

BEFORE INDEPENDENT COMMISSIONERS

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of the Proposed Porirua District Plan
("Proposed Plan")

STATEMENT OF EVIDENCE OF STEPHEN CHILES ON BEHALF OF KIWIRAIL HOLDINGS LIMITED

NOISE AND VIBRATION

1. INTRODUCTION

- 1.1 My full name is Dr Stephen Gordon Chiles. I have the qualifications of Doctor of Philosophy in Acoustics from the University of Bath and Bachelor of Engineering in Electroacoustics from the University of Salford, UK. I am a Chartered Professional Engineer and Fellow of the UK Institute of Acoustics.
- 1.2 I am self-employed as an acoustician through my company Chiles Ltd. I have been employed in acoustics since 1996, as a research officer at the University of Bath, a principal environmental specialist for Waka Kotahi NZ Transport Agency ("**Waka Kotahi**"), a consultant for the international firms Arup, WSP, and URS, and for the specialist firms Marshall Day Acoustics and Fleming & Barron. I am contracted as the principal advisor to provide the Environmental Noise Analysis and Advice Service to the Ministry of Health and regional public health services.
- 1.3 I have been involved in many situations relating to noise and vibration effects on new or altered sensitive activities around existing infrastructure. I was an Independent Commissioner for plan changes for Queenstown and Wānaka Airports and a plan variation for Port Nelson, which dealt particularly with reverse sensitivity effects in

relation to noise. I have previously been engaged to advise Waka Kotahi and Auckland Transport (roads), KiwiRail (railways), Christchurch City Council (airport) and Environment Canterbury (port) on reverse sensitivity noise issues. I was responsible for producing draft provisions for Clause G6 of the New Zealand Building Code relating to reverse sensitivity for the Ministry of Business, Innovation and Employment.

- 1.4 I have presented acoustics evidence for KiwiRail Holdings Ltd ("**KiwiRail**") on numerous plan changes and plan reviews. I have provided advice to KiwiRail and Waka Kotahi with respect to draft provisions for a future National Planning Standard addressing adverse effects on new sensitive land-uses, or alterations to existing uses, near road and rail corridors.
- 1.5 I am convenor of the New Zealand reference group for "ISO" acoustics standards, an observer of the "IEC" committee for acoustics instrumentation standards and a member of joint Australian and New Zealand committees for acoustics standards. I was Chair of the 2012 New Zealand acoustics standards review, Chair for the development of the 2010 wind farm noise standard, and a member for the 2008 general environmental noise standards.

2. CODE OF CONDUCT

- 2.1 While this is a Council hearing, I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2014 and that I agree to comply with it. I confirm that I have considered all material facts that I am aware of that might alter or detract from the opinions that I express, and that this evidence is within my area of expertise, except where I state that I am relying on the evidence of another person.

3. SCOPE OF EVIDENCE

- 3.1 My statement relates to the Proposed Porirua District Plan ("**Proposed Plan**"), and in particular to KiwiRail's function as a transport network utility operator for the North Island Main Trunk line ("**NIMT**") that passes through the Porirua District. KiwiRail has made a submission on the Proposed Plan supporting provisions in the notified version relating to new and altered sensitive land uses affected by railway noise and vibration.

- 3.2 I have prepared a separate statement of evidence for Waka Kotahi addressing the same issues with respect to state highway noise and vibration. Given the commonality of the issues and the unified approach of Waka Kotahi and KiwiRail, I have often prepared combined evidence on behalf of both parties. However, in this instance, in response to the notified version of the Proposed Plan each party sought slightly different relief. While these remain broadly aligned, I have addressed each in a separate statement of evidence.
- 3.3 The KiwiRail submission seeks that notified provisions in the Proposed Plan be retained to manage adverse effects caused by new and altered buildings containing sensitive activities establishing near the existing NIMT. The purpose of these provisions is to protect the health and amenity of occupants of those buildings, and to avoid or mitigate potential reverse sensitivity effects on KiwiRail's operations on the NIMT.
- 3.4 My evidence relates to the management of railway noise and vibration effects with respect to public health and amenity and will address:
- (a) noise and vibration effects arising from rail infrastructure;
 - (b) methods to manage adverse effects on new and altered buildings containing sensitive activities near existing infrastructure, as well as reverse sensitivity effects on existing infrastructure arising as a result of such activities;
 - (c) the appropriateness of the relief sought by KiwiRail from an acoustics and public health perspective; and
 - (d) the recommendations in the section 42A report in relation to the relief sought by KiwiRail.

4. NOISE AND VIBRATION EFFECTS FROM RAIL INFRASTRUCTURE

- 4.1 It is widely accepted nationally and internationally that sound and vibration from rail networks have the potential to cause adverse health effects on people living nearby.

Noise effects from rail networks

- 4.2 In respect of noise, this has been documented by authoritative bodies such as the World Health Organisation ("**WHO**"),¹ including a relatively recent publication by WHO Europe in October 2018 ("**2018 WHO Guidelines**"), which set out guidelines for managing environmental noise.² These WHO publications are underpinned by robust scientific research. I am not aware of any fundamental disagreement in the acoustics profession with the information published by WHO regarding rail noise effects.
- 4.3 A research project was published in 2019³ specifically addressing the applicability of international data on noise annoyance to New Zealand. For rail noise, this research was based on a survey of 244 people living in the vicinity of the NIMT in South Auckland. The survey was based on the questions and methods set out in the international technical specification ISO/TS 15666,⁴ which is the same approach used in most international studies. The research found that international noise response curves are generally applicable for the New Zealand population, although the New Zealand population may be slightly more noise sensitive. I am currently on the steering groups for two other research projects further investigating these issues: "Community response to noise" and "Social (health) cost of land transport noise exposure in New Zealand".
- 4.4 The 2018 WHO Guidelines are based on a critical review of academic literature and followed a rigorous protocol to determine the quality of evidence of adverse effects. With respect to sound from rail networks, the 2018 WHO Guidelines note the following adverse effects: ischaemic heart disease, hypertension, high annoyance and sleep disturbance. Based on the evidence of adverse effects, WHO makes recommendations to policymakers to reduce rail sound exposure to below a range of guideline values. The relief sought by KiwiRail to retain the notified provisions in the Proposed Plan is consistent with this direction, as an integral part of its broader noise management activities. I describe below some of the steps and actions that KiwiRail implements as part of this management approach.

¹ World Health Organisation, Guidelines for community noise, 1999; World Health Organisation, Burden of disease from environmental noise, 2011.

² World Health Organisation, Environmental noise guidelines for the European region, 2018.

³ Humpheson D. and Wareing R., 2019. Evidential basis for community response to land transport noise, Waka Kotahi Research Report 656. <https://nzta.govt.nz/resources/research/reports/656/>

⁴ International Standards Organisation ISO/TS 15666:2003 Acoustics – assessment of noise annoyance by means of social and socio-acoustic surveys.

Vibration effects from rail networks

- 4.5 With respect to vibration, Norwegian Standard NS 8176⁵ provides a summary of annoyance and disturbance relationships associated with vibration from land-based transport. These relationships show that adverse effects occur at vibration exposures typically found around existing rail networks. This primary issue relates to people in dwellings being disturbed due to feeling vibration, but there is also an interrelated issue that the same vibration can cause buildings to radiate noise inside.

5. METHODS TO MANAGE ADVERSE EFFECTS

- 5.1 I have been involved in different activities undertaken by KiwiRail to manage and reduce this sound and vibration where practicable. These include installation of ballast mat, rail grinding and tamping, ballast cleaning and replacement, and automated monitoring of rolling stock wheel condition. However, even with practicable improvements implemented, the operation of the railway network can result in adverse effects which cannot be completely internalised within its typical designation boundaries, such as noise and vibration. These effects commonly occur within the railway network subject to normal maintenance and cannot be solely attributed to defects in track or rolling stock. In particular, vibration varies significantly depending on ground conditions and localised features such as buried services and structures. Even with "good" ground, track, and rolling stock conditions, there is still inherent vibration from railways that can cause disturbance to activities in proximity to the rail corridor.
- 5.2 As these effects cannot be completely internalised within the corridor, there must be appropriate land use controls in place to manage sensitive development near these transport corridors. Land use controls to avoid or manage adverse noise and vibration effects on new sensitive activities or alterations to such activities are critical in protecting sensitive activities from adverse noise and vibration effects. Such controls, in turn, are fundamental to managing the potential for reverse sensitivity effects on the rail network. The location of incompatible sensitive activities in proximity to rail infrastructure can lead to noise and vibration effects on, and complaints from, sensitive users.
- 5.3 Where it is not practicable to avoid sensitive uses near the rail corridor and new buildings are constructed, or existing buildings are altered, near to the railway network, it is

⁵ Norwegian Standard NS 8176:2017 Vibration and shock - Measurement of vibration in buildings from landbased transport and guidance to evaluation of its effects on human beings.

relatively straight-forward to control internal sound and vibration through the building location (locating buildings as far from the rail corridor as possible), design and systems (like acoustic insulation and mechanical ventilation). In most cases, it is practical to achieve acceptable internal sound and vibration levels using such measures. Thus, with careful design of building location, orientation and materials, future occupants of the building can be protected from the most significant adverse effects associated with railway sound and vibration.

- 5.4 Rules in other district plans commonly control the location and design of sensitive activities such as housing, where such activities seek to locate near existing sound sources such as roads, railways, airports, ports, quarries, industrial sites, industrial and business zones, gun clubs and motorsport facilities. For new houses near existing railways, examples of second-generation operative district plans containing controls include: Christchurch, Dunedin, Tauranga, Hamilton, Palmerston North and Hutt City. In all these existing plans there are requirements to achieve reasonable internal noise levels in sensitive spaces near railways.
- 5.5 In the case of the Proposed Plan, there are controls in NOISE-R5 and NOISE-S2/S3/S4 for new and altered buildings near the NIMT. These controls set an internal railway noise limit (S2), ventilation requirements (S3) and a vibration limit (S4). The internal railway noise limit and ventilation requirements apply within 100 metres of the NIMT. Additionally, the vibration limit applies within 30 metres of the NIMT.

6. RELIEF SOUGHT

- 6.1 KiwiRail's submission seeks to retain the notified provisions in the Proposed Plan: NOISE-R5 and NOISE-S2/S3/S4.
- 6.2 Aspects of the notified provisions vary from controls that I would recommend for rail noise and vibration. While I acknowledge that KiwiRail's submission sought retention of these provisions, from a technical perspective, I consider it is prudent for me to outline the main variations that I would recommend, being:
 - (a) vibration controls over a distance of at least 60m rather than 30m;
 - (b) ventilation specifications to provide thermal comfort; and
 - (c) controls for outdoor noise.

- 6.3 While vibration controls over a 30m distance are a good starting point and I support these, I consider vibration controls over a distance of at least 60m would be preferred. This is in reliance on studies undertaken within both New Zealand and internationally that indicate vibration effects from rail are typically at levels which would disturb neighbouring activities up to, and in some cases beyond this distance, where appropriate controls are not applied. A control which only extends 30m is likely to result in vibration effects on unmitigated buildings beyond this distance.
- 6.4 I also consider ventilation controls which include requirements for systems to provide sufficient airflow with heating and cooling functions necessary to ensure the overall efficacy of acoustic insulation and ventilation installed in neighbouring buildings. This kind of mitigation relies on doors and windows within properties to be closed in order to meet internal noise levels set by controls. If sufficient airflow with heating and cooling is not provided, occupants will typically open windows and doors in hotter months for comfort, undermining the noise mitigation. For this reason it is typically recommended that ventilation units with higher airflows and heating and cooling functions are provided, to avoid occupants needing to open doors and windows.
- 6.5 Research into adverse health effects from environmental noise is based on normal domestic use of indoor and outdoor living areas. While some effects such as sleep disturbance are specific to the indoor environment, other health effects relate to noise exposure of people in both indoor and outdoor environments. I therefore consider that controls are also warranted for outdoor living environments.
- 6.6 While I consider these aspects could improve the notified provisions, KiwiRail has taken a pragmatic approach and submitted in support of the notified provisions seeking for them to be retained.

7. SECTION 42A REPORT

- 7.1 For railway noise, in the section 42A report Mr Rory Smeaton recommends accepting KiwiRail's submission in part, subject to generally minor amendments in response to other submissions. Specifically, Mr Smeaton recommends retaining the fundamental parts of the notified standards NOISE-S2/S3. In terms of railway noise, I agree with Mr Smeaton that these controls are necessary to manage adverse noise effects on people.
- 7.2 In paragraph 39 of the section 42A report Mr Smeaton notes that KiwiRail may wish to address submission points by Steve Grant [158.2 and 159.2]. Those submission points

are *"Please clarify what is New Zealand Rail's contribution to the noise issue besides creating it."* I have discussed above at paragraph 5.1 routine management and maintenance activities undertaken by KiwiRail, that assist in controlling noise emissions.

- 7.3 For railway vibration, KiwiRail's submission has been reviewed for the Council by Mr Nigel Lloyd.⁶ Mr Lloyd and in turn Mr Smeaton recommend rejection of KiwiRail's submission point on this matter, and on the basis of the submission by Kāinga Ora recommend removing the railway vibration standard NOISE-S4. This appears to be primarily because Mr Lloyd considers that NOISE-S4 is not efficient. However, while Mr Lloyd considers that NOISE-S4 is not efficient, and that developers may find vibration mitigation "unpalatable", he does not recommend any alternative to address the adverse vibration effect.
- 7.4 In his evidence Mr Lloyd discusses various factors associated with railway vibration, but his evidence does not appear to contend that there is not an adverse effect that necessitates mitigation; only that it might be inconvenient for developers to implement that mitigation. I do not consider this is an appropriate reason not to mitigate adverse effects.
- 7.5 The vibration criterion is in accordance with a recognised standard (NS 8176), which appears to be accepted by Mr Lloyd in paragraphs 34 and 35 of his evidence, at least with respect to road vibration. In my opinion the notified provision uses this standard to set a criterion appropriate to manage adverse effects on people. The criterion does not provide absolute protection but is set at a level whereby NS 8176 estimates that 20% of people would be expected to be highly or moderately annoyed by vibration.
- 7.6 I consider this presents a degree of residual adverse health effect which is undesirable. As discussed above, I would typically recommend vibration controls for the rail network to be applied at least 60m from the rail corridor, rather than just 30m. The proposed control of 30m therefore already reflects a pragmatic reduction, focused on the most severe effects on a community basis. By comparison, if the controls were to seek avoidance of all effects, or only negligible residual effects, they would require vibration controls over a significantly wider area and would be anticipated to require substantial modifications to many new building designs (such as base isolation). As the 30m control already reflects a pared back approach, I do not consider it appropriate to reduce these

6

Statement of evidence of Mr Lloyd dated 1 December 2021, as attached to the section 42A report by Rory Smeaton dated 3 December 2021.

controls even further to impose no vibration controls at all, and leave the significant effects on buildings within the immediate vicinity of the rail corridor unmitigated.

- 7.7 As noted above, land within 30m of the NIMT is that most likely to be significantly affected by railway noise and vibration. By setting a vibration performance standard it enables this land to be developed subject to appropriate design. I agree with Mr Lloyd that for some sites with higher vibration exposures, appropriate design for a sensitive activity may involve some cost and complexity. However, with the criterion proposed, some buildings may be found not to require any treatment. In other cases, modification to foundation designs or building layouts might be required, and for the highest vibration exposures base isolation may be required if the site layout cannot be adjusted. In my opinion the performance standard allows developers to accurately evaluate this true cost (including achieving a healthy home for future residents) of developing a site near the NIMT as opposed to alternative sites that are not affected by railway vibration.
- 7.8 In my opinion, retention of the notified provisions as sought by KiwiRail will allow for new and altered buildings near the NIMT that provide most people with acceptable indoor living conditions. This should manage adverse health and amenity effects experienced by those people to a reasonable degree, which in turn should assist in managing reverse sensitivity effects on KiwiRail.

8. CONCLUSION

- 8.1 Sound and vibration from rail corridors can give rise to adverse health and amenity effects on sensitive land uses located nearby. The research and guidelines relating to these effects are widely accepted internationally and applied in New Zealand.
- 8.2 KiwiRail continuously works to reduce existing sound and vibration exposure and to manage the effects of their operations on existing sensitive activities. However, due to the nature of its operations, KiwiRail (as with many large infrastructure providers) is unable to internalise all noise and vibration effects associated with its activities.
- 8.3 Adverse effects on new and altered buildings for sensitive activities can be avoided and managed through well understood controls in district plans. In my opinion, it is critical that the Proposed Plan includes controls to manage the location and design of sensitive activities near the NIMT, to protect people from adverse effects and in turn to manage potential reverse sensitivity effects on KiwiRail.

- 8.4 The notified version of the Proposed Plan includes rules to manage adverse effects on sensitive activities in new and altered buildings near the existing NIMT. KiwiRail submitted in support of these provisions.
- 8.5 The section 42A report generally recommends retaining the notified rail noise provisions, but not the rail vibration provisions. I consider that vibration controls are necessary and in my opinion, the notified provisions should be retained to manage adverse railway noise and vibration effects on people living in proximity to the rail corridor.

Stephen Chiles
21 January 2022