MARSHALL DAY Acoustics

# DOWNTOWN CARPARK SITE DEVELOPMENT ASSESSMENT OF EFFECTS

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Project: **DOWNTOWN CARPARK SITE DEVELOPMENT**

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## 1.0 SUMMARY

Marshall Day Acoustics ("**MDA**") has been engaged by RCP on behalf of Precinct Properties New Zealand Limited ("**Precinct**") to advise on the proposed development of the Downtown Carpark Site into an integrated mixed-use precinct ("**Project**"), located at 2 Lower Hobson Street in the Auckland City Centre ("**Site**"). 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 partly within of the road reserve). The Project will redevelop the Site to provide for a mixed-use precinct providing for commercial, residential, hotel, retail, food and beverage, and civic uses.

The redevelopment involves an excavated four-level basement, three podium buildings, two towers, new public spaces and a 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.

This report provides an acoustic review of the proposed activities and assesses the impact on the surrounding environment. The main considerations are:

- Construction noise effects are predicted to be reasonable if good practice mitigation and management measures are implemented
- Demolition and D-wall piling is predicted to infringe the noise limits, by five decibels for up to three and a half months, at the neighbouring M Social building to the north, with measures proposed to manage associated effects
- Sheet piling is predicted to infringe the noise limits at four neighbouring buildings, by up to 15 decibels for up to two weeks, with measures proposed to manage associated effects
- Construction vibration is predicted to comply with the cosmetic damage and amenity limits at all neighbouring buildings
- Operational noise emission is predicted to comply with the relevant criteria at all times
- Building envelope and internal sound insulation for apartments and hotel rooms will be designed to comply with appropriate criteria

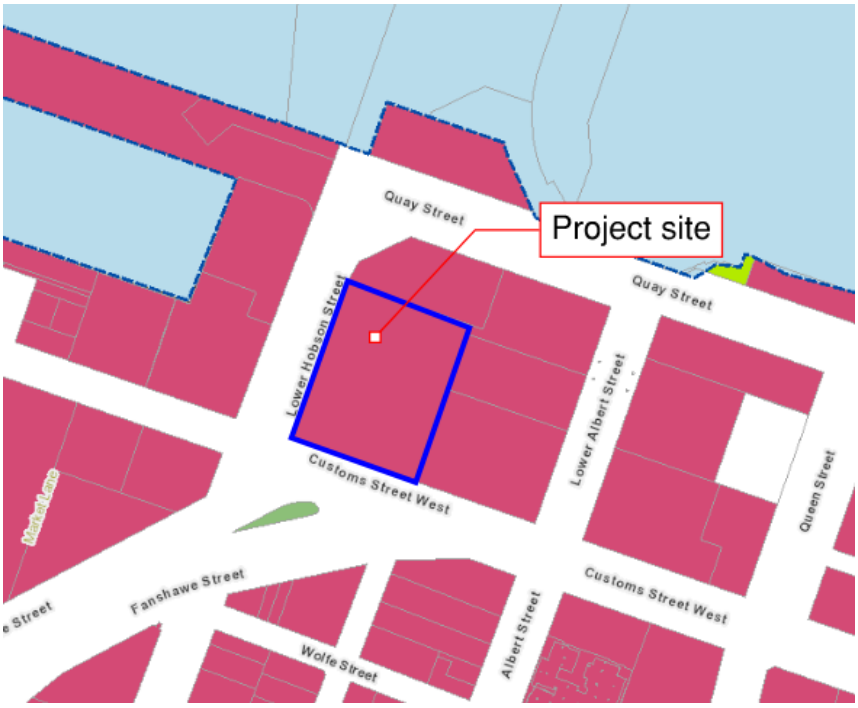
0 contains a glossary of acoustic terminology.

## 2.0 PROJECT DESCRIPTION

### 2.1 The Site and Surrounds

An Auckland Unitary Plan ("**AUP**") map is provided in Figure 1 showing the Site and surrounding zones. The Site is zoned *Business - City Centre*. The sites adjacent to the Site are all in 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 Site on the ground and first floor. Typically, hotel rooms are less sensitive for the majority of the day eg 10am to 4pm, however we understand that M Social regularly have air crew stay and they sleep during the day.

**HSBC Building – 188 Quay Street**

This building is a typical commercial building with ground floor lobby accommodating retail and food and beverage spaces, with offices in the upper floors. The closest part of the building to the Site is a carpark. We have not assessed the carpark as it is not a regularly occupied or sensitive space.

**Aon Building – 29 Customs Street West**

This building is a typical commercial building with ground floor lobby accommodating retail and food and beverage spaces, with offices in the upper floors. There currently exists a Kindercare daycare on the podium level of this building, however we understand they will have vacated the building prior to works commencing.

**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 AUP.

## 2.2 Proposed Development

The project includes:

- Demolition of the existing carparking building and associated pedestrian bridge and vehicle ramps
- Removal of the concrete slab including foundations and services
- Excavation of a 4-level (plus a sub-floor) basement
- Construction of the following buildings:
  - Tower 1 – Commercial (55 levels including the podium)
  - Tower 2 – Hotel and residential (45 levels including the podium)
  - 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

We have adopted the AUP standards for our assessment of this Project. They provide appropriate noise and vibration limits during construction, noise limits during operation and adequately protect sensitive spaces from reverse sensitivity impacts.

The relevant AUP standards are summarised the following sections.

## 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.

We consider these noise limits appropriate for assessing construction noise within the inner city.

## 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 than 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*." We consider this standard appropriate for assessment of cosmetic building damage and note that it has been used successfully in Auckland since adoption of the AUP.

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

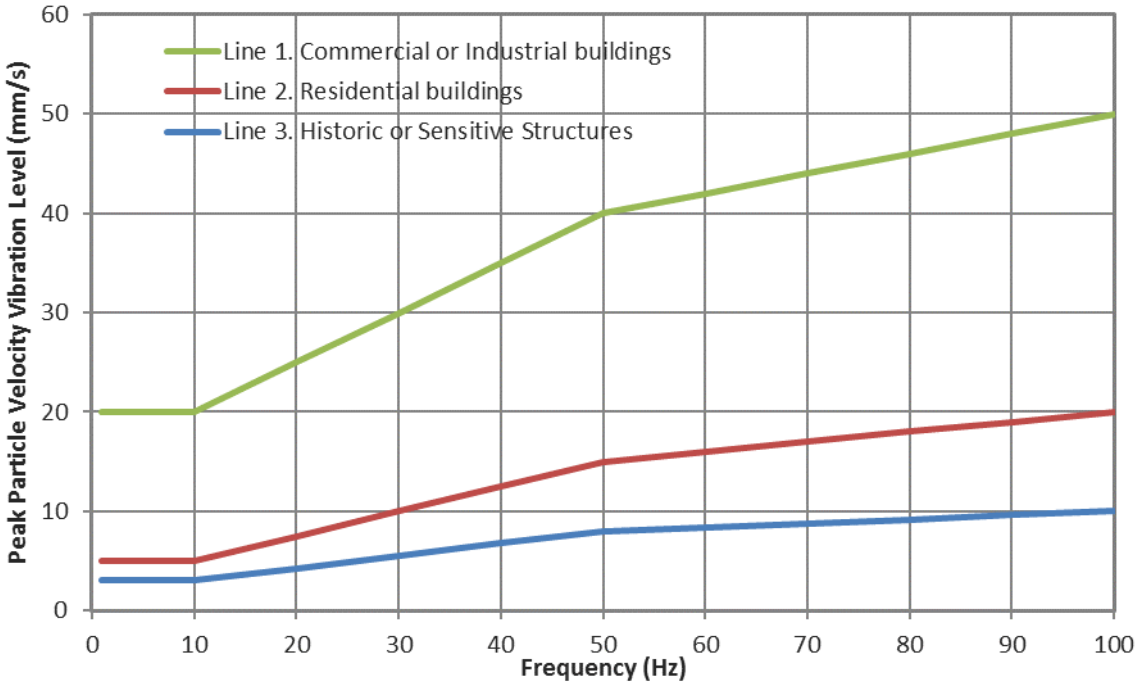



**Table 2: Vibration at horizontal plane of highest floor (DIN 4150-3 1999: Tables 1 and 3)**

| 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 Vibration Amenity

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. AUP rule E25.6.30 (1)(b) requires construction vibration in any axis on the floor of interest to comply with the levels in Table 3.

**Table 3: AUP Amenity Vibration Limits**

| Receiver | Period | Peak Particle Velocity |
|---|---|---|
| Occupied activity sensitive to noise | 10:00pm - 7:00am<br>7:00am - 10:00pm | 0.3 mm/s<br>2.0 mm/s |
| Other occupied buildings | At all times | 2.0 mm/s |

## 3.3 Operational Noise Emissions

Table 4 summarises the AUP noise limits between adjacent sites.

**Table 4: AUP Noise Limits at Surrounding Properties**

| Zones | Day & Time | | Level[1] |
|---|---|---|---|
| Business - City Centre Zone<br>To<br>Business - City Centre Zone<br>*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 $L_{Aeq}$<br>65 dB $L_{eq}$ at 63 Hz<br>60 dB $L_{eq}$ at 125 Hz<br>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 & 25.6.10)

The apartments must be designed so that the internal sound levels do not exceed the limits summarised in Table 5.

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.

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 5: Internal Sound Levels**

| Room | Time | Internal Sound Levels |
|---|---|---|
| Bedrooms and sleeping areas | 11.00 pm – 7.00 am | 35 dB $L_{Aeq}$<br>45 dB $L_{eq}$ at 63 Hz<br>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 this noise level too stringent for living rooms and can be difficult to achieve with typical systems available on the market. We recommend that ventilation for living rooms be designed to 40 dB $L_{Aeq}$.

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 (Tower 2) straddles the 58 dB $L_{Aeq}$ and 60 dB $L_{Aeq}$ City Centre Port Noise Overlay in the AUP. 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 $L_{Aeq}$

Table D25.6.1.2 provides a spectrum for the façade noise level. Rule D25.6.1(4) sets out the requirements for mechanical ventilation like Rule E25.6.10(3).

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

This rule is slightly less stringent than E25.6.10. We recommend that the Project adopt E25.6.10 and for simplicity not Condition to D25.6.1. We note that compliance with E25.6.10 would ensure compliance with D25.6.1.

# 4.0 EXISTING NOISE ENVIRONMENT

The existing noise environment around the downtown carpark is dominated by traffic on Customs Street West and Lower Hobson Street. The site is also in the 60 dB $L_{Aeq}$ contour of the City Centre Port Noise Overlay.

On 25 May 2025 between 11am and 4pm, we took short term measurements around the site to gain an understanding of the typical daytime noise levels. These measurements show that noise levels typically range between 65 and 70 dB $L_{Aeq(15min)}$. These measurements were dominated by traffic.Port noise was not audible. We expect traffic noise to reduce at night.

The hotel façade starts at approximately 40m above street level and the apartment levels start approximately 75m above street level. We predict that ambient noise levels at the lowest hotel floors would be 60 – 65 dB $L_{Aeq}$ during the day. This aligns well with the façade sound insulation requirements of Rule E25.6.10 and D25.6.1(6). We conclude that these rules will also adequately protect the hotel and apartments from the existing noise environment.

# 5.0 CONSTRUCTION NOISE AND VIBRATION

## 5.1 Hours of work

We understand that demolition and construction hours will generally be Monday to Friday 7am – 6pm and Saturdays 8am – 5pm. Construction hours may be extended for the following activities:

- Customs Street vehicle bridge demolition – 24h works over two weekends
- Lower Hobson Street pedestrian bridge demolition – 24h works over one weekend
- Large concrete pours – anticipated 3am start
- Sheet piling within 40m of Aon – 5pm to 10:30pm Monday to Friday

## 5.2 Construction phase durations

The total construction period, including contingency, is estimated to be 5.5 years. However, the high noise activities will occur mostly during demolition, excavation and construction of foundations. The estimated duration for each phase is:

- Demolition 11.5 to 12 months (including 3 months of enabling works)
- Retention and excavation 10 to 12 months
- Basement structure 10.5 to 12 months
- Building construction 24 to 27 months (including podium and towers)

At this stage of the project a contractor has not been engaged. Based on discussions with the design team, we have identified the following activities with the potential to create the greatest noise and vibration effects. We focus on them as the primary indicators of the noise and vibration effects.

## 5.3 Demolition

### Customs Street vehicle bridge

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

We have been informed that this work will likely occur over two weekends and works would occur 24 hours per day.

### Lower Hobson Street pedestrian bridge

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

We have been informed that this work will likely occur over one weekend and works would occur 24 hours per day.

### Downtown carpark building demolition

The main carpark building is proposed to be demolished using a top-down methodology. From discussions with the applicant's team, we understand that the following will occur:

- A scaffold will be erected on all four sides and have an incorporated noise barrier
- A mobile crane will lift excavators and skid steers onto the roof of the carpark
- The slab structure will be demolished with pulveriser and breaker attachments (and potentially concrete saws)
- The skid steers will progressively clear the demolished rubble from the floor and transfer the rubble to the designated drop-zones

- Once the demolition debris is cleared, excavators will demolish columns, then re-commence slab demolition on the next lower floor, and the process repeats
- The scaffold with noise barrier will reduce is height as the building is demolished, but remain 2m above the floor being demolished

Once piling is completed (see below), excavation will commence. 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.

## 5.4 Building Construction

Based on discussions with the design team, we have identified the following activities with the potential to create the largest noise and vibration effects. We focus on them as the primary indicators of the noise and vibration effects.

**Diaphragm wall**

A diaphragm wall (d-wall) will be constructed around the northern and western perimeter of the site.

**Sheet piling**

The southern and eastern perimeter of the Site is proposed to have a sheet piled wall. The sheet piles will be pre-drilled to minimise noise and vibration and only the final ~2m of pile will be vibrated in. Tonkin + Taylor have informed us that sheet piling (including pre-drilling and vibro) will take approximately three weeks to complete.

**Excavation**

We have been informed that excavation will typically occur with excavator mounted buckets. There is a small possibility that rippers, rock saws or breaker attachments will be required.

**Building piles**

Foundation piling will occur across the site using large piling rigs using augers or circular cutters with buckets. Pile casings will be required but these will be pushed and rotated into the ground.

**Large concrete pours**

It is expected that large concrete pours will need to start early in the morning. We have been informed that 3am is a typical start time for a project of this scale. We recommend that daytime hours be prioritised where practicable.

**General building construction**

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

## 5.5 Construction Noise & Vibration Mitigation and Management

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

### 5.5.1 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.

### 5.5.2 Concrete Cutting

Where practical, we recommend prioritising using a wire saw for cutting concrete. A wire saw is approximately 14 decibels quieter than a concrete saw.

When a concrete saw is required to be used within 25m of the façade of M Social at 196 – 200 Quay Street and within 50m of any other adjacent building, 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 saw 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 below, 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, will be involved in its design.

### 5.5.3 Noise Barriers

During the demolition phase the existing carpark building will have a scaffold with integrated noise barrier on all four sides. As the building is demolished the scaffold with noise barrier will be reduced in height but maintained at 2m above the floor being demolished. This noise barrier will be effective for receivers at or below the floor currently being demolished, but ineffective for receivers higher as they will look over the barrier.

Ground level noise barriers should be implemented where they provide effective screening to occupied spaces of neighbouring buildings. We note that these barriers will be ineffective for the upper floors of buildings as the surrounding receivers are all multi-level and will look over the barrier.

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 2m above the works, 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.

### 5.5.4 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. As a contractor has not

yet been appointed, the CNVMP should create a process for the Best Practical Option for noise mitigation and management to be identified and followed.

We have prepared a draft CNVMP which is attached and includes:

- Noise and vibration limits
- Hours of works
- Identification of the likely sources of noise emissions during the project works
- Identification of the likely noise and vibration levels and duration of exposure for activities during the Project works
- Identification of the duration, frequency, and timing of works to manage disruption
- Identification of potentially affected receivers
- Processes for engaging with potentially affected receivers
- Measures for controlling noise and vibration
- A complaints procedure
- Methods and frequency for construction noise and vibration monitoring, and reporting of monitoring results and outcomes
- Noise and vibration management training requirements
- A requirement for the review and update of the CNVMP:
    - annually after its first certification
    - where there are changes to the construction methodology during the project works that are likely to result in material changes to noise and vibration levels from those addressed in the CNVMP
    - where noise or vibration monitoring has been undertaken and the setback distances for compliance with the limits can be updated

The draft CVNMP should be finalised once a contractor is engaged and more is known about the construction methodology, activity locations, duration, and practicality of mitigation measures and submitted to Council for certification 20 working days prior to works commencing.

We recommend Schedules to the CNVMP be prepared for activities that cannot comply with the noise limits. These will be prepared throughout construction when particularly high noise or vibration activities are predicted or measured to exceed the noise limits.

The Schedules must be prepared prior to the works occurring and submitted to Council for information at least five days prior to the start of the relevant works. Each Schedule should include:

- The activity start and finish dates, equipment, and methodology
- A plan showing the location of the activity and the receivers to be affected by a measured or predicted exceedance
- For each identified receiver, the predicted noise and / or vibration levels and durations of the exceedance
- The proposed site-specific noise and / or vibration mitigation measures that are proposed to be adopted and any mitigation options that have been discounted as being impracticable, and the reasons why
- A summary of the consultation undertaken with each identified receiver, and how consultation has been considered

- The locations, times, and types of any monitoring

## 5.6 Construction Noise

### 5.6.1 Noise Levels

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

**Table 6: 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 |
| D Wall and Bored piling | 106 | 87 | 81 | 75 | 66 | 20 |
| Vibro sheet piling | 116 | 97 | 91 | 85 | 76 | 52 |
| Concrete saw | 115 | 96 | 90 | 84 | 75 | 48 |
| Wire saw | 101 | 82 | 76 | 70 | 61 | 11 |

* includes 5 dB mitigation from breaker shroud

We have predicted the highest representative noise levels at the adjacent buildings, as shown in Table 7. We predict compliance at all other buildings. The predicted 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 $L_{Aeq}$ or less as the works move further away.

**Table 7: Highest representative noise levels**

| Building Address | Predicted Noise Level, dB $L_{Aeq}$ | | | Duration of infringement |
|---|---|---|---|---|
| | D wall / Bored Piling | Sheet Piling | Concrete saw (slab removal) | |
| M Social – 196 – 200 Quay Street | 79 | < 75 | 80[1] – 75 | 3.5 months |
| Aon Building – 29 Customs Street West – Tower | 76 | 85 | < 75[1] | 1.5 weeks |
| Aon Building – 29 Customs Street West – Podium | 79 | 90 | < 75[1] | 2 weeks |
| HSBC – 188 Quay Street – Tower | < 75 | 80 | < 75[1] | 1 week |
| The Sebel - 85 Customs Street West | < 75 | 80 | < 75[1] | 1 week |

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

### 5.6.2 Construction Noise Effects

Construction noise effects are assessed by how people receiving the noise may respond. The effects 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.

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 50 dB $L_{Aeq}$ or less. This is reasonable for this transient space. Noise levels in the most exposed hotel rooms are predicted to be 45 dB $L_{Aeq}$ or less. This will be reasonable for occupants during the day. If people are trying to sleep, there may be some disturbance for sensitive occupants. M Social could prioritise rooms on higher floors and within the centre of the hotel for guests who are likely to be day sleepers (ie air staff) where noise levels will be less than 40 dB $L_{Aeq}$, which is typically suitable for sleeping during the day.

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 at all times.

We note that the worst case (when works are closest to M Social) noise levels are compliant with the Saturday noise limits between 7am and 11pm (80 dB). This shows that construction noise levels of this magnitude are expected within the Business City Centre Zone.

Internal noise levels are predicted to be less than 40 dB $L_{Aeq}$ in the most exposed hotel rooms and the conference room for activities that comply with the noise limits. This will be suitable for a wide range of activities including sleeping during the day.

**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 Site. This is reasonable in an office environment, and we note that this level is the same as the AUP 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 at the closest position to the Aon building will generate internal noise levels of up to 60 dB $L_{Aeq}$ within the podium and 55 dB $L_{Aeq}$ within the tower. The occupants will likely find these levels unacceptable and would actively seek respite for any extended periods. We recommend that sheet piling within 40m of the Aon building be undertaken between 5pm and 10:30pm Monday to Friday or on Saturdays when occupancy will be lower. This is expected to take 1.5 weeks to complete.

Vibratory sheet piling at 40m or greater is predicted to result in internal noise levels of 50 dB $L_{Aeq}$ or less which is reasonable for an office environment.

**HSBC – 188 Quay Street – Tower**

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

Internal noise levels from vibratory sheet piling are predicted to be 50 dB $L_{Aeq}$ or less which is reasonable for an office environment.

**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. Internal noise levels are predicted to be less than 40 dB $L_{Aeq}$ in the apartments

for activities that comply with the noise limits. This will be noticeable but unlikely to interfere with daytime activities.

Vibratory sheet piling will typically occur Monday to Friday 7am – 6pm and Saturdays 8am – 5pm. The hours of sheet piling will be extended to 10:30pm Monday to Friday or 7am to 11pm Saturdays when within 40m of the Aon building. During these extended hours works, external noise levels at the Sebel are predicted to be 70 dB $L_{Aeq}$ or less. This is expected to take one and a half weeks to complete.

During the closest vibratory sheet piling, noise levels within the apartments on Lower Hobson Street are predicted be 50 dB $L_{Aeq}$ or less, for a period of approximately one week. This will be undertaken during typical construction hours and will be reasonable for most occupants.

Façades not facing Hobson Street are predicted to receive noise levels of 70 dB $L_{Aeq}$ or less from vibratory sheet piling. Noise levels within these apartments are predicted to be less than 40 dB $L_{Aeq,}$ which would be noticeable but unlikely to impact daytime activities.

We understand that the Sebel also has concerns about hotel guests trying to sleep during the day. For the weeklong period where noise levels are elevated, the Sebel could prioritise rooms on Customs Street West and higher floors for day sleepers where noise levels will be less than 40 dB $L_{Aeq}$, which is typically suitable for sleeping during the day.

We note that the worst case (when works are closest to the Sebel) sheet piling noise levels are compliant with the Saturday noise limits between 7am and 11pm (80 dB $L_{Aeq}$). This shows that construction noise levels of this magnitude are expected within the Business City Centre Zone.

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

## 5.7 Construction Vibration

Table 8 summarises the expected set back distances for high vibration equipment to achieve compliance with the AUP rules.

**Table 8: Indicative setback distances for vibration levels (in PPV) at building foundations**

| | Vibration setback distance (m) | | | | |
|---|---|---|---|---|---|
| | Vibration Amenity | | Cosmetic Building Damage[1] | | |
| | BS 5228 | AUP | Heritage | Residential | Commercial |
| Equipment | 1 mm/s | 2 mm/s | 2.5 mm/s | 5 mm/s | 10 mm/s |
| Small excavator (2 - 5t) mounted concrete breaker | <1 | 1 | 2 | 1 | 1 |
| Medium excavator (8 – 10t) mounted concrete breaker | 2 | 3 | 4 | 3 | 2 |
| Sheet piling (based on predrilled holes) | 11 | 4 | 8 | 3 | 1 |

1 – Includes 100% safety factor

Construction vibration received at all other surrounding properties is predicted to comply with the amenity and cosmetic damage limits, including the heritage building at 204 Quay Street. Regardless, vibration may be perceptible at times (up to 1mm/s), but generally reasonable with effective prior engagement.

# 6.0 OPERATIONAL NOISE ASSESSMENT

## 6.1 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.

## 6.2 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.

# 7.0 FAÇADE SOUND INSULATION

At this stage, the façade design is still in preliminary design. However, in our experience, the façade of the apartments and hotel can be designed (at the detailed design stage) to provide sufficient sound insulation. Design compliance should be demonstrated during the building consent stage.

Table 9 summarises the typical building envelope construction arrangements that will enable compliance.

**Table 9: Indicative/example Building Envelope Construction**

| Building Element | Construction |
|---|---|
| Roof | Concrete roof structure<br>Minimum 300 mm deep ceiling cavity and absorptive cavity blanket<br>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<br>150 mm cavity<br>Steel backpan with 140mm rockwool or fibreglass insulation<br>2x13 mm Noiseline Plasterboard internal lining |
| Masonry Wall | Paint finish concrete panels<br>45 mm timber studs with absorptive cavity blanket<br>13 mm Standard Plasterboard |

# 8.0 CONCLUSION

With our recommendation that a CNVMP be prepared and implemented throughout the demolition and construction of the Project, and the proposed conditions of consent relevant to acoustics proposed by the Applicant, construction noise effects are predicted to be reasonable. Operational noise emission is predicted to comply with the relevant criteria at all times. Compliance can be readily achieved with the façade insulation rules in the AUP.

## 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.<br><br>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. 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.<br><br>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). |