



**Project:** 110 Jervois Quay

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**Report No.:** Rp 001 20211048

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|                |             |                 | 02 March '21 | S. Arden       | B. Wood          |

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## TABLE OF CONTENTS

|       |   |    |
|-------|---|----|
| 1.0   | INTRODUCTION .....  | 4  |
| 2.0   | SITE DESCRIPTION AND PROPOSED ACTIVITY .....              | 4  |
| 2.1   | Subject site and receiving environment .....              | 4  |
| 2.2   | Activity Description.....                                 | 5  |
| 3.0   | PERFORMANCE STANDARDS .....                               | 5  |
| 3.1   | Operational Noise.....                                    | 5  |
| 3.2   | Construction Noise and Vibration .....                    | 6  |
| 3.2.1 | Noise.....  | 6  |
| 3.2.2 | Vibration – Cosmetic Building Damage .....                | 7  |
| 4.0   | PREDICTED NOISE LEVELS – OPERATIONAL NOISE .....          | 9  |
| 4.1   | Noise Emissions from Fixed Plant.....                     | 9  |
| 4.2   | Noise Emissions from Activities.....                      | 10 |
| 5.0   | PREDICTED NOISE AND VIBRATION LEVELS – CONSTRUCTION ..... | 10 |
| 5.1   | Noise .....   | 10 |
| 5.2   | Vibration.....  | 11 |
| 6.0   | PROPOSED CONDITIONS.....                                  | 11 |

## APPENDIX A GLOSSARY OF TERMINOLOGY

## 1.0 INTRODUCTION

A commercial development is proposed for the site at 110 Jervois Quay. This is the current site of the Michael Fowler Centre car park, between Wakefield Street and Jervois Quay in Wellington.

Marshall Day Acoustics has been engaged by MFC Development LP to provide acoustical design advice to assist with a Resource Consent application for the proposed development.

Currently, the design is in early stages. However, we have carried out a provisional assessment on the ability for this project to meet the relevant noise requirements of the Wellington City Council District Plan (the “District Plan”), based on information received to date. Additionally, we have recommended noise conditions to be included in the consent documentation.

A glossary of acoustic terminology used in this report is included as Appendix A.

## 2.0 SITE DESCRIPTION AND PROPOSED ACTIVITY

### 2.1 Subject site and receiving environment

The subject site is located at 110 Jervois Quay, Wellington. Under the District Plan, the subject site is zoned “Central Area”.

The site boundary, as defined in the District Plan, includes the Michael Fowler Centre and Te Ngākau Civic Square, with the proposed building to be located in the southern portion of this larger site.

The subject site, the proposed building location, and the closest receivers potentially affected by noise and vibration are shown in Figure 1.



Figure 1: Subject site and closest sensitive receivers (shaded blue)

[base image: LINZ]

## 2.2 Activity Description

The main noise sources associated with the operation of the site will be mechanical plant to service the building. There is also a roof terrace to be located on the northwestern corner of Level 4. For full details of this location, refer to the architectural drawings submitted for consent.

The majority of the mechanical plant would be located on the roof. This would either be adjacent to, or inside the rooftop plant room.

Within the plant room, there would be pumps and HVAC equipment (for example, Air Handling Units). Outside the plant room, there would be two chillers and two outdoor units.

There may also be other smaller plant items associated with the operation of the building, for example, extract fans for ancillary spaces.

## 3.0 PERFORMANCE STANDARDS

### 3.1 Operational Noise

The District Plan addresses noise from ‘fixed plant’ and noise from ‘activities’ separately. Under the District Plan, fixed plant is defined as the following:

*“Fixed Plant: means plant that is permanently or temporarily located and operated at any location and includes mechanical and building services equipment such as equipment that is:*

- *required for ventilating, extracting, heating, cooling, conditioning, and exhaust either of buildings or commercial activities;*
- *associated with boilers or plant equipment, furnaces, incinerators or refuse equipment;*
- *electrical equipment, plumbing (including pumps), lift or escalator equipment; or*
- *similar plant, equipment, items, rooms or services.”*

‘Activities’ includes all non-residential activities, not covered by the definition of ‘fixed plant’.

The relevant rules, in respect of noise which apply to sites zoned Central Area, can be found in Chapter 13 of the District Plan title ‘Central Area Rules’.

Standard 13.6.1.1 applies to fixed plant and standard 13.6.2.1 applies to Activities. These standards are reproduced below:

#### 13.6.1.1 Noise (fixed plant)

*Note, all activities have a duty to avoid unreasonable noise under section 16 of the Resource Management Act regardless of the standards set in this Plan. The best practicable option shall be adopted to ensure that the emission of noise does not exceed a reasonable level.*

13.6.1.1.1 *Noise emission levels from fixed plant shall not exceed the following at or within the boundary of any land parcel, or at the outside wall of any building on any site, other than the building or site from which the noise is emitted:*

*At all times:        55 dB LAeq(15min)*  
*10pm to 7am:      70 dB LAFmax*

[...]

#### 13.6.2.1 Noise

*Note, all activities have a duty to avoid unreasonable noise under section 16 of the Resource Management Act regardless of the standards set in this Plan. At all times Council retains its power under the Act to ensure that the general duty under sections 16 and 17 to avoid unreasonable noise and avoid, remedy or mitigate any adverse effects of activities on the environment is met, and section 326*

may be used to control excessive noise. The best practicable option shall be adopted to ensure that the emission of noise does not exceed a reasonable level.

13.6.2.1.1 [Except for noise from port related activities which is covered in 13.6.2.1.4a] noise emission levels when measured at or within the boundary of any fee simple site or at the outside wall of any building on any site, other than the site from which the noise is emitted, shall not exceed the following:

At all times: 60 dB  $L_{Aeq(15min)}$

At all times: 85 dB  $L_{AFmax}$

Noise levels are measured and assessed in accordance with NZS 6801:2008 “Acoustics - Measurement of Environmental Sound” and NZS 6802:2008 “Acoustics - Environmental Noise”.

## 3.2 Construction Noise and Vibration

### 3.2.1 Noise

Chapter 13 of the District Plan does not address noise from construction activities directly. However, Chapter 3 of the District Plan (“District Plan General Provisions”) states:

*“Noise from construction, maintenance and demolition activities, including those associated with the urgent repair of utilities to maintain continuity of service, on any site or on any road shall comply with, and be measured and assessed using, the recommendations of NZS 6803:1999 Construction Noise.”*

The noise limits of NZS 6803:1999 depend on the duration of construction works. Construction projects which are of a shorter duration have a higher allowable noise limit than those of a longer duration. For this project, we expect the long term duration limits to apply. These are reproduced Table 1 and

Table 2.

**Table 1: Recommended upper limits for construction noise received in residential zones** (from New Zealand Standard NZS 6803:1999 ‘Acoustics – Construction Noise’ Table 2)

| Time of week                | Time period | Duration of work<br>Long-term duration, $L_{Aeq}$ (dB) |           |
|-----------------------------|-------------|--|-----------|
|                             |             | $L_{eq}$   | $L_{max}$ |
| Weekdays                    | 0630-0730   | 55   | 75        |
|                             | 0730-1800   | 70   | 85        |
|                             | 1800-2000   | 65   | 80        |
|                             | 2000-0630   | 45   | 75        |
| Saturdays                   | 0630-0730   | 45   | 75        |
|                             | 0730-1800   | 70   | 85        |
|                             | 1800-2000   | 45   | 75        |
|                             | 2000-0630   | 45   | 75        |
| Sundays and public holidays | 0630-0730   | 45   | 75        |
|                             | 0730-1800   | 55   | 85        |
|                             | 1800-2000   | 45   | 75        |
|                             | 2000-0630   | 45   | 75        |

**Table 2: Recommended upper limits for construction noise received in industrial or commercial areas (from New Zealand Standard NZS 6803:1999 'Acoustics – Construction Noise' Table 3)**

| Time of week | Time period | Duration of work                          |
|--------------|-------------|---|
|              |             | Long-term duration, L <sub>Aeq</sub> (dB) |
| All days     | 0730-1800   | 70  |
|              | 1800-0730   | 75  |

*Notes in the standards to the tables above:*

7.2.5

*The night time limits in Table 2 shall apply to activities carried out in industrial or commercial areas where it is necessary to prevent sleep interference, specifically where there are residential activities, hospitals, hotels, hostels, or other accommodation facilities located within commercial areas. The limits in Table 2 may also be used to protect other specific noise sensitive activities at certain hours of the day.*

7.2.6

*One major factor which should be considered is whether there is a relatively high background sound level (L<sub>90</sub>) due to noise from sources other than construction work at the location under investigation. In such cases limits should be based on a determination of the existing level of noise in the area (a "background plus" approach).*

7.2.7

*Where there is no practicable method of measuring noise outside a building, the upper limits for noise measured inside the building shall be the levels stated in tables 2 and 3 minus 20 dB. This is considered to be a typical value for the sound reduction normally achieved in New Zealand buildings with doors and windows closed."*

### 3.2.2 Vibration – Cosmetic Building Damage

The District Plan does not address vibration resulting from construction activities. However, guidance can be found in DIN 4150-3:2016 "Vibrations in buildings – Part 3: Effects on structures". This Standard is used widely in New Zealand to assess potential for vibration causing damage to buildings and is frequently referenced in consent conditions issued by Wellington City Council.

Vibration sources are assessed as being either short-term (transient)<sup>1</sup> or long term. The limits, as set out in DIN 4150-3:2016, are reproduced below.

**Table 3: Guideline values for evaluating effects of short-term vibration (DIN 4150-3 2016: Table 1)**

| Structure Type                             | Peak Particle Velocity Vibration Level (mm/s) |                                 |
|--|---|---------------------------------|
|  | Topmost floor, horizontal direction           | Floor slabs, vertical direction |
| Line 1. Commercial or Industrial buildings | 40  | 20                              |
| Line 2. Residential buildings              | 15  | 20                              |
| Line 3. Historic or Sensitive Structures   | 8   | 20                              |

<sup>1</sup> 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"

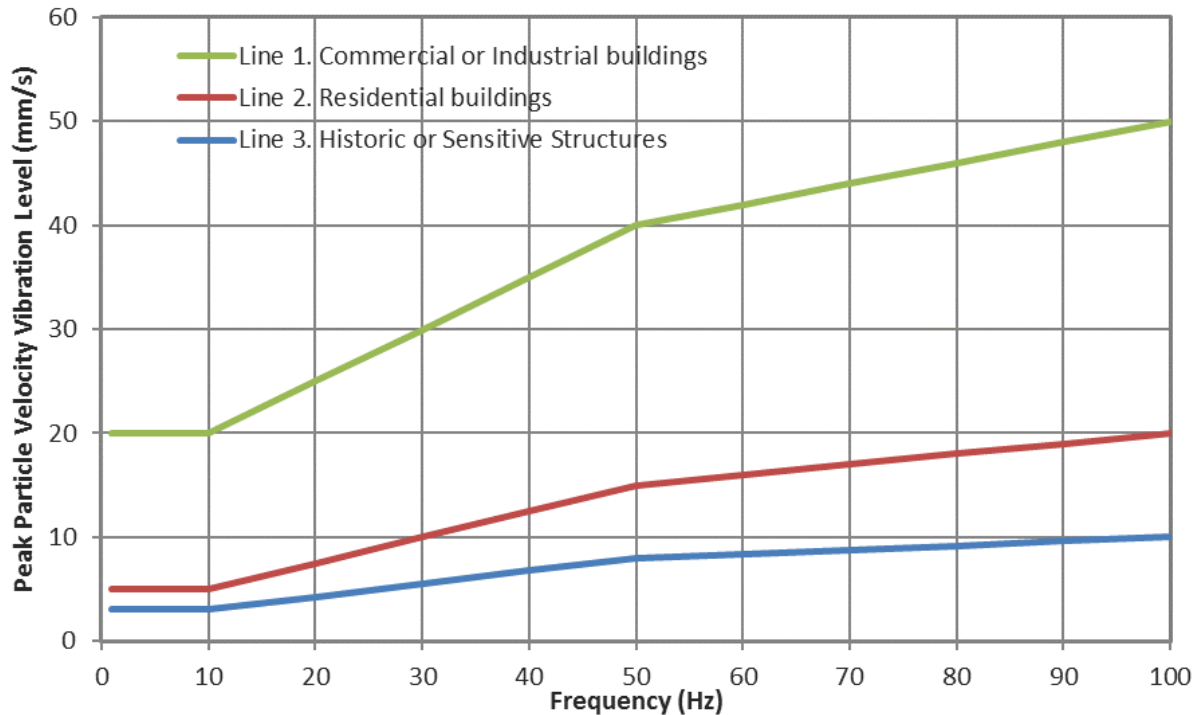


Figure 2: Short-term (transient)<sup>1</sup> vibration at building foundations (DIN 4150-3 2016: Figure 1)

Table 4: Guideline values for evaluating effects of long-term vibration (DIN 4150-3 2016: Table 4)

| Structure Type                             | Peak Particle Velocity Vibration Level (mm/s) |                                 |
|--|---|---------------------------------|
|  | Topmost floor, horizontal direction           | Floor slabs, vertical direction |
| Line 1. Commercial or Industrial buildings | 10  | 10                              |
| Line 2. Residential buildings              | 5   | 10                              |
| Line 3. Historic or Sensitive Structures   | 2.5   | 10                              |

These criteria relate to the avoidance of cosmetic damage of a building, such as cracking in paint or plasterwork. Building cosmetic damage effects are deemed ‘minor damage’ in the Standard and can generally be easily repaired. The thresholds of cosmetic damage to a building 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.*"

Note that the above criteria are the limits to avoid structural damage to buildings. People will be able to ‘feel’ vibration at lower levels than these criteria. During pre-works consultation, this needs to be conveyed to concerned residents and building occupants. This will be addressed in the Construction Noise and Vibration Management Plan (CNVMP). We have proposed a condition requiring a CNVMP.



#### 4.0 PREDICTED NOISE LEVELS – OPERATIONAL NOISE

The following section outlines the predicted noise levels from the operation of the site.

##### 4.1 Noise Emissions from Fixed Plant

As stated previously, the design is in early stages and as such, plant has not been selected. In determining the expected noise levels, we have made assumptions on the noise level of the proposed plant.

For the purposes of this assessment, the following sound power levels have been assumed for plant not contained within the plant room.

- Chillers  $L_{WA}$  98 dB (per unit)
- Outdoor units  $L_{WA}$  88 dB (per unit)

These assumed sound power levels are for high capacity units and are likely conservative.

The equipment located within the plant room will consist of pumps and air handling units. These plant items can be attenuated sufficiently to ensure the cumulative noise level does not exceed the District Plan noise limits. This would be done by ensuring the plant room construction has adequate sound insulation built into the design, and by installing attenuators to air handling units (if required). Attenuation options will need to be determined as the design progresses.

Similarly, extract fans elsewhere in the building can easily be designed to comply with the District Plan noise limits, when combined with the noise from other plant, by using attenuators.

The predicted noise levels from mechanical plant, based on the above, is shown in Table 5. The noise levels presented are at the floor of the assessment location, most exposed to noise from mechanical plant.

**Table 5: Predicted noise levels from mechanical plant**

| Assessment Location  | Predicted Noise Level $L_{Aeq(15mins)}$ , dB |
|----------------------|--|
| 1 Market Lane        | 47   |
| 3 Market Lane        | 35   |
| 25 Cuba Street       | 47   |
| 138 Wakefield Street | 48   |
| 142 Wakefield Street | 50   |
| Amora Hotel          | 49   |

The noise levels are predicted to easily comply with the District Plan fixed plant noise limit of 55 dB  $L_{Aeq(15mins)}$ . For fixed plant, the  $L_{AFmax}$  is typically 1 -2 dB above the  $L_{Aeq}$  noise level. Therefore, the  $L_{AFmax}$  limit of 70 dB would be comfortably complied with.

Should the plant noise contain special audible characteristics (SACs) as defined by NZS 6802:2008), a +5 dB adjustment would be added to the predicted noise levels. Regardless of the presence of SACs, noise from fixed plant would remain compliant with District Plan noise limits.

## 4.2 Noise Emissions from Activities

Activity noise considered in this assessment includes from people on the level 4 rooftop terrace. For the purposes of this assessment, we have assumed a large congregation of 50 people on this terrace. The predicted noise levels from this activity are shown in Table 6.

**Table 6: Predicted noise levels from Level 4 roof terrace**

| Assessment Location  | Predicted Noise Level $L_{Aeq(15mins)}$ , dB |
|----------------------|--|
| 1 Market Lane        | < 40   |
| 3 Market Lane        | < 40   |
| 25 Cuba Street       | 52   |
| 138 Wakefield Street | 54   |
| 142 Wakefield Street | 51   |
| Amora Hotel          | 43   |

The predicted noise levels comfortably comply with the District Plan activity noise limit of 60 dB  $L_{Aeq(15mins)}$ . For people noise, the  $L_{AFmax}$  would be no more than 10 dB above the  $L_{Aeq}$  noise level. Therefore, the  $L_{AFmax}$  limit of 85 dB would also be comfortably complied with.

We further note that compliance with the District Plan noise limits would be achieved with up to 200 people using the rooftop terrace.

## 5.0 PREDICTED NOISE AND VIBRATION LEVELS – CONSTRUCTION

### 5.1 Noise

At this stage, a construction methodology has not been developed sufficiently to carry out a noise assessment and specifics of any exceedances cannot be reliably determined.

The distance between the proposed building and the closest occupied buildings is 20 metres. Therefore, it is highly unlikely that the construction noise limits would be complied with at all times. This is not unusual for construction sites in Wellington.

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 within appropriate hours of the day. The Resource Management Act 1991 requires the adoption of the best practicable option (BPO) 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.”*

We consider that the noise levels will be generally reasonable with the application of the BPO measures that would be set out in a suitable Construction Noise and Vibration Management Plan (CNVMP). The works would be undertaken during the daytime hours and would be typical of construction activity on many other large building sites in the city.

## 5.2 Vibration

We understand that currently the Contractor is considering installing piles using a bottom driven impact methodology. This method has been selected as it provides the highest level of resilience for the building.

Bottom driven impact piling causes higher vibration levels than other methods such as bored piling. Previously, we have worked with Willis Bond on Tākina (Wellington Convention Centre) and Victoria Lane Apartments where this piling method has been implemented. For both these projects, we have implemented protocols to monitor and limit the effect of vibration on the surrounding environment.

For both Tākina and Victoria Lane Apartments, piles were driven very close to buildings. For this project, the closest buildings are set back at comparatively greater distances. Therefore, based on the results of the previous projects, we expect that the limits of DIN 4150-3:2016 would be comfortably complied with.

Furthermore, we expect the highest vibration levels generated by piling would be lower than those measured during piling operations at both Tākina and Victoria Lane Apartments.

Final protocols for management of vibration will need to be developed prior to the commencement of piling operations.

## 6.0 PROPOSED CONDITIONS

The following sets out our recommended conditions of consent for the proposal. The intention of these conditions is to ensure that the noise requirements of the District Plan are addressed, and that sufficient information is provided to the Compliance Monitoring Officer.

### Construction Activities

1. Construction noise shall be measured and assessed in accordance with New Zealand Standard NZS 6803:1999 “Acoustics - Construction Noise” and comply with the following Project Standards at any occupied building, unless otherwise provided for in the CNVMP (condition 3).

| Time of week                       | Time of period | dB LAeq | dB LAmax |
|------------------------------------|----------------|---------|----------|
| <b>Weekdays</b>                    | 0630-0730      | 55      | 75       |
|                                    | 0730-1800      | 70      | 85       |
|                                    | 1800-2000      | 65      | 80       |
|                                    | 2000-0630      | 45      | 75       |
| <b>Saturdays</b>                   | 0630-0730      | 45      | 75       |
|                                    | 0730-1800      | 70      | 85       |
|                                    | 1800-2000      | 45      | 75       |
|                                    | 2000-0630      | 45      | 75       |
| <b>Sundays and Public Holidays</b> | 0630-0730      | 45      | 75       |
|                                    | 0730-1800      | 55      | 85       |
|                                    | 1800-2000      | 45      | 75       |
|                                    | 2000-0630      | 45      | 75       |

2. Construction vibration shall be measured and assessed in accordance with German Standard DIN 4150-3:2016 “Structural Vibration – Part 3: Effects of Vibration on Structures” and comply with the limits of that standard, unless otherwise provided for in the CNVMP (condition 3).

**Construction Noise and Vibration Management Plan (CNVMP)**

3. A Construction Noise and Vibration Management Plan (CNVMP) must be prepared by a suitably qualified person in accordance with Annex E of NZS 6803:1999 and submitted to the compliance monitoring officer for approval at least 10 days prior to the commencement of the works. The CNVMP must be implemented throughout the Project. The CNVMP objectives are to:
  - a) Identify and adopt the best practicable option (BPO) for the management of construction noise and vibration.
  - b) Define the procedures to be followed when the noise and vibration standards in Conditions 1 and 2 cannot be met.
  - c) Inform the duration, frequency and timing of works to manage disruption.
  - d) Require engagement with affected receivers and timely management of complaints.

**Noise to Boundary**

4. The consent holder shall ensure that all fixed plant is located, specified and operated so that the cumulative noise emissions from fixed plant do not exceed the noise limits set out in Rule 13.6.1.1.1 of the District Plan, when measured and assessed in accordance with NZS 6801:2008 "*Acoustics – Measurement of environmental sound*" and NZS 6802:2008 "*Acoustics - Environmental Noise*"
5. The consent holder shall ensure that all activities are located, specified and operated, so that the cumulative noise emissions from activities do not exceed the noise limits set out in Rule 13.6.2.1.1 of the District Plan, when measured and assessed in accordance with New Zealand Standard NZS 6801:2008 "*Acoustics – Measurement of environmental sound*" and NZS 6802:2008 "*Acoustics - Environmental Noise*".
6. Prior to, or at the same time that an application is made for building consent, an acoustic design certificate shall be submitted to the Compliance Monitoring Officer for approval. The acoustic design certificate shall be prepared by a suitably qualified person, demonstrating compliance with the noise limits, as required by Condition 4 and 5.

## APPENDIX A GLOSSARY OF TERMINOLOGY

|                                |  |
|--------------------------------|--|
| <b>Noise</b>                   | A sound that is unwanted by, or distracting to, the receiver.  |
| <b>dB</b>                      | <u>Decibel</u><br>The unit of sound level.<br><br>Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of $P_r=20 \mu\text{Pa}$ i.e. $\text{dB} = 20 \times \log(P/P_r)$  |
| <b>dB(A)</b>                   | 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.   |
| <b>A-weighting</b>             | The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.   |
| <b><math>L_{Aeq}(t)</math></b> | 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.   |
| <b><math>L_{Amax}</math></b>   | The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.  |
| <b>Sound Insulation</b>        | When sound hits a surface, some of the sound energy travels through the material. 'Sound insulation' refers to ability of a material to stop sound travelling through it.  |
| <b>Vibration</b>               | 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). |
| <b>PPV</b>                     | <u>Peak Particle Velocity</u><br>For Peak Particle Velocity (PPV) is the measure of the vibration aptitude, zero to maximum. Used for building structural damage assessment.   |
| <b>NZS 6801:2008</b>           | New Zealand Standard NZS 6801:2008 " <i>Acoustics – Measurement of environmental sound</i> "   |
| <b>NZS 6802:2008</b>           | New Zealand Standard NZS 6802:2008 " <i>Acoustics – Environmental Noise</i> "  |
| <b>NZS 6803:1999</b>           | New Zealand Standard NZS 6803: 1999 " <i>Acoustics - Construction Noise</i> "  |