BEFORE A PANEL OF INDEPENDENT HEARING COMMISSIONERS AT WELLINGTON

I MUA NGĀ KAIKŌMIHANA WHAKAWĀ MOTUHEKE O TE WHANGANUI-A-TARA

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of the hearing of submissions on Te Mahere - Rohei Tūtohua the Wellington City Proposed District Plan
HEARING TOPIC:	Stream 5 – Noise

STATEMENT OF PRIMARY EVIDENCE OF JON ROBERT STYLES ON BEHALF OF KĀINGA ORA – HOMES AND COMMUNITIES

(ACOUSTICS)

18 JULY 2023

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1. EXECUTIVE SUMMARY

1.1 My full name is Jon Robert Styles. My evidence covers submissions and further submissions on the Proposed Plan Change in relation to the provisions that manage the control and exposure to noise and vibration from State Highways, the rail network and the Wellington International Airport.

1.2 My evidence addresses the following matters:

(a) Recommendations on the controls on vibration from the rail network

(b) Recommendations on the controls on vibration from the state highway network

(c) General support for the acoustic treatment provisions in S4 and S5

(d) Recommended use of the term “Suitable qualified and experienced acoustic expert”

(e) General support for PDP controls relating to WIAL

1.3 **Summary on rail vibration -** I do not support the rail vibration controls until or unless KiwiRail can justify that the effects are great enough to warrant them based on sufficiently robust vibration data and accompany justification for the controls. I consider that there are a number of matters that should be addressed before the most appropriate controls on rail vibration can be determined.

1.4 **Summary on road vibration –** I do not support any road vibration controls unless Waka Kotahi can produce sufficiently robust evidence on the actual and likely effects of road vibration beyond the boundaries of its own road corridors. I consider that there are a number of matters that should be addressed before the most appropriate controls on rail vibration can be determined.

1.5 **General support for S4 and S5** – I generally support the acoustic treatment controls in S4 and S5. I consider that they will provide good

outcomes for the range of noise sensitive activities that they will apply to. I consider that these controls are suitable for managing exposure to commercial, entertainment, port, airport, road and rail noise as provided for by the PDP.

1.6 **"Suitably qualified and experienced acoustic expert"** – S4 and S5 of the Noise Chapter utilise the term "acoustic engineer" to describe the person that would be suitable for carrying out the acoustic design work under these standards.

1.7 I consider that the term "Suitably qualified and experienced acoustic expert" is a more appropriate term that properly recognises the qualifications of a significant portion of the acoustic consultants working in New Zealand, and that are perfectly capable of carrying out the work required by S4 and S5. My observation is that this term is widely used in New Zealand.

1.8 **Defining the extent of road noise by modelling** – The PDP currently adopts a standard 'setback' method of defining the spatial extent of the road noise controls. These are standard distances that ignore a range of important factors, including screening and effects on propagation from buildings, motorway structures and topography.

1.9 The alternative to the standard setback approach is the 'modelled approach', whereby the noise levels are modelled as contours that take into account the wide variety of factors that influence the amount of noise generated in the road corridor and the physical environment that influences the distance that the noise levels will propagate.

1.10 I understand that the Waka Kotahi submission indicates that modelled contours are available for adoption by the PDP.

1.11 Mr Hunt concludes at his paragraph 83 that he prefers the modelled approach. I consider that there are significant benefits in terms of efficiencies and accuracy with the modelled approach and I strongly support it's use for defining the spatial extent of road noise controls.

1.12 **Defining the extent of rail noise effects** - I agree with the Council that controls requiring acoustic treatment for noise sensitive activities near

to rail lines is appropriate. KiwiRail seek controls that are based on a standard setback approach.

1.13 As with the controls for road noise, I strongly support the use of a modelled approach for defining the areas of land that would be subject to controls for rail noise.

1.14 **Controls relating to WIAL** - The evidence of Mr Hunt sets out a comprehensive assessment of the PDP provisions relating to the WIAL and the considerable number of submission points raised in respect of WIAL noise issues. I support the evidence of Mr Hunt and I strongly support the PDP provisions for managing the effects of WIAL noise with the amendments proposed by Mr Hunt.

1.15 **Proposed Noise Chapter provisions** – I have worked with Mr Lindenberg to draft some amendments to the noise chapter provisions. These are attached as Appendix B to his evidence.

2. INTRODUCTION

2.1 My full name is Jon Robert Styles. I am an acoustic consultant and director and principal of Styles Group Acoustics and Vibration Consultants. I lead a team of 8 consultants specialising in the measurement, prediction and assessment of environmental and underwater noise, building acoustics and vibration working across New Zealand and internationally.

2.2 I have approximately 22 years of experience in the acoustics and noise control industry. For the first four years I was the Environmental Health Specialist – Noise at the Auckland City Council, and for the latter 18 years I have been the Director and Principal of Styles Group Acoustics and Vibration Consultants. I have a Bachelor of Applied Science (EH) majoring in Environmental Health.

2.3 I am the past-President of the Acoustical Society of New Zealand. I have completed two consecutive two-year terms as the President from 2016 to 2021. I have been on the Council of the Society for approximately 15 years. Styles Group is a member firm of the

Association of Australasian Acoustical Consultants (AAAC) and I am on the Executive team of the AAAC. My role on the Executive is to oversee the development of guidelines for acoustical consultants to follow in their day-to-day work and to participate in the governance of the AAAC generally.

2.4 Most recently I have advised Kāinga Ora on similar noise-related issues (noise from road, rail and airports) in the review of the Selwyn, Porirua, Waikato, New Plymouth, Christchurch and Central Hawkes Bay District Plans. I advised the Whangarei District Council through the recent Urban and Services Plan Change process and appeal process that dealt with the District Plan provisions for managing exposure to road and rail noise.

2.5 I have worked on District Plan provisions relating to the management of road, rail and airport noise in a significant number of different processes around New Zealand. I was involved in the appeals relating to the recent Notice of Requirements (NoRs) and alterations to the Wellington International Airport Limited (WIAL) designations. I am very familiar with the outcomes of that process and the noise issues faced by WIAL and the community surrounding it.

2.6 I been directly advising the Gore District, Kaipara District, Napier City Council, Taupō District Council and Whangarei District through District Plan Councils through full District Plan review processes. I assisted the Auckland Council through the development of the Auckland Unitary Plan and continue to provide advice to Auckland Council on both Council initiated and private plan change requests. I have also assisted many private clients through plan change and review processes across New Zealand.

2.7 In preparing this evidence I have read the Section 32 and Section 42A reports together with the associated appendices prepared by Council staff and with a focus on the evidence prepared by Mr Hunt and Mr Syman (noise experts for WCC).

2.8 I have worked with Mr Lindenberg closely on the development of our position in areas where the technical noise and vibration matters overlap with planning considerations and provisions.

2.9 The recommended amendments to the provisions under consideration in Hearing Stream 5 that are included in **Attachment B** to Mr Lindenberg's statement of evidence include my input and recommendations.

Code of Conduct

2.10 Although this is a Council hearing, I confirm that I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2023. I have complied with the Code of Conduct in preparing this evidence and agree to comply with it while giving evidence.

2.11 Except where I state that I am relying on the evidence of another person, this written evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

Scope of Evidence

2.12 My evidence covers submissions and further submissions on the Proposed Plan Change in relation to the provisions that manage the control and exposure to noise and vibration from State Highways, the rail network and the Wellington International Airport.

2.13 My evidence will address the following matters:

(a) The reasons for why I consider that there should be no rules or standards that control the way the receiving environment responds to the potential for vibration generated by roads and rail;

(b) The reasons why I generally support the acoustic treatment provisions set out in S4 for 'High' noise exposure and S5 for 'Moderate' noise exposure;

(c) My support for defining the spatial extent of controls relating to road and rail noise by modelling the noise levels and therefore accurately defining the extent of the effect that requires control;

(d) The reasons for changing the phrase “acoustic engineer” in the Noise Chapter (and anywhere else in the PDP) to the phrase “suitably qualified acoustic expert”; and

(e) General support for the PDP provisions relating to WIAL, including the amendments proposed by Mr Hunt and in attachment B to Mr Lindenberg’s evidence.

2.14 Where appropriate and relevant, my evidence will reference and rely on the evidence of whose opinion I agree with. My evidence refers primarily to the evidence of Mr Syman and Mr Hunt for the WCC and Mr Lindenberg for Kāinga Ora.

3. VIBRATION CONTROLS FOR ROAD AND RAIL

3.1 The noise chapter of the PDP contains no controls relating to managing the vibration from the operation of the State Highway and rail networks.

3.2 The submissions from Waka Kotahi and KiwiRail seek the addition of specific rules and standards that require the receiving environment to manage the potential and variable effects of vibration generated by road and rail, without any provisions or controls in the PDP that would require Waka Kotahi or KiwiRail to minimise the generation of vibration at the source (inside their designations).

3.3 The controls sought by Waka Kotahi and KiwiRail essentially require that vibration generated by road and rail traffic does not exceed a level of 0.3 mm/s V_{w95} when measured inside a range of defined noise / vibration sensitive activities .

3.4 The controls sought by Waka Kotahi and KiwiRail do not encourage or require any effort to reduce vibration at the source.

3.5 The evidence of Mr Syman for WCC sets out that he does not support the introduction of vibration controls for road and rail as sought by Waka

Kotahi and KiwiRail. Mr Syman appears to take a stronger view in respect of road vibration than he does for rail vibration.

3.6 Mr Syman appears to support the concept of some controls for managing the exposure to rail vibration but does not support the relief sought by KiwiRail given the lack of information to justify them.

3.7 Mr Syman considers that the risk of vibration issues near to roads is low, given the low inherent levels of road vibration, and the ability of Waka Kotahi to avoid or minimise vibration issues by repairs and maintenance of the road itself.

3.8 I agree with the reasons given by Mr Syman for rejecting the relief sought by Waka Kotahi and KiwiRail. I provide some additional commentary below.

Managing vibration from the rail network

3.9 In my experience, vibration effects extending beyond the rail corridor at a level requiring some degree of control is more common for rail than for State Highway networks. The movement of laden freight trains is generally responsible for the highest vibration levels. Passenger trains typically generate lower vibration levels due to their lower mass and better suspension (put simply).

3.10 In my view, the potential for rail vibration controls should only be considered for the PDP if there is relevant and robust evidence on the actual and likely effects of rail vibration beyond the boundaries of KiwiRail's rail corridors and across land where the PDP provides for the development of noise sensitive activities. Such evidence would need to address:

(a) Whether or not it is typical for rail vibration levels to exceed 0.3mm/s V_{w95} in buildings on land where the PDP provides for the development of noise sensitive activities;

(b) If so, what are the typical vibration levels and adjacent to what parts of the rail network do they arise;

(c) Would the adoption of the BPO and KiwiRail's own policies for reducing the problem still result in vibration levels outside the rail corridor regularly or typically exceeding a level of 0.3mm/s V_{w95} and if so why, at what level and at what distance; and

(d) If the vibration levels are found to typically exceed 0.3mm/s V_{w95} beyond the rail corridor, at what rate does the vibration attenuate over distance and how large does the effects area need to be.

(e) Are different standards appropriate for different sections of the railway network, such as where train speeds are low and / or where heavy rail freight in parts of the network is unusual or not a feature; and

(f) Even if the evidence does demonstrate that vibration levels exceed 0.3mm/s V_{w95} on land where noise sensitive activities are anticipated by the PDP, are those effects happening often enough and at the most sensitive times of the day to justify vibration controls as a response?

3.11 **Summary on rail vibration -** I do not support the rail vibration controls until or unless KiwiRail can justify that the effects are great enough to warrant them based on sufficiently robust vibration data that represents forecast train volumes and the various train speeds found on the Wellington rail network, and after the BPO has been adopted to reduce the effects at or near the source.

Managing vibration from the road network

3.12 In my experience, the vibration from traffic moving on a well-constructed road is generally quite low, and much lower than for rail.

3.13 The main reasons for road traffic generating less vibration than rail is because the typical mass of road vehicles is significantly less than that of trains (and less than freight trains in particular), and the suspension systems of cars and trucks is generally far superior, resulting in significantly less energy being imparted into the ground.

3.14 As Mr Symans points out at his paragraph 41, the majority of vibration issues from road traffic occur where there might be a defect in the road. My experience is also that vibration issues are far more likely in higher speed environments.

3.15 I understand that all of Wellington's State Highway network is comprised of motorways except for the section of State Highway One that runs generally east of Willis St to the airport. This section of State Highway One is low speed (50km/hr).

3.16 Waka Kotahi's proposed vibration standard would apply to any activity sensitive to noise within 40 metres from the legal boundary of the State Highway network. The controls proposed by Waka Kotahi require either:

(a) A very expensive (≈$100k) base-isolation solution that is only provided for single storey dwellings; or

(b) The engagement of a consultant to measure and predict vibration levels on the subject site to determine whether any treatment is required, and if so, what that treatment might be.

3.17 Mr Symans notes at paragraph 35 of his evidence that there is generally a shortage of expertise and equipment for the assessment of this type of vibration in New Zealand and Wellington. That is my experience as well. The Styles Group team travel all over New Zealand for these types of assessments.

3.18 I am concerned that if a developer commissioned a vibration measurement and an assessment by a consultant, and that assessment showed that there was a vibration issue that would increase the cost of building (or potentially make it unfeasible) the defect in the pavement that is causing the issue could be dealt with by regular maintenance and without notice soon after the project was either abandoned or the expensive building works were carried out.

3.19 I consider that the highly dynamic nature of any potential issues means that dealing with the potential issue in the receiving environment becomes highly uncertain, expensive and potentially highly inefficient.

3.20 The design, construction and compliance costs of implementing the indoor vibration controls will be significant and have not been quantified by Waka Kotahi.

3.21 I detail the costs of the various assessments in Appendix A of this evidence. These are based on my experience of working with similar controls elsewhere in New Zealand.

3.22 It is my experience that District Plan standards controlling building vibration from operational road networks are extremely unusual in District Plans throughout New Zealand. I am aware of only one District Plan (the Lower Hutt District Plan) that includes building vibration controls.

3.23 In my view, their rarity is because it is generally accepted that:

(a) Significant levels of vibration extending beyond the boundaries of the state highway network are unusual; and

(b) In the unusual circumstances where effects do arise on land where noise sensitive activities are provided for, the vibration should be remedied at source (i.e., by the roading authority).

3.24 I refer to Waka Kothi's own guidance[1] on the cause and remedy of significant vibration levels from road corridors:

> *"Generally, when significant vibration can be felt inside a house this is a result of a nearby road-surface defect such as a pothole, rutting, or a manhole with an abrupt transition to the surrounding road surface.*
>
> *If such a defect is confirmed, the Transport Agency will review the significance of the vibration concern, the condition of the road, and any programmed road maintenance/re-surfacing work in the area and develop a plan to repair/correct the defect, if required.*

[1] https://www.nzta.govt.nz/roads-and-rail/highways-information-portal/technical-disciplines/environment-and-sustainability-in-our-operations/environmental-technical-areas/noise-and-vibration/frequently-asked-questions/

In some cases, there may be issues with the road pavement (the engineered 'soil' layer that provides a strong and stable base for a smooth road surface) which can cause vibration to travel farther from the road and/or be more noticeable. In such cases, the Transport Agency will review the requirement to re-construct the road pavement. This is a major undertaking, and if required, would likely be programmed in at the time of the next major road rehabilitation/resurfacing work in the area."

3.25 Waka Kotahi has not provided any evidence to suggest that vibration from road traffic on the Wellington network is an issue that requires control in the receiving environment at all, let alone to a distance of 40m.

3.26 **Summary on road vibration -** In my opinion, before any road vibration controls are considered for the PDP, Waka Kotahi needs to produce evidence on the actual and likely effects of road vibration beyond the boundaries of its own road corridors. This evidence should be sufficiently detailed to confirm:

(a) Whether or not it is typical for vibration levels to exceed 0.3mm/s V_{w95} inside noise sensitive activities built in areas where the PDP anticipates development;

(b) If so, what are the typical vibration levels, and under what circumstances do they arise;

(c) Are there specific parts of the Wellington State Highway network that would be likely to generate more vibration than other parts; and

(d) Would the adoption of the BPO and Waka Kotahi's own policies for reducing the problem still result in vibration levels outside the road corridor regularly or typically complying with a level of 0.3mm/s V_{w95} and if so, under what circumstances.

3.27 I consider that these factors need to be weighed against the costs and practicalities of conducting the necessary vibration measurements and assessments and the costs of mitigation.

4. GENERAL SUPPORT FOR ACOUSTIC TREATMENT CONTROLS S4 AND S5

4.1 I generally support the acoustic insulation controls set out in S4 for 'high noise areas' and in S5 for 'moderate noise areas'.

4.2 The acoustic insulation requirements adopt the ISO method of specifying the acoustic performance using the $D_{tr,2m,nT,w} + C_{tr}$ method (the D_{tr} method).

4.3 The D_{tr} method specifies how much external noise the building envelope has to attenuate for the occupants inside. The method contains adjustments for a range of factors to create a standardised specification for a standard room.

4.4 The D_{tr} method differs from the 'dBA' method that is common in other District Plans around New Zealand.

4.5 The dBA method simply specifies that an internal noise level must not be exceeded based on a specified external noise level (from road, rail, port or airport noise, for example).

4.6 I consider that the D_{tr} method and the dBA method both have their own pros and cons. Most of these are technical and vary according to the character and variability of noise that the controls are designed to deal with.

4.7 In this case, the PDP uses the same D_{tr} method to control the acoustic treatment provisions for all noise sources covered by S4 and S5. This includes:

(a) Airport noise

(b) Road noise

(c) Rail noise

(d) Port noise

(e) Entertainment noise

(f) Commercial and industrial noise

4.8 Given the wide variety in the character, level and variability of the noise that S4 and S5 are proposed to manage, I am comfortable with the use of the D_{tr} method in the PDP.

5. REASONS WHY 'ACOUSTIC ENGINEER' IS INAPPROPRIATE

5.1 The proposed provisions in S4 and S5 use the term "acoustic engineer" to specify who can prepare assessments and design certificates that the Council will accept.

5.2 I consider that this term unreasonably narrows the number of people in the acoustic consulting industry that could do the work.

5.3 I consider that the term "Suitably qualified and experienced acoustic expert" is a more appropriate term that properly recognises the qualifications of a significant portion of the acoustic consultants working in New Zealand, and that are perfectly capable of carrying out the work required by S4 and S5. My observation is that this term is widely used in New Zealand.

5.4 In my role on the Executive of the AAAC I have been involved in a survey of all AAAC member firms in Australia and New Zealand to determine whether the individuals from each company have qualifications consistent with the term 'engineer'. The Australian Acoustical Society (AAS) have also conducted the same survey. This was carried out in response to the Victorian state government introducing new legislation that restricted certain work to only those with an engineering qualification.

5.5 The results of the survey have not been made public yet, however I am aware that a significant proportion of AAAC and AAS members have qualifications in areas such as science, mathematics and physics, and not engineering.

5.6 My experience after being in the Council of the ASNZ for 15 years and President of it for nearly 5 years is that the acoustics consulting industry in New Zealand has very similar characteristics.

5.7 There is no Bachelor of Engineering (acoustics) qualification available in New Zealand at the current time and I am not aware that there has been such an offering here historically either. The qualifications to meet the term used in S4 and S5 would therefore require education offshore.

5.8 Despite the different qualifications, the entire membership is generally capable of carrying out the work in S4 and S5 provided they are suitably experienced in that particular area of work.

5.9 For these reasons, I consider that the term “acoustic engineer’ used in S4 and S5 (and anywhere else in the PDP) should be replaced with “Suitably qualified and experienced acoustic expert”.

6. DEFINING THE EXTENT OF ROAD NOISE BY MODELLING

6.1 The evidence of Mr Hunt discusses the various merits of adopting a ‘modelled approach’ to defining the area of land subject to acoustic treatment controls for road noise[2].

6.2 The PDP currently adopts a standard ‘setback’ method of defining the spatial extent of the road noise controls. These are standard distances that ignore a range of important factors, including screening and effects on propagation from buildings, motorway structures and topography. All of these are regular features in the Wellington State Highway environment.

6.3 Mr Hunt concludes at his paragraph 83 that he prefers the modelled approach, but does not recommend it in this case as Waka Kotahi have not provided the contours or the supporting information for them in this process.

6.4 I consider that there are significant benefits in terms of efficiencies and accuracy with the modelled approach compared to the standard ‘set back’ approach as set out in the PDP.

6.5 I consider that relying on modelled noise level contours rather than a standard metric setback ensures the burden of mitigation does not extend any further into the community than is absolutely necessary.

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[2] Paragraphs 77 to 85

6.6 I understand that the Waka Kotahi submission indicates that modelled contours are available for adoption by the PDP.

6.7 I strongly support the use of the modelled approach to defining the spatial extent of controls.

7. RAIL NOISE CONTROLS, AND DEFINING THE EXTENT OF RAIL NOISE BY MODELLING

7.1 I agree with the Council that controls requiring acoustic treatment for noise sensitive activities near to rail lines is appropriate.

7.2 The evidence of Mr Syman discusses the provisions of S4 and S5 against the KiwiRail submission.

7.3 Mr Syman states that a standalone set of provisions that only deal with rail noise are not required, because the provisions of S4 and S5 can manage the issue adequately. I agree.

7.4 Mr Syman notes that the noise generated by the rail network can vary depending on the characteristics of the network in any particular area. Train speed and type (freight or passenger) are perhaps the two greatest variables. I agree.

7.5 I consider that the PDP controls and the KiwiRail submission approach these variables in a relatively blunt fashion by using standard setback distances from the rail line. Mr Syman's evidence makes similar comments.

7.6 As with the road noise controls, the standard setback distances incorporate potentially significant inefficiencies by ignoring a range of factors that can influence the rail noise level at any particular property.

7.7 These factors include:

(a) Train speed on each part of the network

(b) Train type on each part of the network (freight and passenger or passenger only)

(c) Screening by topography

(d) Screening by buildings

(e) The effects of tunnels, bridges and other structural features

7.8 As with the controls for road noise, I strongly support the use of a modelled approach for defining the areas of land that would be subject to controls for rail noise.

7.9 I consider that the modelled approach will be far more efficient and accurate, as it will be capable of appropriately catering for the factors noted above.

8. CONTROLS RELATING TO WIAL

8.1 The evidence of Mr Hunt sets out a comprehensive assessment of the PDP provisions relating to the WIAL and the considerable number of submission points raised in respect of WIAL noise issues.

8.2 I advised the Guardians of the Bay through the appeal process on the WIAL 4and WIAL 5 designations (main airport and east-side area respectively). My involvement in that process has given me a very good insight into the noise issues arising from WIAL and in the surrounding communities.

8.3 I support the evidence of Mr Hunt and I strongly support the PDP provisions for managing the effects of WIAL noise with the amendments proposed by Mr Hunt.

8.4 I consider that the provisions of S4 and S5 are adequate for managing the airport noise effects and I agree with Mr Hunt that these are sufficient on their own. I disagree with WIAL that a standalone set of standards are required.

8.5 I also agree with Mr Hunt that a number of the WIAL designation provisions should be reflected in the PDP. My general view on this is that the bottom-line limits and controls in the designation conditions should also be included in the PDP. The designation conditions that set out the methods for ‘how’ those limits and controls are achieved are best-left in the designation conditions, as only WIAL are responsible for administering these.

8.6 Based on my experience, having the noise limits and defined controls in the District Plan as well as the Designation conditions aids in the understanding of how other associated plan provisions work, the ability for the Council to enforce the provisions and the ability for lay readers of the District Plan to understand how the District Plan noise chapter provisions work together.

8.7 I have worked with Mr Lindenberg to make a small number of changes to the controls relating to WIAL. Those changes are generally minor and relate to the wording and do not change any fundamental part of the controls. Those changes are set out in Appendix B to the evidence of Mr Lindenberg.

Jon Robert Styles

18 July 2023

APPENDIX A – Brief note on the cost of vibration mitigation

In my experience, the costs of complying with the proposed noise standards may include:

1) Acoustical design work to achieve the specified internal noise levels. This is generally straightforward and for a typical dwelling the cost would generally be between $500 and $1000 +GST.

2) Additional construction costs to achieve the specified internal noise levels, such as thicker glass or double-glazing, a heavier façade materials, sarking under the roof, additional layers of plasterboard, solid core doors in the façade. Based on my experience, the extra costs of building materials and labour can be significant (>$50,000 +GST) for dwellings very close to major roads or dwellings close to railway lines. The cost is typically less for a new-build compared to retrofitting insulation to an existing building.

3) Installing mechanical cooling (air conditioning) and a mechanical fresh air supply to enable people to keep their windows and doors closed to keep the noise out. In my experience the cost of this ranges considerably based on the size of the building and the number of rooms. For a typical single-level dwelling, it is my experience that either a ducted heat pump system would be required, or a system comprising at least two indoor high-wall or cassette units, as well as a one or more small, silenced fans to provide an exchange of fresh air. In my experience, the cost of these systems can range from approximately $1000 +GST for the supply and install of a fresh air fan, (or fans) where air conditioning is already proposed, or $10k to $20k +GST for an air conditioning system and silenced fans where none were otherwise proposed.

4) Resource consent processes. The estimation of these costs is beyond my area of expertise.

5) The cost of meeting the proposed vibration standards is generally much greater than for noise.

If a new noise sensitive activity or an alteration to an existing noise sensitive activity is proposed within the vibration effects area, the following procedure would generally be necessary:

1) The applicant would need to engage a suitably qualified vibration expert to carry out vibration measurements at the location of the proposed noise sensitive activity.

2) The vibration measurements would need to capture at least 15 pass-bys of the vibration source of interest. If it were for road vibration, the measurements could probably be conducted in a few hours (to capture 15 trucks in the lane(s) of interest).

3) If it was rail vibration, the seismograph would need to be set up and left for several days to capture 15 freight train pass-bys. The time and cost of this work would be significant. The instrument would need to be secured and a power source arranged for the week or two of measurements required. This may include solar power and in some instances additional secure enclosures if the site is otherwise open.

4) The pass-by data would need to be analysed against the requirements of NS8176E and a brief report prepared that sets out the measured vibration levels and confirming whether the vibration levels in the proposed noise sensitive activity would be less than 0.3mm/s V_{w95}.

Based on my experience, the cost of an initial road vibration assessment would be in the order of $3k to $4k +GST. There are few consultants with the necessary equipment and expertise to do this work in New Zealand, so it is likely that many assessments would be completed by consultants from outside the region.

The cost of a rail vibration assessment would be considerably greater given the likelihood that the assessment period would be for at least a week and probably longer. I estimate that the cost of a rail vibration assessment would be in the order of $5k to $8k +GST, and possibly more if security, solar panels and extensive travel is required.

If the vibration assessment demonstrates that the vibration level in the proposed noise sensitive activity will be greater than 0.3mm/s V_{w95}, the options for the applicant would generally be:

1) Isolate the building from the ground vibration by using base isolation techniques. My experience is that the cost of this treatment would typically be $100k +GST for a single-level dwelling on top of the cost of the build itself.

2) Build a larger building from heavy masonry construction. The additional mass of the structure (compared to a lightweight structure) would assist in reducing the vibration level inside the noise sensitive activity. This option is high-risk and, in my experience, high-cost compared to normal dwelling construction methods and materials.

3) Abandon the proposal due to cost. In my experience, this option is commonly adopted when applicants find out the true cost and difficulty of dealing with the vibration issues.

In my experience, option (3) above is often found to be the only viable option.

In some cases, the applicant has only found out the implications of the vibration controls after resource consent has been granted. The vibration assessment might be required by a condition of consent to be addressed before the building is occupied. By the time the vibration survey has been undertaken and results provided, plans to build are well underway and construction has started in some cases. My experience is that this has lead to the abandonment of the development in some cases and significant financial losses.