shouting. Addressing a large group of children will not be possible.
- A noise of 60 – 65 dB L_{Aeq} in the outdoor play area will require shouting to effectively communicate with the children.
- A noise level of 60 dB L_{Aeq} or below should be generally acceptable for temporary activities.
- A noise level of 55 dB L_{Aeq} is what is typically considered appropriate for day to day noise levels

Internal noise levels are predicted to be 45 dB L_{Aeq} or less. This will be reasonable for typical daytime childcare activities. In sleep areas it may cause difficulties for children trying to sleep.

If additional noise reduction is required over and above the noise barrier to ensure reasonable acoustic amenity in the sleeping areas then alterations (e.g. secondary glazing) to the façade of the sleep room or moving the sleep room to a quieter area in the tenancy should be investigated.

We also recommend that temporary relocation be considered. This may include other office space within the building that could be used as a play area when noise levels are at their highest.

We note that Kindercare is already located within a high noise environment. On the 24 June 2024 between 2pm and 3pm we visited the site to measure the existing noise environment. The measurements were dominated by idling buses, trucks waiting at the lights and extract fans on the Downtown Carpark. We measured a noise level of 70 dB L_{Aeq} at the edge of the podium facing Customs Street and a noise level of 63 dB L_{Aeq} halfway down the alleyway between the Downtown Carpark and the Aon building. We consider this indicative of the noise levels in the outdoor play area.

The permitted noise limits (E25.6.8) in this zone are 65 dB L_{Aeq} between 7 am – 11 pm. Additionally, using the averaging provisions of New Zealand Standard NZS 6802:2008 *Acoustics - Environmental Noise*, noise levels of up to 70 dB L_{Aeq} are permitted by the AUP for up to 5 hours per day. These noise levels could be received in the outdoor play area.

High noise levels are (or have the potential to be) part of the day to day environment of Kindercare and would need to be managed by centre staff.

Overall, with effective consultation, mitigation and management measures (which have been recommended in this report) in place and taking into account the high noise environment we consider the noise effects on Kindercare to be reasonable.

4.4 Construction Vibration

Table 7 summarises the expected set back distances for high vibration equipment to achieve compliance with the AUP rules.

Table 7: Indicative vibration levels at building foundations

	Vibration setback distance (m)			
	Vibration Amenity	Cosmetic Building Damage		
	AUP	Heritage	Residential	Commercial
Equipment	2 mm/s	2.5 mm/s	5 mm/s	10 mm/s
Small excavator (2 - 5t) mounted concrete breaker	4	4	2	1
Medium excavator (8 – 10t) mounted concrete breaker	8	8	5	3
Sheet piling (based on predrilled holes)	8	15	6	3

Sheet piling is predicted to exceed the amenity limit at the Aon Building at 29 Customs Street West. We predict vibration from vibratory sheet piling will be up to 4 mm/s. We note that vibratory sheet piling will only occur outside typical business hours and that the building will largely be unoccupied at those times. We consider the effects from this exceedance acceptable.

Construction vibration received at all other surrounding properties is predicted to comply with the amenity and cosmetic damage limits. Regardless, vibration may be perceptible at times, but generally acceptable with effective prior engagement.

4.5 Unitary Plan Framework

While construction noise is usually undesirable, it is temporary and not necessarily unreasonable when all the relevant factors are taken into consideration.

The foreword of New Zealand Standard NZS 6803:1999 "*Acoustics – Construction Noise*" states:

> "*Construction noise is an inherent part of the progress of society. As noise from construction is generally of limited duration, people and communities will usually tolerate a higher noise level provided it is* ***no louder than necessary, and occurs with appropriate hours of the day****. The Resource Management Act 1991 requires the* ***adoption of the best practicable option to ensure*** *the emission of noise from premises does not exceed a* ***reasonable level****. The Act also imposes a duty on every person to avoid, remedy, or mitigate any adverse effect on the environment arising from an activity carried on by, or on behalf of, that person*."

Additionally, the AUP objective, policies, rules and matters of discretion support the New Zealand Standard NZS 6803:1999 assessment of construction activities.

AUP **objectives** E25.2 (1) requires that:

> *"People are protected from* ***unreasonable*** *levels of noise and vibration",*

while (4) states:

> *"Construction activities that cannot meet noise and vibration standards are* ***enabled while controlling duration, frequency and timing*** *to manage adverse effects".*

This acknowledges that there are often periods or activities where the construction noise standards cannot be met. The objective is to enable them provided they are no louder than necessary, and are aligned with the New Zealand Standard NZS 6803:1999 objectives.

AUP **policy** E25.3 (2) requires:

> *"Minimise,* ***where*** *practicable, noise and vibration at its source or on the site from which it is generated to mitigate adverse effects on adjacent sites"*

while (10) states:

> *"Avoid, remedy or mitigate the adverse effects of noise and vibration from construction, maintenance and demolition activities while having regard to:*
>
> *a) the sensitivity of the receiving environment; and*
>
> *b) the proposed duration and hours of operation of the activity; and*
>
> c) ***the practicability of complying*** *with permitted noise and vibration standards*."

Again, this acknowledges the practicability of compliance. The noise and vibration assessment and a CNVMP would address all three elements.

AUP **rules** E25.6.28 (primarily) requires compliance with the stated noise limits. However, as discussed above, this is not always practicable and exceedances of the noise standards are often reasonable provided it is the BPO.

AUP **matters of discretion** in E25.8.2 (1) parts (a) and (b) state (note other parts are not particularly relevant to construction noise):

> *a) "whether activities can be managed so that they do not generate unreasonable noise and vibration levels on adjacent land uses particularly activities sensitive to noise*
>
> *b) the extent to which the noise or vibration generated by the activity:*
>
> - *will occur at times when disturbance to sleep can be avoided or minimised; and*

- *will be compatible with activities occurring or allowed to occur in the surrounding area; and*
- *will be limited in duration, or frequency or by hours of operation; and*
- *will exceed the existing background noise and vibration levels in that environment and the reasonableness of the cumulative levels; and*
- *can be carried out during daylight hours, such as road works and works on public footpaths"*

It is considered that the noise and vibration levels will be generally reasonable with the adoption and implementation of a CNVMP. The works would also be undertaken during the day and are consistent with what would be expected from construction activities on many large building sites within the urban environment.

5.0 OPERATIONAL NOISE ASSESSMENT

5.1 Mechanical Services Plant

The mechanical services plant is in plantrooms and on the roof. Our experience shows that mechanical plant in a Business Zone can readily achieve compliance with the noise rules with good acoustic design, installation, and maintenance.

5.2 Retail and Food & Beverage

The ground floor and first floors have retail and food & beverage tenancies that face into and out of the site. We anticipate that these tenancies should be able to readily comply with the noise limits at neighbouring buildings. The operators may need to moderate the level of music noise at night to ensure compliance.

6.0 FAÇADE SOUND INSULATION

At this stage, the façade design is still in concept design. However, in our experience, the facade of the apartments can be designed to provide sufficient sound insulation to comply with AUP Rule E25.6.10 and D25.6.1(1), (2) and (3). Design compliance should be demonstrated during Building Consent.

Table 8 summarises the typical building envelope construction arrangements that will enable compliance with the AUP rules.

Table 8: Indicative/example Building Envelope Construction

Building Element	Construction
Roof	Concrete roof structure Minimum 300 mm deep ceiling cavity and absorptive cavity blanket 1x13 mm plasterboard on suspended metal ceiling batten system
Glazing (DGU)	12.76 mm acoustic laminate / 12 mm airgap/ 8 mm monolithic
Solid Curtain Wall	Steel/Aluminium cladding panels 150 mm cavity Steel backpan with 140mm rockwool or fibreglass insulation 2x13 mm Noiseline Plasterboard internal lining
Masonry Wall	Paint finish concrete panels 45 mm timber studs with absorptive cavity blanket 13 mm Standard Plasterboard

7.0 INTERNAL SOUND INSULATION

The slab and ceiling between the level 5 commercial tenancy and the level 6 apartments will need to comply with NZ Building Code Clause G6 and E25.6.9.

Based on typical office activities and slab arrangements, in our experience, compliance with E25.6.9 will be readily complied with. Additionally, activities in apartment common areas (e.g. pool, social areas), can comply with E25.6.9 with good design practices.

APPENDIX A GLOSSARY OF TERMINOLOGY

SPL or L_P	Sound Pressure Level. A logarithmic ratio of a sound pressure measured at distance, relative to the threshold of hearing (20 µPa RMS) and expressed in decibels.
SWL or L_W	Sound Power Level. A logarithmic ratio of the acoustic power output of a source relative to 10^{-12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
dB	Decibel - The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 µPa, i.e. dB = 20 x log(P/Pr)
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
$L_{Aeq\ (t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{Amax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
PPV	Peak Particle Velocity For Peak Particle Velocity (PPV) is the measure of the vibration aptitude, zero to maximum. Used for building structural damage assessment.
Noise	A subjective term used to describe sound that is unwanted by, or distracting to, the receiver.
Vibration	When an object vibrates, it moves rapidly up and down or from side to side. The magnitude of the sensation when feeling a vibrating object is related to the vibration velocity. Vibration can occur in any direction. When vibration velocities are described, it can be either the total vibration velocity, which includes all directions, or it can be separated into the vertical direction (up and down vibration), the horizontal transverse direction (side to side) and the horizontal longitudinal direction (front to back).

APPENDIX B DEMOLITION NOISE AND VIBRATION ASSESSMENT

MARSHALL DAY Acoustics

DOWNTOWN CARPARK – DEMOLITION RESOURCE CONSENT

Rp 001 20230126 | 11 July 2024

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Approved	-	-	11/07/2024	Shaun King	Craig Fitzgerald

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1.0 SUMMARY

Marshall Day Acoustics (MDA) has been engaged by RCP on behalf of Precinct Properties to advise on the demolition of the Downtown Carpark at 2 Lower Hobson Street

This report provides an acoustic review of the proposed activities and assesses compliance against the Unitary Plan noise and vibration rules. The main considerations are:

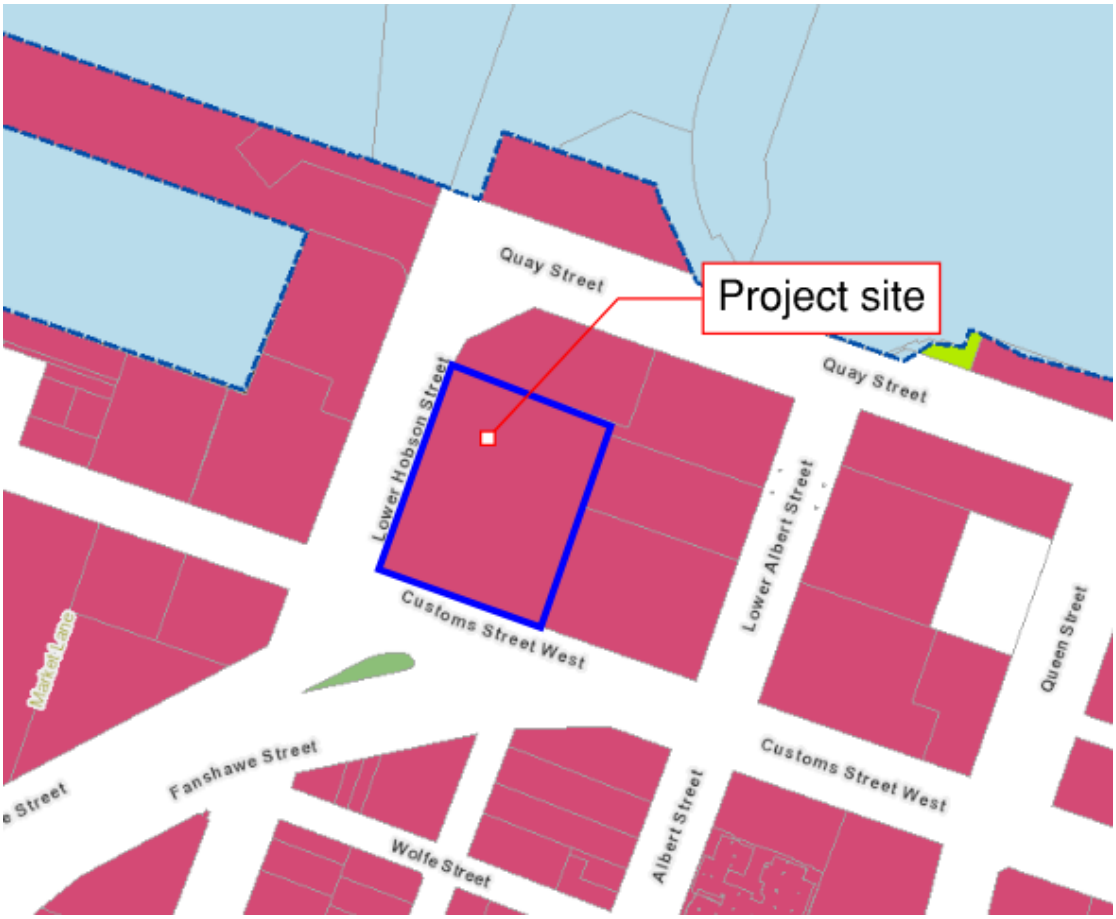
- Demolition noise is predicted to infringe the limits at three neighbouring buildings
- We predict that demolition noise effects will be reasonable if good practice mitigation and management measures are implemented
- Demolition vibration is predicted to comply with the limits at all neighbouring buildings
- It is considered that the noise and vibration levels will be generally reasonable with the adoption and implementation of a Demolition Noise and Vibration Management Plan (DNVMP). The works would also be undertaken during the day and are consistent with what would be expected from demolition activities on many large building sites within the urban environment.

Appendix A contains a glossary of acoustic terminology.

2.0 THE SITE AND SURROUNDING RECEIVERS

An Auckland Unitary Plan (AUP) map is provided in Figure 1 showing the development site and surrounding zones. The site is zoned *Business - City Centre.* The sites adjacent to the development site are all the same zone.

Figure 1: AUP Map



The surrounding receivers are a mixture of commercial and hotel/apartment buildings. The nearest receivers, their use and sensitivities are described below.

M Social – 196 – 200 Quay Street

This is a hotel. The façade of the hotel facing the project site is mostly back of house spaces and corridors. These spaces are not acoustically sensitive. There are some offices and a conference room facing the project site on the ground and first floor. Typically, hotels rooms are less sensitive during the middle of the day e.g. 10am to 4pm.

HSBC Building – 188 Quay Street

This building is a typical commercial building with ground floor lobby, retail and food and beverage spaces with offices in the upper floors. The closest part of the building to the project site is a carpark. We have not assessed demolition noise levels at the carpark as it's not a regularly occupied space.

Aon Building – 29 Customs Street West

This building is a typical commercial building with ground floor lobby, retail and food and beverage spaces with offices in the upper floors.

On the ground floor there is a Kindercare childcare centre which has an outdoor play area facing the project site. This outdoor play area is likely a sensitive area for noise. Their opening hours are 7:30am to 5.30pm Monday to Thursday and 7:30amd to 5pm on Friday.

The Sebel - 85 Customs Street West

This building is hotel/apartments on the upper levels with ground floor retail/food and beverage.

204 Quay Street

This building is a mixture of offices and food and beverage spaces. The building has a Historic heritage Overlay in the Unitary Plan.

Schedule 14.1 (ID:01969) does not list any primary features. The heritage values are identified as historical (A), physical attributes (F) and aesthetic (G). The overlay excludes the interior of the building.

The HNZPT heritage listing states that the notable features are the fenestration and associated horizontal concrete "ledges" uses as ornament and the lettering on the façade. These features are unlikely to be vibration sensitive.

We have concluded that the heritage listing does not appear to be related to vibration sensitivity. Therefore, we have assessed the vibration sensitivity of this building as a commercial building.

1-3 Albert Street

This building is a typical commercial building with ground floor lobby, retail and food and beverage spaces with offices in the upper floors.

22 Fanshawe Street

This building is a typical commercial building with ground floor lobby and food and beverage spaces with offices in the upper floors.

3.0 NOISE AND VIBRATION PERFORMANCE STANDARDS

3.1 Construction Noise (Rule E25.6.28)

AUP Rule E25.6.28 sets construction noise limits for the City Centre zone. The relevant limits are reproduced in Table 1.

Table 1: Construction noise limits for construction duration of at least 15 days

Time	Noise Limit	
	Average ($L_{Aeq(30min)}$)	Maximum (L_{AFmax})
Monday to Friday 6.30am – 10:30pm	75 dB	90 dB
Saturday 7am-11pm	80 dB	90 dB
Sunday 9am – 7pm	65 dB	85 dB
All other times	60 dB	75 dB

Construction noise must be measured and assessed in accordance with the provisions of New Zealand Standard NZS 6803:1999 "*Acoustics - Construction Noise*". The noise limits apply at 1m from external façades of occupied buildings.

3.2 Vibration (Rule E25.6.30)

3.2.1 Cosmetic Building Damage

AUP rule E25.6.30 (1)(a) requires construction vibration to be measured and assessed in accordance with German Standard DIN 4150-3:1999 "*Structural vibration – Part 3: Effects of vibration on structures*". The short-term (transient)[1] vibration limits in Figure 2 apply at building foundations in any axis. The vibration limits in all other cases are summarised in Table 2.

The criteria relate to the avoidance of cosmetic building damage, such as cracking in paint or plasterwork. Cosmetic building damage effects are deemed 'minor damage' in the Standard and can generally be easily repaired. The cosmetic building damage thresholds are much lower those that would result in structural damage. The Standard states: "*Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur*."

[1] Short-term (transient) vibration is "*vibration which does not occur often enough to cause structural fatigue and which does not produce resonance in the structure being evaluated*"

Figure 2: Short-term (transient)[1] vibration at building foundations (DIN 4150-3 1999: Figure 1)

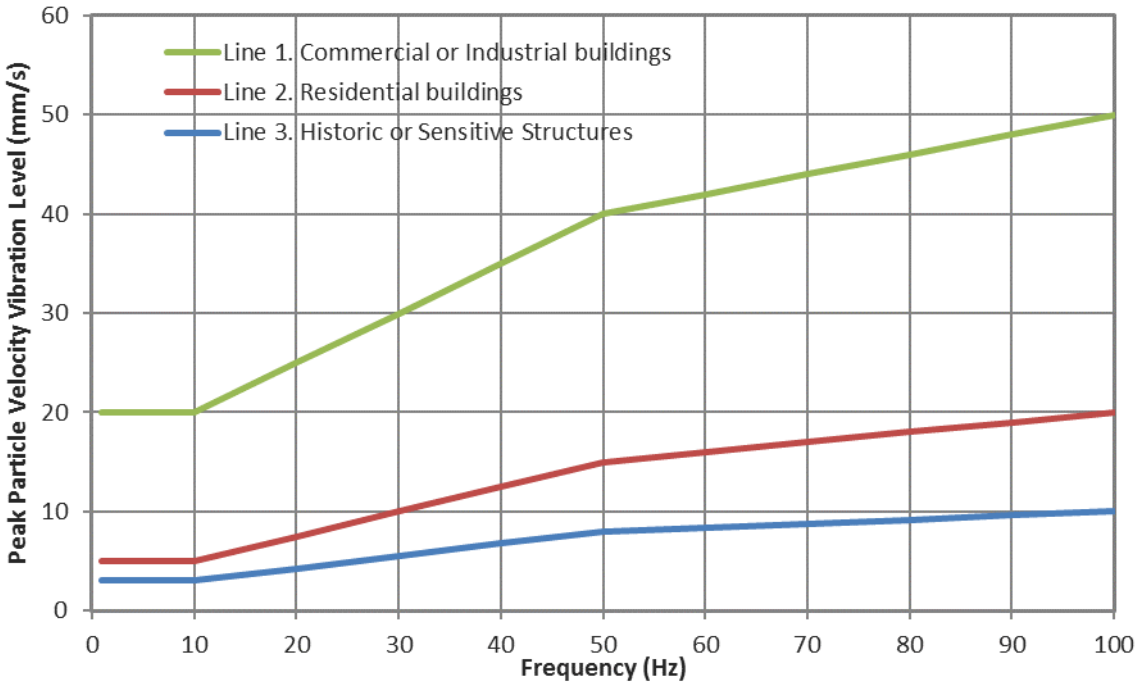


Table 2: Vibration at horizontal plane of highest floor (DIN 4150-3 1999: Tables 1 and 3)

Structure Type	Peak Particle Velocity Vibration Level (mm/s)	
	Short-term (transient)[1]	Long-term (continuous)[2, 3]
Line 1. Commercial or Industrial buildings	40	10
Line 2. Residential buildings	15	5
Line 3. Vibration Sensitive Structures	8	2.5

3.2.2 Building Amenity

AUP rule E25.6.30 (1)(b) requires construction vibration to comply with 2 mm/s PPV in any axis on the floor of interest. Where construction vibration is predicted to exceed this threshold for more than three days, the occupants of buildings within 50 m must be advised of the works no less than three days prior to the works commencing and the vibration level must not exceed 5 mm/s whilst occupied.

[2] Long-term (continuous) vibration is types not covered by the short-term vibration definition

[3] The long-term (continuous) criteria can apply at all floor levels, but levels are normally highest at the top floor

4.0 DEMOLITION NOISE AND VIBRATION

4.1.1 Demolition Methodology

We understand that demolition hours will generally be Monday to Friday 7am – 6pm and Saturdays 8am – 5pm. Demolition hours may be extended to Monday to Friday 6.30am – 10.30pm and Saturdays 7am – 11pm to enable works to occur outside sensitive hours of neighbouring buildings.

It is estimated that demolition will take 12 months to complete.

Based on discussions with the design team, we have identified the following high noise demolition activities. We focus on them as the primary indicators of the noise effects.

Customs Street vehicle bridge

The Customs Street vehicle bridge is proposed to be demolished using a cut and crane method.

At this point in time, it is unclear if this work needs to be programmed to occur during Saturday and Sunday when traffic volumes are lower. To be conservative, we have assumed Saturday and Sunday works.

Lower Hobson Street pedestrian bridge

The Lower Hobson Street pedestrian bridge is proposed to be demolished using a cut and crane method.

At this point in time, it is unclear if this work needs to be programmed to occur during Saturday and Sunday when traffic volumes are lower. To be conservative, we have assumed Saturday and Sunday works.

Downtown carpark building demolition

The main carpark building is proposed to be demolished in three stages, with the western side of the building demolished first, followed by the eastern side.

Most of the demolition will be undertaken using a cut and lift methodology. However, there will be periods where excavator mounted breakers will be required. We understand that only small (1-5t) excavators will be used for this activity due to load limits on the slab.

Once large pieces of the building are lifted to the ground, these may be further broken up before being loaded onto a truck for offsite transport. This will occur with an excavator with hydraulic pulveriser attachments and breakers if required. This activity should be positioned to maximise the distance to the nearest receivers.

We understand that demolition will stop and existing ground level and removal of the foundations is not part of this consent.

4.2 Demolition Noise & Vibration Mitigation and Management

The two most effective demolition noise mitigation measures to reduce noise level are screening (e.g. noise barriers) and alternative equipment selection. Management measures (e.g. communication/consultation, scheduling, training, and monitoring) are effective at minimising residual demolition noise effects.

4.2.1 Breaker Shroud

We recommend that any concrete breaking be undertaken using a shroud, such as the Hushtec rock breaker noise control attachment. These breaker shrouds typically reduce noise levels by 5-7 decibels.

4.2.2 Noise Barriers

A scaffold lined with an acoustic barrier is proposed to the full eastern façade of the Downtown Carpark building. The scaffold will be the full height of the Downtown Carpark building and will be decreased as the building comes down. The height of the scaffold will stay high enough to block line of sight to the works from the Aon podium.

The following guidelines will be incorporated in the design and utilisation of the scaffold:

- The panels should be constructed from materials with a minimum surface mass of 6.5 kg/m^2. Suitable panels include 12 mm plywood or the following proprietary 'noise curtains':
  - SealedAir 'WhisperFence 24dB' (www.sealedair.com)
  - Hushtec 'Premium Series Noise Barrier' (www.duraflex.co.nz)
  - Soundbuffer 'Performance Acoustic Curtain' (soundbuffer.co.nz)
  - Hoardfast 'Fast Wall Premium PVC partition panels' (www.ultimate-solutions.co.nz)
  - Safesmart 'Acoustic Curtain 6.5kg/m$^{2'}$ (www.safesmartaccess.co.nz)
  - Alternatives should be approved by a suitably qualified acoustic specialist because some proprietary noise curtains have insufficient surface mass for general use
- The panels should be abutted or overlapped to provide a continuous screen without gaps at the bottom or sides of the panels

4.2.3 Concrete Cutting Enclosure

When concrete cutting is required within 25m of the façade of M Social at 196 – 200 Quay Street and the Aon Building at29 Customs Street West we recommend using an enclosure. Noise enclosures surround the source on more than one side and have a roof (an example is included as Figure B.3 in NZS 6803: 1999). As concrete cutting noise is dominated by high frequency sound, a well designed enclosure will provide 15 decibels or more of attenuation.

- Enclosures can be made from the noise curtains listed above, or the following proprietary options are available:
  - Echo Barrier 'Cutting Station' (www.supplyforce.co.nz)
  - Soundbuffer 'Cutting Enclosure' (soundbuffer.co.nz)
  - Hushtec 'Acoustic Tent' (www.duraflex.co.nz)

If a custom enclosure is needed, a suitably qualified and experienced acoustic specialist, such as a Member of the Acoustical Society of New Zealand (MASNZ), will be involved in its design.

4.2.4 Equipment selection

In general, we consider the proposed demolition methodologies represent the best practicable option. For example, a cut and lift methodology is proposed for the majority of the demolition and small excavators with breaker attachments are proposed to be used only when required.

4.2.5 Demolition Noise and Vibration Management Plan

We recommended that a DNVMP be prepared and implemented throughout the demolition period. We have prepared a draft DNVMP which is attached and includes:

- The performance standards that must, where practicable, be complied with
- Predicted noise and vibration levels for relevant equipment and/or activities
- Mitigation considerations to identify the BPO with respect to demolition noise and vibration
- Noise and vibration monitoring requirements, with triggers and feedback mechanisms
- Communication, consultation, and complaints response protocols

4.3 Demolition Noise

4.3.1 Noise Levels

Table 3 presents the typical noise levels and setbacks from the activity required to achieve compliance for representative demolition activities.

Table 3: Demolition noise levels at 1m from a building façade (excluding screening)

Equipment	Sound Power Level (dB L_{Aeq})	Noise Level (dB L_{Aeq})				Setback (m)
		5 m	10 m	20 m	50 m	75 dB L_{Aeq}
Excavator with pulveriser	104	85	79	73	65	16
Excavator (20t)	103	84	78	72	64	14
Mobile crane (35t)	98	79	73	67	58	8
Small excavator (2 - 5t) mounted concrete breaker*	106	87	81	75	66	20
Medium excavator (8-10t) mounted concrete breaker*	111	92	86	80	71	33
Concrete cutting	115	96	90	84	75	48

* includes 5 dB from breaker shroud

We have predicted the highest representative noise levels at the adjacent buildings in Table 4. We predict compliance at all other buildings including Kindercare. These noise levels would only occur for a short period when works are closest. We have provided estimated durations of the exceedances based on the demolition programme. During this time the infringements would range between the highest representative level and 75 dB L_{Aeq} as the work moves further away.

Table 4: Highest representative noise levels

Building Address	Predicted Noise Level, dB L_{Aeq} Demolition (concrete cutting)	Duration of infringement
M Social – 196 – 200 Quay Street	81[1] – 75	6 months
Aon Building – 29 Customs Street West – Tower	82 – 75	3 months
HSBC Building – 188 Quay Street – Tower	82 – 75	6 months

[1] includes 15 dB of shielding from a concrete cutting enclosure

4.3.2 Demolition Noise Effects

The effects generated by demolition noise occur in the locations that people regularly occupy. For the adjacent buildings these are internal to the building.

We provide a discussion for each location below.

M Social – 196 – 200 Quay Street

The façade of the hotel facing the project site is mostly back of house spaces and corridors. Noise levels in the corridors are predicted to be 55 dB L_{Aeq} or less. This will be reasonable for this transient space with prior communication. Noise levels in the hotel rooms are predicted to be 40 dB L_{Aeq} or less. This will be acceptable for occupants during the day. If people are trying to sleep, there may be some disturbance.

Level 1 of M Social has a conference room facing the construction site. This space has no external windows and a double wall construction. Noise levels in this space are predicted to be 45 dB L_{Aeq} or less. With a speech amplification system there shouldn't be any issues addressing large groups. Group activities could procced without significant disturbance.

Aon Building – 29 Customs Street West – Tower and HSBC Building – 188 Quay Street - Tower

Internal noise levels are predicted to be 52 dB L_{Aeq} or less in the offices facing the project site. This is typically acceptable in an office environment. Concentration and communication would begin to be affected for people sensitive to noise.

4.4 Demolition Vibration

Table 5 summarises the expected set back distances for high vibration equipment to achieve compliance with the AUP rules.

Table 5: Indicative vibration levels at building foundations

	Vibration setback distance (m)			
	Vibration Amenity	Cosmetic Building Damage		
	AUP	Heritage	Residential	Commercial
Equipment	2 mm/s	2.5 mm/s	5 mm/s	10 mm/s
Small excavator (2 - 5t) mounted concrete breaker	4	4	2	1
Medium excavator (8 – 10t) mounted concrete breaker	8	8	5	3

Demolition vibration received at all surrounding properties is predicted to comply with the amenity and cosmetic damage limits. Regardless, vibration may be perceptible at times, but generally acceptable with effective prior engagement.

4.5 Unitary Plan Framework

While demolition noise is usually undesirable, it is temporary and not necessarily unreasonable when all the relevant factors are taken into consideration.

The foreword of New Zealand Standard NZS 6803:1999 "*Acoustics – Construction Noise*" states:

> "*Construction noise is an inherent part of the progress of society. As noise from construction is generally of limited duration, people and communities will usually tolerate a higher noise level provided it is* ***no louder than necessary, and occurs with appropriate hours of the day****. The Resource Management Act 1991 requires the* ***adoption of the best practicable option to ensure*** *the emission of noise from premises does not exceed a* ***reasonable level****. The Act also imposes a duty on every person to avoid, remedy, or mitigate any adverse effect on the environment arising from an activity carried on by, or on behalf of, that person*."

Additionally, the AUP objective, policies, rules and matters of discretion support the New Zealand Standard NZS 6803:1999 assessment of construction activities.

AUP **objectives** E25.2 (1) requires that:

> *"People are protected from* ***unreasonable*** *levels of noise and vibration",*

while (4) states:

> *"Construction activities that cannot meet noise and vibration standards are* ***enabled while controlling duration, frequency and timing*** *to manage adverse effects".*

This acknowledges that there are often periods or activities where the construction noise standards cannot be met. The objective is to enable them provided they are no louder than necessary, aligned with the New Zealand Standard NZS 6803:1999 objectives.

AUP **policies** E25.3 (2) requires:

> *"Minimise,* ***where*** *practicable, noise and vibration at its source or on the site from which it is generated to mitigate adverse effects on adjacent sites"*

while (10) states:

"Avoid, remedy or mitigate the adverse effects of noise and vibration from construction, maintenance and demolition activities while having regard to:

a) the sensitivity of the receiving environment; and

b) the proposed duration and hours of operation of the activity; and

c) ***the practicability of complying*** *with permitted noise and vibration standards*."

Again, this acknowledges the practicability of compliance. The noise and vibration assessment and a CNVMP would address all three elements.

AUP **rules** E25.6.28 (primarily) requires compliance with the stated noise limits. However, as discussed above, this is not always practicable and exceedances of the noise standards are often reasonable provided it is the BPO.

AUP **matters of discretion** in E25.8.2 (1) parts (a) and (b) state (note other parts are not particularly relevant to construction noise):

a) "whether activities can be managed so that they do not generate unreasonable noise and vibration levels on adjacent land uses particularly activities sensitive to noise

b) the extent to which the noise or vibration generated by the activity:

- *will occur at times when disturbance to sleep can be avoided or minimised; and*
- *will be compatible with activities occurring or allowed to occur in the surrounding area; and*
- *will be limited in duration, or frequency or by hours of operation; and*
- *will exceed the existing background noise and vibration levels in that environment and the reasonableness of the cumulative levels; and*
- *can be carried out during daylight hours, such as road works and works on public footpaths"*

It is considered that the noise and vibration levels will be generally reasonable with the adoption and implementation of a Construction Noise and Vibration Management Plan (CNVMP). The works would also be undertaken during the day and are consistent with what would be expected from demolition activities on many large building sites within the urban environment.

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dB	Decibel - The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 µPa, i.e. dB = 20 x log(P/Pr)
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
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L_{Amax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
PPV	Peak Particle Velocity For Peak Particle Velocity (PPV) is the measure of the vibration aptitude, zero to maximum. Used for building structural damage assessment.
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MARSHALL DAY Acoustics

DOWNTOWN CARPARK PROJECT
CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

Rp 002 20230126 | 31 July 2024

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1.0 INTRODUCTION

Marshall Day Acoustics (MDA) has been engaged by Precinct Properties to prepare a Construction Noise and Vibration Management Plan (CNVMP) for the Downtown Carpark Project. The project involves the demolition of the Downtown carpark at 2 Lower Hobson Street and the construction of a mixed use development with 3 buildings.

This CNVMP is required to satisfy [Consent Condition Y]. It identifies the performance standards for the Project and sets out best practicable options (BPO) for noise and vibration management.

This CNVMP will be implemented throughout the demolition and construction period. It should be considered a 'living document' that will be expanded and updated as the Project progresses. It is the primary tool for managing the Project's construction noise and vibration effects.

A glossary of terminology is included in Appendix A.

2.0 PROJECT DESCRIPTION

2.1 Overview

The works involve:

- Demolition of the existing carparking building and associated pedestrian bridge and vehicle ramps
- The excavation of a 5-level basement plus a plant level (6 Levels overall)
- Construction the following buildings:
  - Tower 1 – Commercial (30 Levels) and Residential (15 Levels)
  - Tower 2 –Residential (34 Levels)
  - Three podium buildings including office spaces, retail and food and beverage units and a new public realm space known as the Urban Room (Te Urunga Hau).

Site maps showing [works, sensitive receivers, land marks etc] are attached in Appendix B.

The works are scheduled for approximately [X months], between [month year] and [month year].

Construction hours will be Monday to Friday 7am – 6pm and Saturdays 8am – 5pm. Construction hours may be extended to Monday to Friday 6.30am – 10.30pm and Saturdays 7am – 11pm to enable high noise works to occur outside sensitive hours of neighbouring buildings.

2.2 Construction Methodology

Here is a summary of the construction methodology:

Overall summary

Construction hours will generally be Monday to Friday 7am – 6pm and Saturdays 8am – 5pm. Construction hours may be extended to Monday to Friday 6.30am – 10.30pm and Saturdays 7am – 11pm to enable high noise works to occur outside sensitive hours of neighbouring buildings.

The high noise activities will occur mostly during foundations and excavation. The predicted duration for each phase is:

- Piling, Foundations and excavation 9 months
- Basement works 14 months
- Building construction 40 months

The following high noise demolition and construction activities. The focus is on them as the primary indicators of the noise effects.

Foundations and excavation

A diaphragm wall (d-wall) will be constructed around the northern and western perimeter of the site (see Appendix B). The southern and eastern perimeter of the site is proposed to have a sheet piled wall. To minimise noise and vibration from sheet piling, the following methodology is proposed.

- Sheet piles are pre-drilled during typical construction hours
- Sheet piles are pressed in without using the vibration function during typical construction hours
- Sheet piles vibrated to final depth outside typical business hours (Mon to Fri 5.30pm to 10.30pm and Sat 7am to 11pm)

Tonkin and Taylor have informed us that vibratory sheet piling will take approximately 3 weeks to complete.

Following this, the foundation piling will commence across the site using bored piling rigs.

Once piling is completed, excavation will commence along with installation of ground anchors. During this phase, it may be necessary to remove inground foundations leftover from the demolition phase. This would be undertaken using a medium (8-10t) excavator with breaker attachment.

Building construction

The remainder of the construction period will involve typical commercial building construction methodologies, including as concrete works, cranage and hand tools.

2.3 Contact Details

Contact details for the relevant personnel are listed in Table 1. The Project Manager is responsible for implementing this CNVMP.

Table 1: Contacts

Role	Name	Organisation	Phone	Email
Project Manager	TBC	TBC	TBC	TBC
Engagement	TBC	TBC	TBC	TBC
Acoustic Specialist	TBC	TBC	TBC	TBC

2.4 Conditions of Consent

This CNVMP is required to satisfy the following (proposed) Conditions of Consent….

3.0 NOISE

3.1 Noise Performance Standards

Construction noise must be measured and assessed according to New Zealand Standard NZS 6803:1999 "*Acoustics – Construction Noise*". The noise limits apply at 1m outside the façades of buildings, and only while they are occupied.

The construction noise limits from AUP Rule E25.6.28 are 75 dB L_{Aeq} and 90 dB L_{AFmax} during the daytime works period are summarised in Table 2..

Table 2: Construction noise limits for construction duration of at least 15 days

Time	Noise Limit	
	Average ($L_{Aeq(30min)}$)	Maximum (L_{AFmax})
Monday to Friday 6.30am – 10:30pm	75 dB	90 dB
Saturday 7am-11pm	80 dB	90 dB
Sunday 9am – 7pm	65 dB	85 dB
All other times	60 dB	75 dB

3.2 Predicted Noise Levels

Table 3 predicts levels for high-noise construction activities. It identifies the equipment that requires mitigation and/or management and the source-receiver distances where the risk begins. It will be kept up to date by the Acoustic Specialist when new information becomes available, e.g. through noise monitoring (Section 7.2).

Table 3: Construction noise levels at 1m from a building façade (excluding screening)

Equipment	Sound Power Level (dB L_{Aeq})	Noise Level (dB L_{Aeq})				Setback (m)
		5 m	10 m	20 m	50 m	75 dB L_{Aeq}
Excavator with pulveriser	104	85	79	73	65	16
Excavator (20t)	103	84	78	72	64	14
Mobile crane (35t)	98	79	73	67	58	8
Small excavator (2 - 5t) mounted concrete breaker*	106	87	81	75	66	20
Medium excavator (8-10t) mounted concrete breaker*	111	92	86	80	71	33
Concrete cutting	115	96	90	84	75	48
Concrete truck and pump	103	84	78	72	64	14

Equipment	Sound Power Level (dB L_{Aeq})	Noise Level (dB L_{Aeq})				Setback (m)
		5 m	10 m	20 m	50 m	75 dB L_{Aeq}
Mobile crane (35t)	98	79	73	67	59	14
D Wall and Bored piling	111	92	86	80	71	33

* includes 5 dB from breaker shroud

Table 4: Highest representative noise levels

Building Address	Predicted Noise Level, dB L_{Aeq}		Duration of infringement
	Dwall / Bored Piling	Sheet Piling	
M Social – 196 – 200 Quay Street	79	77	3 months
Aon Building – 29 Customs Street West – Tower	76	88	6 weeks
Aon Building – 29 Customs Street West – Podium	79	94	6 weeks
HSBC – 188 Quay Street – Tower	< 75	80	3 weeks
The Sebel - 85 Customs Street West	< 75	80	3 weeks

3.3 Noise Effects

The noise level received inside a sensitive space (e.g. bedroom, office, living room) will depend on the external noise level, the façade performance (particularly the glazing) and the acoustics of the room. These factors can vary widely.

NZS 6803 states that, where it is not possible to measure at 1 metre from the façade, an internal assessment can be done instead assuming a façade sound level difference of 20 decibels. However, 20 decibels is conservative (i.e. low) for modern buildings.

With knowledge of the façade glazing type, typical façade performance can be estimated as follows:

- Partially open windows (all buildings) 15 decibels
- Closed windows (historic lightweight house) 20 decibels
- Closed windows (modern house or apartment) 25 decibels
- Closed windows (modern masonry apartment or commercial building) 30 decibels

Table 5 provides guidance on daytime noise effects inside different types of buildings based on the external noise level and typical the glazing types.

Table 5: Daytime noise levels in commercial & industrial buildings and habitable rooms in dwellings

External Noise Level (dB L_{Aeq})	Estimated Internal Noise Level (dB L_{Aeq})			
	Sealed glazing (office building)	Closed windows (modern building)	Closed windows (older building)	Open windows (all buildings)
90 – 95	60 – 65	65 – 70	70 – 75	75 – 80
85 – 90	55 – 60	60 – 65	65 – 70	70 – 75
80 – 85	50 – 55	55 – 60	60 – 65	65 – 70
75 – 80	45 – 50	50 – 55	55 – 60	60 – 65

External Noise Level (dB L_{Aeq})	Estimated Internal Noise Level (dB L_{Aeq})			
	Sealed glazing (office building)	Closed windows (modern building)	Closed windows (older building)	Open windows (all buildings)
70 – 75	40 – 45	45 – 50	50 – 55	55 – 60

The responses of building occupants vary, but with effective prior engagement (Section 6.0) can be summarised as follows:

- < 45 dB L_{Aeq} Noticeable, but unlikely to interfere with daily activities
- 45 – 50 dB L_{Aeq} Typically acceptable, but concentration and communication would begin to be affected
- 50 – 55 dB L_{Aeq} Annoyance for some occupants and personal conversations would require a slightly raised voice
- 55 – 60 dB L_{Aeq} Generally unacceptable and occupants would actively seek respite for any extended periods
- > 60 dB L_{Aeq} Unacceptable for extended periods

4.0 VIBRATION

4.1 Vibration Performance Standards

4.1.1 Cosmetic Building Damage

AUP rule E25.6.30 (1)(a) requires construction vibration to be measured and assessed in accordance with German Standard DIN 4150-3:2016 "*Vibrations in buildings – Part 3: Effects of vibration on structures*".

The short-term (transient)[1] vibration limits in Figure 1 apply at building foundations in any axis.

The long-term (continuous)[2] vibration limits in Table 6 apply at all floor levels, but levels are normally highest in horizontal axes on the top floor.

DIN 4150-3 limits are for avoiding cosmetic building damage, such as cracking in paint or plasterwork. Cosmetic building damage effects are deemed 'minor damage' in the Standard and can generally be easily repaired. The Standard states: "*Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur*." Much higher vibration levels (i.e. an order of magnitude higher) would be needed for potential structural damage.

[1] Short-term (transient) vibration is "*vibration which does not occur often enough to cause structural fatigue and which does not produce resonance in the structure being evaluated*"

[2] Long-term (continuous) vibration includes types not covered by the short-term vibration definition

Figure 1: Short-term (transient)[1] vibration at building foundations (DIN 4150-3 2016: Figure 1)

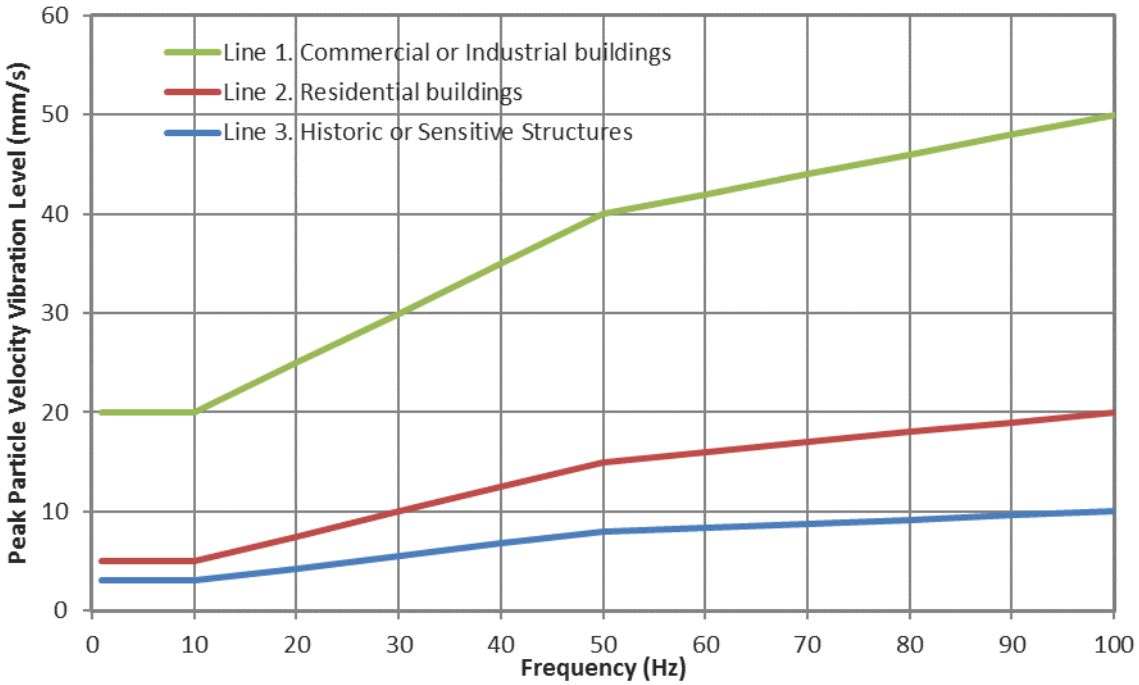

Table 6: Vibration at horizontal plane of highest floor (DIN 4150-3 2016: Tables 1 and 4)

Building Type	Peak Particle Velocity Vibration Level (mm/s)	
	Short-term (transient)[1]	Long-term (continuous)[2]
Line 1. Commercial or Industrial	40	10
Line 2. Residential	15	5
Line 3. Vibration sensitive	8	2.5

4.1.2 Amenity

AUP rule E25.6.30 (1)(b) requires construction vibration to comply with the limits in Table 7 in any axis when measured in the corner of the floor of the storey of interest for multi-storey buildings, or within 500mm of ground level at the foundation of a single storey building.

Table 7: Vibration amenity at horizontal plane of floor level of interest (AUP E25.6.30.1)

Receiver	Peak Particle Velocity Vibration Level (mm/s)	
	0700 – 2200	2200 – 0700
Occupied activity sensitive to noise	2	0.3
Other occupied buildings	2	2

Where construction vibration from daytime works (7am to 6pm) is predicted to exceed 2mm/s PPV for no more than three days, the occupants of all buildings within 50m must be advised of the works at least 3 days prior to the works commencing (Section 6.1) and the vibration level must not exceed 5mm/s.

4.2 Predicted Vibration Levels

Table 7 predicts levels for high-vibration construction activities. It identifies the equipment that requires mitigation and/or management, and the source-receiver distances where the risk begins.

The predictions are based on regression analysis of available vibration measurements. The amenity setbacks are based on typical levels, whereas the setbacks for cosmetic building damage are more conservative (i.e. addition of a 100% safety factor) to inform the need for pre-construction building condition surveys (Section **Error! Reference source not found.**).

Table 7 will be kept up to date by the Acoustic Specialist when new information becomes available and through vibration monitoring (Section 7.3).

Table 8: Indicative vibration levels at building foundations

	Vibration setback distance (m)			
	Vibration Amenity	Cosmetic Building Damage		
	AUP	Heritage	Residential	Commercial
Equipment	**2 mm/s**	**2.5 mm/s**	**5 mm/s**	**10 mm/s**
Small excavator (2 - 5t) mounted concrete breaker	4	4	2	1
Medium excavator (8 – 10t) mounted concrete breaker	8	8	5	3
Sheet piling	8	15	6	3

4.3 Vibration Effects

The main vibration concern of building owners and occupants is usually building damage, but they will feel vibration at levels much lower than those that would cause damage. Identified receivers will be informed about the vibration levels they may experience, and be assured that vibration damage can only occur at levels well above the threshold of perception (Section 6.1).

British Standard BS 5228-2:2009 "*Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*" provides guidance on the amenity effects of vibration. The descriptions are reproduced below, and are supplemented with our own descriptions for 2mm/s and 5mm/s (to bridge the gap between 1 and 10 mm/s in the Standard):

- 0.14mm/s PPV — Just perceptible in the particularly sensitive environments
- 0.3 mm/s PPV — Just perceptible in normal residential environments
- 1 mm/s PPV — Typically acceptable with prior notification
- 2 mm/s PPV — Clearly perceptible but typically acceptable (during daytime only) in dwellings and workplaces if it occurs intermittently, and with effective prior engagement.
- 5mm/s PPV — Highly unsettling in dwellings and workplaces. If prolonged, some occupants may want to leave the building. Computer screens will shake, and items could fall off shelves if they are not level.
- 10 mm/s PPV — Likely to be intolerable for any more than a very brief period

5.0 MITIGATION AND MANAGEMENT

5.1 Training

All staff will participate in an induction training session before starting work on the construction, with attention given to the following matters:

- Activities with the potential to generate high levels noise and/or vibration
- Mitigation and management measures (Section 5.0)
- Sensitive receivers and any agreements made through engagement (Section 6.0)
- Monitoring requirements (Section 7.0)

As the construction progresses, any updates of noise and vibration matters will be addressed during regular site meetings and/or 'toolbox' training sessions.

5.2 Equipment Selection

When selecting construction equipment:

- Use quieter construction methodologies where practicable (e.g. pulverising instead of concrete breaking)
- Use electric motors rather than diesel engines where practicable
- Use rubber tracked equipment rather than steel tracked equipment where practicable
- Use equipment that is suitably sized for the task
- Maintain equipment well to minimise rattles, squeaks etc
- Fit engines with exhaust silencers and engine covers where practicable
- Avoid tonal reversing or warning alarms (beepers). Alternatives include broadband alarms (squawkers/quackers), flashing lights, proximity sensors, reversing cameras and spotters

5.3 Scheduling

Avoid night works unless it can be demonstrated to be the BPO.

Scheduling is an important management tool, particularly where a receiver expresses concern about construction works at a certain time of day. Where necessary, high noise and vibration noisy works will be programmed to minimise disturbance.

Scheduling activities to be undertaken when nearby sensitive receiver buildings are unoccupied is the most effective measure as it avoids the effect. For example, piling works could be undertaken during the daytime when occupants of a dwelling are at work/school.

Scheduling should be considered as the first measure for all activities which are predicted to exceed the relevant noise and vibration limits. If scheduling is not practicable, then other measures such as noise barriers, revising methodology and temporary relocation should be considered.

5.4 General Measures

Complaints can arise even if the noise and vibration levels comply with the Project limits. To minimise complaints, the following common mitigation measures are recommended:

- Avoid unnecessary noise. This means managing the site to ensure:
  - No shouting
  - No unnecessary use of horns
  - No loud site radios

  - No rough handling of material and equipment
  - No banging or shaking excavator buckets
  - No unnecessary steel on steel contact (e.g. during the loading of scaffolding on trucks)
  - No high engine revs. This includes choosing the right sized equipment and turning engines off when idle.
- Avoid unnecessary vibration. This means managing the site to ensure:
  - No unnecessary dropping of heavy objects
  - No potholes, bumps or corrugations in site accessways
  - Excavator operators are skilled and use their machine considerately
- Mitigate track squeal from tracked equipment, such as excavators. This may include tensioning and watering or lubricating the tracks regularly
- Locate stationary equipment (e.g. generators) away from noise sensitive receivers and/or screen them behind site buildings and material stores
- Orient mobile machinery to maximise the distance between the engine exhaust and the nearest sensitive building façade (e.g. excavators)
- Utilise noise barriers and enclosures where appropriate (Section 5.5)
- Utilise specific measures for the following activities:
  - Excavators (Section 5.6)
  - Concrete cutting (Section 5.7)
  - Concrete and rock breaking (Section 5.8)
  - Piling (Section 5.9)
  - Rattle Guns (Section **Error! Reference source not found.**)
- Engagement is complete (Section 6.0) prior to commencing high-noise and vibration activities
- Undertake monitoring (Section 7.0)

5.5 Noise Barriers and Enclosures

5.5.1 Temporary Noise Barriers

Temporary noise barriers will be installed on the edge of the Anon Building podium at 29 Customs Street West on the ground floor and level 2.

Temporary noise barriers will be used where an activity is predicted to exceed the construction noise limits (Section 3.2), unless they are ineffective (e.g. where a receiver is elevated and would look over the barrier). They will be installed prior to works commencing and maintained throughout the works.

Effective noise barriers typically reduce the received noise level by 10 decibels.

Where practicable, the following guidelines will be used in designing and installing temporary noise barriers:

- The panels will have a minimum surface mass of 6.5 kg/m^2. Suitable panels include 12 mm plywood or the following proprietary ‘noise curtains’: proprietary
  - SealedAir ‘WhisperFence 24dB’ (www.sealedair.com)
  - Hushtec ‘Premium Series Noise Barrier’ (www.duraflex.co.nz)
  - Soundbuffer ‘Performance Acoustic Curtain’ (soundbuffer.co.nz)

- Hoardfast 'Fast Wall Premium PVC partition panels' (www.ultimate-solutions.co.nz)
- Safesmart 'Acoustic Curtain 6.5kg/m^{2}' (www.safesmartaccess.co.nz)
- Alternatives will be approved by a suitably qualified and experienced acoustic specialist

- The panels will be a minimum height of 2 m, and higher if practicable to block line-of-sight
- The panels will be abutted, battened or overlapped to provide a continuous screen without gaps at the bottom or between panels
- Barriers will be positioned as close as practicable to the high-noise activity to block line-of-sight between the activity and noise sensitive receivers. A site hoarding at the boundary may not be effective for all receivers. Add extra barriers close to high-noise activities to ensure effective mitigation for sensitive receivers on upper floors.

5.5.2 Noise Enclosures

When concrete cutting is required within 25m of the façade of M Social at 196 – 200 Quay Street an enclosure will be used.

Noise enclosures surround the source on more than one side and have a roof (an example is included as Figure B.3 in NZS 6803: 1999). How effective an enclosure is depends on how well the noise source can be enclosed without constraining its operation (e.g. mobility, heat, dust, lighting).

Where practicable, the following guidelines will be used in designing and installing enclosures:

- Enclosures will be considered where a noise barrier can't achieve compliance noise limits, particularly for stationary plant such as compressors, pumps, generators, air tools and paver cutting stations
- Enclosures can be made from the noise curtains listed above, or the following proprietary options are available:
  - Echo Barrier 'Cutting Station' (www.supplyforce.co.nz)
  - Soundbuffer 'Cutting Enclosure' (soundbuffer.co.nz)
  - Hushtec 'Acoustic Tent' (www.duraflex.co.nz)

If a custom enclosure is needed, a suitably qualified and experienced acoustic specialist, such as a Member of the Acoustical Society of New Zealand (MASNZ), will be involved in its design.

5.6 Excavators

All excavators can generate high noise and vibration levels. The actual level they generate depends very much on the experience and temperament of the operator.

- Use the right sized excavator for the job
- Operate the bucket and armature with smooth movements (avoid jerking)
- Tip material from the bucket rather than shaking it clean where practicable
- Avoid hitting the bucket on the ground or dropping heavy objects
- Control the weight shift of the excavator to avoid the tracks lifting and thudding on the ground

5.7 Concrete Cutting

- Avoid evening and night-time periods and Sundays/public holiday
- Select blades that:
  - Are sharp
  - Maximise the number of teeth
  - Minimise the blade width
  - Minimise gullet depth
  - Have built in vibration damping slots
- Use a unit fitted with a blade shroud and operate with a water supply
- Use noise barriers for concrete cutting or a noise enclosure (Section 5.5)
- Minimise the cutting period and/or the number of cutting periods (e.g. complete all cutting in one extended period rather than two shorter periods with the same overall duration)

5.8 Concrete and Rock Breaking

- Avoid evening and night-time periods and Sundays/public holidays
- Minimise the amount of breaking needed (e.g. use a crushing shear or pulveriser attachment in place of a breaker, or use a cut and lift approach to enable breaking offsite)
- Match the size of breaker to the scale of the works. It should be large enough to carry out the work efficiently, but not over-sized (avoiding unnecessary noise and vibration)
- For concrete breaking, make an initial perimeter saw cut at the perimeter to reduce vibration transfer to nearby buildings
- Ensure effective noise mitigation is in place using noise barriers and enclosers (Section 5.5) and/or a breaker blanket (e.g. Hushtec 'breaker attachment' – www.duraflex.co.nz)
- Minimise the breaking period (e.g. remove larger boulders for breaking offsite), and/or the number of breaking periods (e.g. complete all breaking in one extended period rather than two shorter periods with the same overall duration)
- For rock breaking, initial breaking will be undertaken near buildings and monitored to inform compliance (Section 7.3). This may also create a 'trench' of fractured rock between the breaker and the buildings that will mitigate subsequent breaking vibration
- Match the chisel/tip type to the material and use a dampened bit to avoid ringing
- Avoid 'blank' firing by placing the chisel on the rock or concrete before starting, and minimising firing after it breaks through

5.9 Piling

- Avoid evening and night-time periods and Sundays/public holidays
- Prioritise piling methods that minimise noise and vibration (e.g. augured, screw or press-in piles rather than drop-hammer, impact hammer or vibratory methods)
- For bored piling, avoid shaking the auger to remove spoil where practicable. Shaking the kelly bit connection creates very loud banging that often results in noise complaints. If spoil does not fall off the auger easily, use tools to scrape the auger clean if necessary. If shaking is required due to Health and Safety constraints, ensure bushes are well maintained to minimise steel on steel contact.

6.0 ENGAGEMENT

6.1 Communication

6.1.1 Before construction

Written communication (e.g. newsletter) will be provided to building occupants within 50 m of the site at least 1 week prior starting construction. It will include:

- Details of the overall works, its timing and duration
- Contact details and names of personnel whose job is to receive complaints and enquiries (should also match a person identified in Section 0)
- Acknowledge that some activities (listed in this document) are predicted to generate high noise and/or vibration levels and may result in disturbance for short periods

6.1.2 During construction

Once construction has begun, ongoing communication is important. Regular communication during the works will include:

- Public site signage that includes contact details
- Details of upcoming activities that may result in disturbance
- Any changes to scheduled timing and duration of activities

Occupants of buildings predicted to receive vibration levels exceeding 2mm/s PPV for more than three days will be advised at least 3 days prior to the works commencing (Section 4.1.2).

6.2 Consultation

Consultation will be offered to the sensitive receivers listed in Table 9 and Appendix B. These are the neighbours where noise and/or vibration is predicted to exceed the performance standards.

Table 9: Sensitive receivers

Address	Building Type[3]	Occupancy	Noise (Section 3.2)	Vibration (Section 4.2)	
				Amenity	Cosmetic Building Damage
196 – 200 Quay Street	Commercial	Hotel	X	-	-
29 Customs Street West	Commercial	Office	X	X	-
29 Customs Street West	Commercial	Childcare Centre	X	X	-
188 Quay Street	Commercial	Office	X	-	-

The purpose of consultation is to address concerns about noise and vibration on a case-by-case basis. The Project Manager will address any concerns and complaints in accordance with Section 6.3. A copy of all correspondence will be made available to Council upon request.

Where nearby sensitive receivers are identified with particularly noise and/or vibration sensitive equipment and/or activities (e.g. childcare centre), a suitably qualified and experienced specialist

[3] Classifications with respect to Tables 1 and 4 of DIN 4150-3:2016 "Vibrations in buildings – Part 3: Effects of vibration on structures" (i.e. historic/sensitive, residential or commercial/industrial)

(e.g. Member of the Acoustical Society of New Zealand) will review the performance standards to ensure they are appropriate and participate in consultation.

Receivers that do not want ongoing consultation, will be offered communication (Section 6.1).

The following will be implemented by the Project Manager (or nominated person):

- If any exceedance of the cosmetic building damage standard is measured, that vibration activity will cease as soon as safe and practicable to do so
- Review the construction methodology, mitigation measures and management strategies to ensure they represent the BPO. The BPO considers:
  - Practicability
  - Predicted noise/vibration benefits
  - The interests of affected parties
  - Implications for Project timing and duration
  - Cost
- Consultation with affected parties to understand their sensitivities, including times they are home. The objective is to establish a collaborative approach to managing adverse noise and vibration effects
- A Project representative will be contactable during work hours (Section 0)
- A record of consultation will be kept at the site office and be available to affected parties and Council if requested
- Implement any measures agreed with the affected party in good faith
- Monitor the activity to verify the extent of any adverse effects (Section 7.0)
- If the vibration cosmetic building damage limits are exceeded (Section 4.1), a building condition survey will be undertaken (Section **Error! Reference source not found.**).
- Consider installing mechanical ventilation systems in buildings where external windows must be closed to avoid significant adverse noise effects and no alternative ventilation system is present. Only consider this option after all other BPO management and mitigation has been applied.
- Consider temporary relocation of sensitive receivers where all BPO management and mitigation measures have been applied and significant adverse noise effects are still likely. This will be in exceptional cases only, and advice from the Acoustic Specialist will be sought prior.

6.3 Complaints Response

Complaints will be acknowledged immediately where practicable and responded to within one day. If a more detailed response is needed, it will be provided within a timeframe agreed with the complainant.

All construction noise and/or vibration complaints will be recorded in a complaints file that is available to affected parties and Council on request. For each complaint, an investigation will be undertaken as soon as practicable using the following steps:

- Acknowledge receipt of the concern or complaint and record:
  - The name, address and contact details of the complainant (unless they elect not to provide)
  - Time and date the complaint was received and who received it
  - Time and date of the activity that caused the complaint (estimated where not known)

- The complainant's description of the activity and its resulting effects
- Any relief sought by the complainant (e.g. scheduling of the activity)

- Identify the relevant activity and review the activity log to verify the complaint (or otherwise)
- If a complaint relates to building damage, inform the on-duty site manager as soon as practicable and stop the relevant works pending an investigation. In most cases, stopping the activity will provide immediate relief. But in some cases, this may not be practicable for safety or other reasons, in which case the complainant will be kept updated regularly during the time it takes to stop the activity.
- Review data from monitoring (if available) to identify the time in question and, if possible, verify exceedance
- Review the predicted noise and/or vibration levels to determine if the activity was identified. Consider attended monitoring to verify the underlying reference level assumptions
- Review the mitigation and management measures in place to ensure the BPO has been applied (Section 5.0). Review the relief sought by the complainant. Adopt further mitigation and management measures as appropriate.
- Review the potential residual effects if predicted to continue to exceed the relevant performance standards
- Report the findings and recommendations to the Project Manager, implement changes and update this CNVMP as appropriate
- Report the outcomes of the investigation to the complainant, identifying where the relief sought by the complainant has been adopted or the reason(s) otherwise.

7.0 MONITORING

7.1 Overview

This is where a suitably qualified acoustic engineer visits the site and measures levels in real time. This enables:

- Review the implementation of this CNVMP, including the mitigation and management measures in Section 5.0 and engagement in Section 6.0
- Verify the predicted levels are representative and the response protocols are appropriate for the resulting effects
- Determine compliance

7.2 Noise

Construction noise will be monitored:

- In response to a reasonable noise complaint (Section 6.3)
- At 1m from the building façade facing the construction site, or a proxy position adjusted for distance
- By a suitably qualified and experienced specialist (e.g. Member of the Acoustical Society of New Zealand) in accordance with the requirements of New Zealand Standard NZS 6803: 1999 *"Acoustics - Construction Noise"*
- For an appropriate duration, reported with the measured level (e.g. 65 dB $L_{Aeq\,(30min)}$)
- The results will be used to update Section 3.2 if appropriate

7.3 Vibration

Construction vibration will be monitored:

- In response to a reasonable vibration complaint (Section 6.3)
- On the foundations and/or the top floor of the closest building as appropriate (Section 4.1), provided access to the building has been requested and granted
- By a suitably qualified and experienced specialist (e.g. Member of the Acoustical Society of New Zealand) in accordance the requirements of German Standard DIN 4150-3:2016 "*Vibrations in buildings – Part 3: Effects of vibration on structures*"
- For a representative construction duration, measured in 2 second intervals
- The results will be used to update Section 4.2 if appropriate

APPENDIX A GLOSSARY OF TERMINOLOGY

Noise	A sound that is unwanted by, or distracting to, the receiver.
dB	Decibel (dB) is the unit of sound level. Expressed as a logarithmic ratio of sound pressure (P) relative to a reference pressure (Pr), where dB = 20 x log(P/Pr).
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) to more closely approximate the frequency bias of the human ear. A-weighting is used in airborne acoustics.
$L_{Aeq\ (t)}$	The equivalent continuous (time-averaged) A-weighted sound level commonly referred to as the average level. The suffix (t) represents the period, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{AFmax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
NZS 6803:1999	New Zealand Standard NZS 6803: 1999 "Acoustics - Construction Noise"
Vibration	When an object vibrates, it moves rapidly up and down or from side to side. The magnitude of the sensation when feeling a vibrating object is related to the vibration velocity. Vibration can occur in any direction. When vibration velocities are described, it can be either the total vibration velocity, which includes all directions, or it can be separated into vertical (up and down vibration), horizontal transverse (side to side) and horizontal longitudinal direction (front to back) components.
PPV	Peak Particle Velocity (PPV) is the measure of the vibration amplitude, zero to maximum, measured in mm/s.
BS 5228:2009	British Standard BS 5228:2009 "Code of practice for noise and vibration control on construction and open sites, Part 1: Noise, Part 2: Vibration"
DIN 4150-3:2016	German Standard DIN 4150-3:2016 "Vibrations in buildings – Part 3: Effects of vibration on structures"

APPENDIX B SITE