Before the Hearings Commissioners

Under	the Resource Management Act 1991 (the **RMA**)
In the matter of	a submission by KiwiRail Holdings Limited (submitter 51 and further submitter 11)
and in the matter of	Waitomo Proposed District Plan (**Proposed Plan**)

Primary statement of evidence of Catherine Lynda Heppelthwaite regarding Tranche 2 of the Proposed Plan

Dated 4 November 2024

1 INTRODUCTION, QUALIFICATIONS AND EXPERIENCE

1.0 My full name is Catherine Lynda Heppelthwaite. I am a principal planner for Eclipse Group Limited. I am presenting this planning evidence on behalf of KiwiRail Holdings Limited (**KiwiRail**).

1.1 I hold a Bachelor Degree in Resource Studies obtained from Lincoln University in 1993. I am a full member of the New Zealand Planning Institute, a member of the Resource Management Law Association and the Acoustical Society of New Zealand. I have more than 25 years' experience within the planning and resource management field, which has included work for local authorities, central government agencies, private companies and private individuals. Currently, I am practicing as an independent consultant planner and have done so for the past 18 years.

1.2 I have extensive experience with preparing submissions and assessing district plans provisions in relation to noise and vibration, most recently in relation to the New Plymouth, Christchurch, Porirua and Whangarei District Plans where I assisted KiwiRail and/or Waka Kotahi by providing specialist planning evidence on similar issues (noise and vibration) and building setbacks.

2 CODE OF CONDUCT

2.0 I have read the Environment Court's Code of Conduct for Expert Witnesses (2023) and I agree to comply with it. My qualifications as an expert are set out above. I confirm that the issues addressed in this brief of evidence are within my areas of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

3 SCOPE OF EVIDENCE

3.0 My evidence will address the following:

a. the statutory and higher order planning framework;

b. KiwiRail's submissions in relation to Strategic Direction, Network Utilities, Transport, Designations and Natural Character in the Proposed Plan;

c. Council's s42A recommendations; and

d. further amendments required to the plan provisions.

3.1 In preparing my evidence, I have considered the Section 42A Reports prepared for:

i. Strategic Direction[1];

ii. Network Utilities[2];

iii. Transport[3];

iv. Designations[4]; and

v. Natural Character[5].

4 STATUTORY AND HIGHER ORDER PLANNING FRAMEWORK

4.0 In preparing this evidence, I have specifically considered the following:

a. the purpose and principles of the RMA (sections 5-8);

b. provisions of the RMA relevant to plan-making and consenting; and

c. the Waikato Regional Policy Statement (**WRPS**).

4.1 In addition, Council's reporting officers have described the relevant statutory documents (for example, in Ms Wratt's s42A Report on Network Utilities[6]) in a way with which I generally agree or accept and will not repeat here.

4.2 Relevant provisions of the WRPS[7] include:

i. **UFD-O1** – Built Environment

Development of the built environment (including transport and other infrastructure) and associated land use occurs in an integrated, sustainable and planned manner which enables positive environmental, social, cultural and economic outcomes including by:

[…]

3. integrating land use and infrastructure planning, including by ensuring that development of the built environment does not

[1] Prepared by Ms Cathy O'Callaghan dated 2 October 2024.
[2] Prepared by Ms Carolyn Wratt dated 21 October 2024.
[3] Prepared by Ms Carolyn Wratt dated 21 October 2024.
[4] Prepared by Mr Alex Bell dated 21 October 2024.
[5] Prepared by Ms Cathy O'Callaghan dated 2 October 2024.
[6] Section 2.3.
[7] Included in full as Attachment C to my evidence.

compromise the safe, efficient and effective operation of infrastructure corridors;

[…]

5. recognising and protecting the value and long-term benefits of regionally significant infrastructure;

[…]

7. minimising land use conflicts, including minimising potential for reverse sensitivity

ii. **Method UFD-M2** – Reverse sensitivity

Local authorities should have particular regard to the potential for reverse sensitivity when assessing resource consent applications, preparing, reviewing or changing district or regional plans and development planning mechanisms such as structure plans and growth strategies. In particular consideration should be given to discouraging new sensitive activities, locate near existing and planned land uses or activities that could be subject to effects including the discharge of substances, odour, smoke, noise, light spill or dust which could affect the health of people and /or lower the amenity values of the surrounding area.

The relevant policy is: UFD-P1 Planned and co-ordinated subdivision, use and development,

iii. **UFD-P1** – Planned and co-ordinated subdivision, use and development

Subdivision, use and development of the built environment, including transport, occurs in a planned and co-ordinated manner which: […]

4. has regard to the existing built environment.

iv. **UFD-P2** – Co-ordinating growth and infrastructure

Management of the built environment ensures:

1.the nature, timing and sequencing of new development is co-ordinated with the development, funding, implementation and operation of transport and other infrastructure in order to:

a.[…]

b. maintain or enhance the operational effectiveness, viability and safety of existing and planned infrastructure;

c. […]

3. the efficient and effective functioning of infrastructure, including transport corridors, is maintained, and the ability to maintain and upgrade that infrastructure is retained; and […]

4.3 The Emissions Reduction Plan[8] is a matter to be had regard to by Council; of particular relevance within the Emissions Reduction Plan (for rail) is *Action 10.3.1: Support the decarbonisation of freight* which includes as a key initiative:

- *Continue to implement the New Zealand Rail Plan and support coastal shipping*.

4.4 For completeness, the New Zealand Rail Plan (**NZRP**) lists as strategic investment priorities[9]:

- *Investing in the national rail network to restore rail freight and provide a platform for future investments for growth; and*

4.5 While the Emissions Reduction Plan is to be had regard to, its support for the NZRP (among other things) illustrates a strategic forward plan to generally improve and increase train services over time.

5 KIWIRAIL'S SUBMISSIONS

5.0 KiwiRail made a primary submission on the Proposed Plan seeking the following relief:

[8] RMA, section 74(2)(d).
[9] The New Zealand Rail Plan April 2021, Part B. See pages 25 and 38 for key details.

Strategic Direction

a. Add a new objective[10] *SD-O'X' Manage land use activities to avoid, remedy or mitigate adverse effects, including reverse sensitivity effects, of subdivision, land use and development, on regionally significant infrastructure including transport corridors*.

b. Retain as notified SD-O21[11] and SD-O30[12].

Network Utilities

c. Retain as notified NU-P1[13], NU-P5[14], NU-P12[15] and NU-P19[16].

d. Amend NU-R3[17] as follows: *Operation, maintenance,* repair, *and removal of existing network utilities and existing ancillary access tracks.*

e. Amend NU-R3[18] *Outstanding natural features, heritage buildings and structures, sites and areas of significance to Māori and significant archaeological sites* to be a restricted discretionary activity.

f. Retain as notified NU-R12[19] and NU-R17[20].

g. Amend NU-R13[21] *New structures on* or adjacent to *a railway corridor or an indicative road.*

Transport

h. Retain as notified TRAN-O2[22], TRAN-O4[23], TRAN-O5[24], TRAN-P2(7)[25], TRAN-P3[26], TRAN-P7[27] and TRAN-P10[28].

[10] Submission 51.13.
[11] Submission 51.14.
[12] Submission 51.15.
[13] Submission 51.16.
[14] Submission 51.17.
[15] Submission 51.18.
[16] Submission 51.19.
[17] Submission 51.20.
[18] Submission 51.21.
[19] Submission 51.22.
[20] Submission 51.24.
[21] Submission 51.23.
[22] Submission 51.25.
[23] Submission 51.26.
[24] Submission 51.27.
[25] Submission 51.28.
[26] Submission 51.29.
[27] Submission 51.30.
[28] Submission 51.31.

i. Amend TRAN-R9[29] *Erection of structures ~~on or~~ adjacent to a railway corridor or an indicative road*.

j. Amend TRAN -R10[30] *Vehicle access obtained by crossing a railway line: All zones, all precincts* […] *Where: The new vehicle access point from a site to a* road *transport corridor* […].

k. Amend TRAN -R14[31] ~~*Rail level crossings*~~ Rail vehicle crossing setbacks and sightlines *New vehicle access points must be located a minimum of 30m from a railway level crossing, as measured from the closest rail track to the edge of the seal on the vehicle access point; and For railway level crossings controlled by ~~stop signs or~~ give way signs, any structures, vegetation or other visual obstructions must not be located* […].

l. For all zones[32], insert new provisions which require a minimum setback from railway corridor boundaries of 5 metres, including a restricted discretionary activity status for non-compliance with the setback and associated matters of discretion.

m. Modify the definition of *noise sensitive activity*[33] to include *educational activities; health care activities; indoor community activities including libraries and congregation spaces within any place of worship; Hospitals; Marae complex*.

n. For noise sensitive activities in listed zones[34], adding a new standard applying within 100 metres of the legal boundary of any railway corridor boundary (including matters of discretion).

o. For indoor railway vibration in listed zones[35], adding a new standard applying within 60 metres of the legal boundary of any railway corridor boundary (including matters of discretion).

p. Replace definition[36] heading for *Road approach visibility line* with Approach sightline.

[29] Submission 51.32.
[30] Submission 51.33.
[31] Submission 51.34.
[32] Submission 51.49.
[33] Submission 51.04.
[34] Submissions 51.44 and 51.46.
[35] Submission 51.45.
[36] Submissions 51.06 and 51.07.

q. Replace definition[37] heading for *Restart View Line* with Restart sightline.

r. Amend definition[38] of *Transport Corridor* to include railway corridors.

Designations

s. Retain Chapter 55 Designations as notified[39].

t. Remove Significant Natural Area Overlays from KiwiRail's designation (referenced KRH01)[40].

u. Seek removal[41] of designation WDC-51 from the extent of KRH01.

Natural Character

v. Amend NATC-R5[42] Exemptions *as follows: The following activities are exempt from the provisions of NATC – Table 1:* […] *and The operation and maintenance of existing district roads, bridges,* railway corridors *and state highways;.*

5.1 KiwiRail made a further submission opposing New Zealand Historic Places Trust (NZHPT)'s submission[43] which sought to amend NU-P12(2) by including reference to effects management in relation to *the route, site and method selection*. KiwiRail opposed this on the basis that it is unreasonable to require a re-examination of a route or its existing alignment when assessing whether works are necessary.

6 COUNCIL ASSESSMENT AND RECOMMENDATIONS

6.0 The Council's s42A authors make the following recommendations in response to KiwiRail's submissions:

Strategic Direction

a. Ms O'Callaghan[44] recommends an amendment to SD-O30 rather than KiwiRail's request for a new objective (which generally sought that land use activities avoid, remedy or mitigate adverse effects on regionally significant

[37] Submission 51.08.
[38] Submission 51.12.
[39] Submissions 51.50 and 51.52
[40] Submission 51.51.
[41] Submission 51.53.
[42] Submission 51.37.
[43] Submission 11.01 on primary submission 3.29.
[44] S42A, Strategic Direction, paragraph 39.

infrastructure). I support Ms O'Callaghan's recommended amendment to SD-O30 as it is consistent with the direction of the WRPS (specifically UFD-O1 (3), (5) and (7)).

b. SD-O21[45] has been modified to include reference to *additional infrastructure* (including a new definition of *additional infrastructure*); I agree this is a sensible inclusion and support the amended wording for SD-O21.

Network Utilities

c. NU-P1 and NU-P19 are proposed to be retained as notified.

d. NU-P5 is proposed to be deleted[46] as it appears in the Signs Chapter (SIGN-P2); I support the deletion of NU-P5 to avoid duplication.

e. NU-P12 is proposed to be modified[47] by replacing the works "provide for" with "consider". While this is more restrictive, I agree with Ms Wratt that it better reflects the limitations within the remainder of the policy and wider plan provisions.

f. Ms Wratt[48] does not consider it necessary to amend NU-R3 to include repair, as the defined term *maintenance* includes repair. She also considers that other provisions provide for the upgrading of network utilities. I agree that the definition of maintenance would include repair and do not address this further.

g. Ms Wratt proposes an amendment to the activity status of NU-R3 (from discretionary to restricted discretionary)[49] on the basis that *having a lesser activity status will provide greater consistency with NU-R33 and NU-R37*. I have reviewed the case study Ms Wratt has provided and agree with her reasoning.

h. NU-R12 and NU-R17 have been retained as notified with only minor amendment and I do not address these further.

i. Ms Wratt proposes to delete NU-R13[50] on the basis it is duplicated in TRAN-R9. I have assessed TRAN-R9 and agree that NU-R13 and TRAN-R9 are

[45] S42A, Strategic Direction, paragraphs 23 and 24.
[46] S42A, Network Utilities, paragraph 248.
[47] S42A, Network Utilities, paragraph 323.
[48] S42A, Network Utilities, paragraphs 151 and 152.
[49] S42A, Network Utilities, paragraphs 163 and 164.
[50] S42A, Network Utilities, paragraph 13(d).

duplicates and the intended outcome of these provisions is better addressed through TRAN-R9. I also agree that amendments and additions to TRAN-R9 permitted activity standards (2) to (5) are required to ensure the intent of the rule (to control structures <u>adjacent to</u> (not within) the rail corridor/indicative road) is achieved.

<u>Transport</u>

j. Objectives and policies TRAN-O2, TRAN-O4, TRAN-O5, TRAN-P2(7), TRAN-P3, TRAN-P7 and TRAN-P10 are either retained as notified or have minor beneficial changes (eg. TRAN-P10 is now proposed to include active modes). I do not address these further.

k. Ms Wratt addresses[51] both amendments sought by KiwiRail to TRAN-R9 to ensure it would apply to structures within the rail corridor and also KiwiRail's request for a 5m setback of buildings from the rail designation boundary in all (listed) zones. I generally agree with her recommendations and provide some further commentary in Section 7 below.

l. Ms Wratt[52] agrees with KiwiRail's submission to amend TRAN-R10 to refer to new vehicle access points being from a <u>road</u> transport corridor. I agree this is a helpful clarification for rule interpretation.

m. KiwiRail's amendment to TRAN-R14 to delete reference to stop signs has been accepted by Ms Wratt. Ms Butler[53] has confirmed KiwiRail's acceptance of this technical change. KiwiRail also sought to modify the heading from *Rail level crossings* (as notified) to <u>Rail vehicle crossing setbacks and sightlines</u>. Ms Wratt proposes a further amendment of the heading to *Setbacks and sightlines near level rail crossing .* This is suitable but I consider it could be further refined by replacing "near" with "for":

Setbacks and sightlines <u>for</u> ~~near~~ level rail crossing

n. Ms Wratt[54] proposes to modify the definition of *noise sensitive activity* to include noise sensitive activities, which addresses KiwiRail's submission.

[51] S42A, Transport, paragraphs 106 to 110.
[52] S42A, Transport, paragraph 118.
[53] Statement of Evidence of Pam Butler dated 4 November 2024 at [5.5(d)].
[54] S42A, Transport, paragraph 157.

o. Ms Wratt has recommended a 40m setback from the rail corridor for noise sensitive activities (rather than 100m)[55] in listed zones[56] and proposes two new noise rules[57]. Ms Wratt[58] further recommends a mapped overlay within the Proposed Plan (maps) to ensure the noise control is not overlooked. I address these matters further in Section 7.

p. Ms Wratt[59] has not accepted KiwiRail's submission seeking a new standard for Indoor railway vibration (within 60 metres of the railway corridor boundary). I address this further in Section 7.

q. The definition changes for *Road approach visibility line* (to Approach sightline and *Restart View Line* (to Restart sightline) have been accepted by Ms Wratt[60] and Ms Butler[61] has confirmed KiwiRail's agreement to this.

r. I agree with Ms Wratt's[62] amendment to include railway corridors within the definition of *Transport Corridor*. This aligns with the purpose of the Transport Chapter.

Designations

s. Ms Butler, by separate letter (from KiwiRail as requiring authority), has confirmed that KiwiRail accepts Mr Bell's recommendations. I do not address these further.

Natural Character

t. Ms O'Callaghan[63] recommends amending NATC-R5 *Exemptions* to include railway corridors; I agree with her recommendation as it aligns with the remaining exemptions in that rule.

6.1 Ms Wratt[64] considers that NU-P12(2) does not require further amendment (as sought by NZHPT) as the Network Utilities Chapter provides substantive cross references to other chapters objectives and policies. I agree the Proposed Plan

[55] S42A, Transport, paragraph 150.
[56] Submissions 51.44 and 51.46.
[57] S42A, Transport, paragraph 154.
[58] S42A, Transport, paragraph 155.
[59] S42A, Transport, paragraph 149.
[60] S42A, Transport, paragraphs 159 and 160
[61] Statement of Evidence of Pam Butler dated 4 November 2024 at [5.5(e)].
[62] S42A, Transport, paragraph 161.
[63] S42A, Natural Character, paragraph 48.
[64] S42A, Network Utilities, paragraph 324.

should be read as a whole and therefore the changes sought by NZHPT are not necessary.

6.2 I address points (k), (o) and (p) in Section 7 below.

7 RESPONSE TO SECTION 42A REPORTS

Transport TRAN-R9

7.0 Ms Wratt[65] supports amendments to TRAN-R9 (5m setback) to ensure that buildings within 5m of the rail corridor are a restricted discretionary activity and beyond 5m, buildings are permitted.

7.1 I have prepared a s32 assessment[66] which addresses the reasons why a setback is the most appropriate outcome (**Attachment B**). The key points of my s32 assessment are as follows:

a. rail is a nationally significant physical resource; it is at risk from incursions from adjoining land uses (eg. dropped items, building encroachment of maintenance activities);

b. this risk will increase under as areas adjacent to the rail corridor develop further; and

c. a 4.5m to 6.2m boundary setback[67] to undertake building maintenance and to minimise risk of dropped objects has been assessed as the most efficient and effective option to manage risk.

7.2 As described by Ms Butler,[68] KiwiRail generally seeks a 5m setback as a pragmatic balance based on the technical evidence which supported the s32 Report prepared by Galvin Consulting Limited.

7.3 I have considered whether the 5m setback standard is better located within the Transport Chapter (as proposed by Ms Wratt) or included as a zone standard in each zone chapter (as sought in KiwiRail's submission). From a plan user and administration perspective, I prefer the setback standard is located in each zone chapter as this is more visible for plan users (particularly those less

[65] S42A, Transport, paragraphs 106 to 110.
[66] Attachment B, Assessment under Section 32 of the Resource Management Act 1991 Rail Safety Setback July 2024.
[67] As addressed in the *Galvin Consulting Ltd report Advice for KiwiRail on the safety implications of construction and maintenance-related activities adjacent to rail*, Figure 10, appended to the *Assessment under Section 32 of the Resource Management Act 1991 Rail Safety Setback July 2024* (**Attachment B**).
[68] Statement of Evidence of Pam Butler dated 4 November 2024 at [4.13].

familiar with the Proposed Plan). I note that the comparable *minimum setback from road boundaries*[69] standards for residential, general rural and industrial zones are located within the respective zone chapters (acknowledging the road setback is not required in all zones).

7.4 I also recommend an amendment to Ms Wratt's provision TRAN-R9 which modifies the rule heading to refer to the rail designation boundary (which can be clearly identified), rather than the *rail corridor* (which is undefined and less certain).

> *TRAN-R9. Erection of structures on or adjacent to a railway* designation boundary ~~*corridor*~~ *or an indicative road*

Noise and Vibration

7.5 The evidence of Dr Chiles has established that:

a. noise has adverse health and amenity effects on people and based on his analysis, Dr Chiles concludes the appropriate provisions to manage noise effects should apply 100m from the edge of the rail designation boundary[70]; and

a. vibration has adverse health and amenity effects on people living near the rail corridor[71]; Dr Chiles considers that provisions to manage vibration effects should apply 100m from the edge of the rail designation boundary[72].

7.6 I have also reviewed the s32 assessment prepared by Louise Taylor and Lisa Thorne regarding *Standard Railway Noise and Vibration Reverse Sensitivity Provisions*[73] which is included as **Attachment C** to my evidence. I support its conclusions and rely on them to support the application of the noise and vibration provisions sought by KiwiRail.

Noise

7.7 Ms Wratt proposes[74] a suite of provisions based on the Waikato District Plan which requires management of noise where noise sensitive activities are

[69] As notified RESZ-R20, GRUZ-R37 and INZ-R21.
[70] Statement of Evidence of Dr Stephen Chiles dated 4 November 2024 at [6.1].
[71] Statement of Evidence of Dr Stephen Chiles dated 4 November 2024 at [4.1].
[72] Statement of Evidence of Dr Stephen Chiles dated 4 November 2024 at [6.4].
[73] Dated 16 August 2023.
[74] S42A, Transport, paragraph 154.

proposed within 40m of a rail designation boundary. This includes consolidating provisions within the Noise Chapter (rather than in zone specific chapters).

7.8 I support Ms Wratt's approach[75] to delete the zone-specific noise provisions from the Proposed Plan and adopt the more common approach across the country of noise controls being located within the Noise Chapter.

7.9 I do not support Ms Wratt's application of the noise standards to 40m from the rail corridor; rather, I accept the evidence of Dr Chiles in that noise effects can occur for 100m (or further) from the edge of the rail designation boundary and strongly prefer the application of noise controls to 100m.

7.10 Further, Ms Butler, who I understand was directly involved in Waikato District Plan appeal negotiations on rail noise, has described[76] that the 100m Rail Corridor Noise Control Boundary adopted in Waikato District Plan is applicable for <u>all active train lines</u>. Ms Butler[77] has further described that all rail lines in the Waitomo District are active.

7.11 In addition to the 100m application of the noise standard, Dr Chiles and I have identified some minor amendments to Ms Wratt's noise provisions and these are appended as **Attachment A.** Dr Chiles and I have also had discussions with Ms Cowper (for NZTA) and I anticipate my Appendix A will be aligned with the relief she has appended to her evidence.

<u>Vibration</u>

7.12 KiwiRail's submission proposes a 60m vibration control which is not agreed by Ms Wratt. I accept Dr Chiles' assessment that vibration can have adverse health and amenity effects on people (100m or further from the rail corridor) that requires avoidance, remediation or mitigation under the RMA. I note also that Ms Butler[78] has indicated KiwiRail will accept a 60m "Rail vibration alert overlay" instead of vibration controls.

7.0 As Ms Butler has described, the Alert Overlay would be included within the Proposed Plan maps (60m from the rail designation boundary); I propose this

[75] S42A Report Transport, paragraphs 144 and 145.
[76] Statement of Evidence of Pam Butler dated 4 November 2024 at [5.8(a)].
[77] Statement of Evidence of Pam Butler dated 4 November 2024 at [3.2] – [3.3].
[78] Statement of Evidence of Pam Butler dated 4 November 2024 at [5.12].

overlay could be explained within an additional final paragraph under the Overview.

7.1 There are no rules or other provisions associated with the Alert Overlay. It is simply an information tool which enables landowners to make their own design and location decisions should they wish to mitigate such effects. This enables behaviour change and appropriate warning to landowners choosing to locate in proximity to the railway corridor.

7.2 While I prefer 100m rail vibration controls based on the evidence of Dr Chiles, I have provided (in my **Attachment A**) provisions which reflect a 60m Rail Vibration Alert Overlay. I anticipate this would be shown on as a mapped layer in the Proposed Plan.

8 CONCLUSION

8.0 In conclusion:

a. I agree with or accept the recommendations of Ms O'Callaghan in relation to the Strategic Direction and Natural Character Chapters and Ms Wratt for the Network Utilities Chapter.

b. I agree with or accept the recommendations of Ms Wratt in relation to the Transport Chapter except for the following changes:

i. amend the heading of TRAN-R9 to refer to the rail designation boundary (instead of rail corridor) when referring to a rail setback;

ii. minor technical amendment to the heading of TRAN-R14 (rail sightlines):

iii. modify the mapped Rail Noise Overlay to extend to 100m from the rail designation boundary (instead of the recommended 40m);

iv. amendments to the proposed NOISE-RX *Construction of a new building containing a sensitive land use within a State Highway or Rail Corridor Noise Control Boundary* and NOISE-RX *Alterations, additions or change in use of an existing building to add or increase a sensitive land use within a State Highway or Rail Corridor Noise Control Boundary*;

v. include a mapped Rail Vibration Alert Overlay 60m from the rail designation boundary; and

vi. include a new explanatory paragraph explaining the Rail vibration alert overlay within the Noise Chapter under the heading *Overview.*

c. KiwiRail has, as requiring authority, addressed the recommendations on its designations by separate correspondence.

d. The amendments proposed in the respective s42A Reports reflect changes which will either improve plan implementation and/or improve consistency with the WRPS direction.

Cath Heppelthwaite

4 November 2024

Attachment A: Amendments Sought

Base text (black) Section 42A Appendix 1 Recommendation
Recommended amendments; red underline / ~~strikethrough~~

MAPS
Two overlays are included in the Proposed Plan Maps to show:

a. A Rail Vibration Alert Overlay which extends 60m outwards from the edge of the rail designation boundary;

b. A Rail Corridor Noise Control Boundary Overlay which extends 100m outwards from the edge of the rail designation boundary.

TRAN-R9
Erection of structures on or adjacent to a railway designation boundary ~~*corridor*~~ *or an indicative road*

TRAN-R14
Setbacks and sightlines for ~~*near*~~ *level rail crossing*

NOISE-RX

Construction of a new building containing a sensitive land use within a State Highway or Rail Corridor Noise Control Boundary

1. *Activity status: PER*
   Activity-specific standards:
   a. *New buildings are designed, constructed and maintained to ensure that any part of the building located within the State Highway or Rail Corridor Noise Control Boundary and containing an activity listed in NOISE Table 1:*
      i. *complies with the maximum future indoor design noise levels in NOISE Table 1 and meets the ventilation requirements in NOISE Table 2; or*
      ii. *is located so the nearest exterior façade of that part of the building is at least 50m from the formed carriageway of the State Highway and 50m from the formed railway track and there is a solid building, fence, wall or landform that blocks the line of sight from all parts of all windows and doors to that activity to:*
         1. *All parts of the formed carriageway of the State Highway.*
         2. *All points 3.8m directly above the formed railway track; or*
      iii. *is located so it can be demonstrated by way of prediction or measurement by a suitably qualified and experienced acoustic consultant that noise at all exterior façades of that part of the building will be no more than 15 dB above the relevant maximum indoor design noise levels in NOISE Table 1; or*
      iv. *accords with the construction schedule in NOISE Table 3 and meets the ventilation requirements in NOISE Table 2.*

b. *Prior to the construction of any building to which this standard applies, a design report shall be submitted to the Council demonstrating compliance with the maximum indoor design noise levels specified in NOISE Table 1, applying the assumptions in NOISE-RX.2. Alternatively, the design report may be substituted with confirmation that the construction ~~or alteration~~ of~~, or change of use within,~~ the building will meet the construction schedule requirements in NOISE Table 3.*

c. *A commissioning report must be submitted to the Council prior to occupation of the building demonstrating compliance with all of the mechanical ventilation system report requirements in Noise Table 2.*

2. *Assumptions:*
   a. *For State Highways, the design road noise is to be based on measured or predicted external noise levels plus 3 dB.*
   b. *For the Rail Corridor:*
      i. *The source level for railway noise is 70 LAeq(1h) at a distance of 12 metres from the nearest track; and*
      ii. *The attenuation over distance is:*
         - *3 dB per doubling of distance up to 40 metres and 6 dB per doubling of distance beyond 40 metres; or*
         - *As modelled by a Suitably Qualified and Experienced Acoustic Consultant using a recognised computer modelling method for freight trains with diesel locomotives, having regard to factors such as barrier attenuation, the location of the dwelling relative to the orientation of the track, topographical features and any intervening structures.*

3. *Activity status where compliance not achieved: RDIS*
   Council's discretion is restricted to the following matters:

   a. *Adverse effects on health and amenity of people indoors within the Noise Control Boundary overlay.*
   b. *Alternative options for building design or location that would achieve compliance with the standards in NOISE Table 1.*
   c. *Adverse effects on the continuing operation of the State Highway network, or railway corridor as a result of non-compliance with the standards.*
   d. *Any natural or built features of the site or surrounding area that will mitigate noise effects.*
   e. *The outcome of any consultation undertaken with NZTA or KiwiRail.*

NOISE-RX

Alterations, additions or change in use of an existing building to add or increase a sensitive land use within a State Highway or Rail Corridor Noise Control Boundary

1. *Activity status: PER*
   Activity-specific standards:

   a. *The alteration, addition or change of use of an existing building does not increase the gross floor area of an activity listed within NOISE Table 1 within the State Highway or Rail Corridor Noise Control Boundary; or*

b. *An internal alteration to an existing residential unit does not increase the total gross floor area of activities listed in NOISE Table 1 by more than 5m^2 within each 10 year period from [operative date] within the State Highway ~~Noise Effects Area~~ or the Rail Noise ~~Effects Area~~ Control Boundary; or*

c. *Other than internal alterations 5m^2 or less within each 10 year period from [operative date] provided for in (b) above, the alteration, addition or change of use of an existing building increases the gross floor area of an activity listed within Table 1 within the State Highway or Rail Corridor Noise Control Boundary, but the part of the building containing that activity:*
    i. *Is designed, constructed and maintained to comply with the indoor design noise levels specified in NOISE Table 1 and meets the ventilation requirements in NOISE Table 2; or*
    ii. *Is in a location where the nearest exterior façade of that part of the building is at least 50m from the formed carriageway of the State Highway and 50m from the formed railway track and there is a solid building, fence, wall or landform that blocks the line of sight from all parts of all windows and doors to that activity to:*
        1. *All parts of the formed carriageway of the State Highway.*
        2. *All points 3.8m directly above the formed railway track; or*
    iii. *Is in a location where it can be demonstrated by way of prediction or measurement by a suitably qualified and experienced acoustic consultant that the noise at all exterior façades of that part of the building is no more than 15 dB above the relevant noise levels in NOISE Table 1; or*
    iv. *Is designed, constructed and maintained in accordance with the construction schedule in NOISE Table 3 and meets the ventilation requirements in NOISE Table 2.*

d. *Prior to the alteration, addition or change of use of an existing building to which this standard applies, a design report shall be submitted to the Council demonstrating compliance with the maximum indoor design noise levels specified in NOISE Table 1, applying the assumptions in NOISE-RX.2. Alternatively, the design report may be substituted with confirmation that the alteration, addition or change of use within the building will meet the construction schedule requirements in NOISE Table 3.*

e. *A commissioning report must be submitted to the Council prior to occupation of the building demonstrating compliance with all of the mechanical ventilation system report requirements in Noise Table 2.*

2. *Assumptions:*
    a. *For State Highways, the design road noise is to be based on measured or predicted external noise levels plus 3 dB.*
    b. *For the Rail Corridor:*
        i. *The source level for railway noise is 70 LAeq(1h) at a distance of 12 metres from the nearest track; and*
        ii. *The attenuation over distance is:*
            - *3 dB per doubling of distance up to 40 metres and 6 dB per doubling of distance beyond 40 metres; or*
            - *As modelled by a Suitably Qualified and Experienced Acoustic Consultant using a recognised computer modelling method for freight trains with diesel locomotives, having regard to factors*

such as barrier attenuation, the location of the dwelling relative to the orientation of the track, topographical features and any intervening structures.

3. *Activity status where compliance not achieved: RDIS*
   Council's discretion is restricted to the following matters:
   a. *Adverse effects on health and amenity of people indoors within the Noise Control Boundary overlay.*
   b. *Alternative options for building design or location that would achieve compliance with the standards in NOISE Table 1.*
   c. *Adverse effects on the continuing operation of the State Highway network, or railway corridor as a result of non-compliance with the standards.*
   d. *Any natural or built features of the site or surrounding area that will mitigate noise effects*
   e. *The outcome of any consultation undertaken with NZTA or KiwiRail.*

NOISE Table 1 – Maximum indoor design noise levels for State Highway and rail corridor noise

Type of Noise Control Boundary	*Activity*	*Rail Corridor maximum indoor design noise level*	*State Highway maximum indoor design noise level*
State Highway and Rail Corridor	*Bedrooms*	*35dB LAeq*	*40dB LAeq*
	Lecture rooms / theatres, music studios, assembly halls	*35dB LAeq*	*35dB LAeq*
	Conference rooms, drama studios, libraries and designated sleeping rooms for children aged 6 years or younger in schools, early childhood centres or tertiary institutions	*40dB LAeq*	*40dB LAeq*
	Sensitive activities in hospitals including overnight medical care, wards, clinics, consulting rooms, theatres, nurses' stations	*40dB LAeq*	*40dB LAeq*
	Places of assembly including churches,	*35dB LAeq*	*35dB LAeq*

	places of worship and marae		
	Other habitable rooms	*40dB LAeq*	*40dB LAeq*

NOISE Table 2: Mechanical ventilation system

Activity	*Ventilation requirements where windows must be closed to achieve indoor noise levels set out in Noise Table 1*
Habitable rooms for a residential activity	*a. Provides mechanical ventilation to satisfy clause G4 of the New Zealand Building Code; and* *b. is adjustable by the occupant to control the ventilation rate in increments up to a high air flow setting that provides at least 6 air changes per hour; and* *c. provides relief for equivalent volumes of spill air; and* *d. provides cooling and heating that is controllable by the occupant and can maintain the inside temperature between 18^{o}C and 25^{o}C; and* *e. does not generate more than 35 dB LAeq(30s) when measured 1 metre away from any grille or diffuser.*
Other spaces	*To be determined by a suitably qualified and experienced person.*

Alert Layer

Overview The generation of noise is often an inherent part of the operation and function of the diverse range of activities located within the district.
[…]
Please note that the noise rules for wind turbines are located in the energy chapter. The noise rules for temporary diesel generators are contained in the energy chapter (where their use is associated with an energy activity) and in the network utilities chapter (where their use is associated with a network utility). Noise rules for new roads and altered roads that are within the scope of NZS 6806:2010, substations, energy storage batteries and compressors associated with gas transmission pipelines are also contained in the network utilities chapter. In all other circumstances, the provisions of this chapter apply.

A Rail Vibration Alert Overlay has been applied which identifies the vibration-sensitive area within 60 metres each side of the railway designation boundary as properties within this area

may experience rail vibration effects. No specific district plan provisions apply in relation to vibration controls as a result of this Rail Vibration Alert Area. The Rail Vibration Alert Overlay is to advise property owners of the potential vibration effects but leaves with the site owner to determine an appropriate response.

Attachment B: Assessment under Section 32 of the Resource Management Act 1991 Rail Safety Setback July 2024

Assessment under Section 32 of the Resource Management Act 1991

Rail Safety Setback

July 2024

Contents

1. Summary

KiwiRail Holdings Limited (KiwiRail) is a network utility operator and the Requiring Authority[1] for the railway network throughout New Zealand. The rail network is an asset of regional and national importance and is fundamental to the safe and efficient movement of people and goods throughout New Zealand. KiwiRail operates over 3500km of rail network and infrastructure within the rail corridor.

In recent years, there has been an increased focus on enabling housing and intensification in urban areas, particularly in and around transport nodes. From a planning perspective, higher density development has been enabled through the National Policy Statement for Urban Development and the Resource Management (Enabling Housing Supply and Other Matters) Amendment Act 2021. As a result, we can expect to see increased intensification occurring adjacent to the rail corridor. The interface between the rail network and adjoining land uses needs to be carefully managed. In addition to noise and vibration effects (which are outlined in the *Standard Railway Noise and Vibration Reverse Sensitivity Provisions and Section 32 Report* (dated 16 August 2023)), there are critical health and safety issues for both communities and users of the rail network which can arise as a result of this interface without good management.

In addition to the more commonly understood risk of people entering the rail corridor, there are also risks for people undertaking activities on properties adjoining the rail network (e.g. building construction or maintenance, objects falling onto tracks). Interference with the rail corridor can have significant consequences and compromise the levels of service on the rail network. An integrated planning approach is critical to ensure that our urban environments are developed in a way that both provides for the ongoing operation and future development of our transport network while also ensuring that our communities are protected from health and safety effects.

KiwiRail proposes to introduce District Plan setback provisions for buildings and structures on sites adjoining the rail corridor to:

a. manage health and safety effects on communities from the potential conflict between the rail corridor and people; and
b. minimise rail operation and efficiency being compromised due to disruption resulting from unplanned incursions into rail corridor.

The provisions apply only where a new building is proposed or existing building extended on a site adjoining a rail designation boundary.

This assessment has been prepared in accordance with Section 32 and Schedule 1 of the Resource Management Act 1991 (RMA) to assess the inclusion of building setback provisions within District Plans. This report is informed by:

- the Galvin Consulting Ltd report *Advice for KiwiRail on the safety implications of*

[1] New Zealand Gazette, No. 31, 14 March 2013, page 943.

construction and maintenance-related activities adjacent to rail (Galvin Consulting Report) (Attachment 2); and

- the Insight Economics *High Level Assessment of Proposed Building Setbacks Adjacent to the Rail Network* (Insight Report) (Attachment 3).

As part of the section 32 analysis, this report identifies the issues to be addressed, being:

- community health and safety; and
- protection of the rail corridor as a physical resource / significant infrastructure.

This report also considers options beyond district plan provisions[2].

[2] Section 2 and Attachment 4.

2. Issue identification

2.1 Context

As set out in the Galvin Consultancy Report, buildings and structures involve construction activities and, once construction is complete, maintenance, repair and replacement activities throughout a building's life (50+ years).

During construction and ongoing maintenance/repair, people interacting with (including simply walking around) construction equipment and temporary structures require space to undertake these activities safely. These activities are undertaken on sites adjoining the rail corridor.

KiwiRail manages its infrastructure generally within a designated rail corridor. Infrastructure contained within the corridor includes tracks, bridges, tunnels, overhead gantries and signalling systems designed to facilitate the efficient movement of freight and passengers. While KiwiRail primarily focuses on freight transportation and scenic journeys, it also provides infrastructure for urban commuter services in certain regions (eg Auckland and Wellington) and parts of its network are electrified.

The rail corridor has a very different risk profile compared to other sites or land uses. The rail corridor is a hazardous environment. Entry into the rail corridor poses a high consequence risk and significant safety issue to both the person accessing the corridor, and to the rail operations being undertaken. Inappropriate land use and development can adversely impact the safe and efficient operation of the rail corridor.

In addition, it is a common public perception that the rail corridor is 'public' land (without access limitation), particularly where there is no physical barrier to entry and/or trains volumes are lower.

Land adjacent to the rail corridor is increasingly being developed for higher density uses in our urban environments. Among other things, this is a result of the introduction of the National Policy Statement on Urban Development 2020 which directs certain local authorities to enable multi-storey developments in and around transport nodes.[3]

2.2 Risk

Risk arises in a range of circumstances where activities are located in close proximity to the rail corridor boundary. They include:

- building construction;
- building maintenance (including where there is insufficient space between the building and rail corridor to complete maintenance without entering the rail corridor, people installing, moving around and using mobile plant or temporary access structures); and
- falling objects from construction, maintenance and daily use of buildings and spaces.

[3] National Policy Statement on Urban Development 2020, Policy 3.

Sections 4 to 8 of the Galvin Consulting Report describe in detail the types of activities undertaken within[4] and adjacent[5] to the rail corridor along with the types of risk which arise[6]. All of these risks occur where buildings are too close to the corridor, resulting in landowners being unable to safely build, maintain or manage their structures without encroaching into the corridor.

Hazards with the potential to cause significant harm or fatalities include working at height, dropped objects, electricity, unstable ground, and mobile plant including rail vehicles. Events which can harm construction and maintenance workers can also damage the rail network and impact the safety of those working on or using rail. As set out in the Galvin Consulting Report, in New Zealand, there is a lack of situational awareness with respect to rail i.e. people are not aware of the safety hazards presented by rail operations and how their work may affect rail operations and the network. Compounding this limited awareness are particular characteristics of small businesses and DIYers who carry out construction and maintenance work.

Examples of resulting risks include:

a. if a person or object encroaches onto the rail corridor there is a risk of electrocution where there are electrified lines and / or risk of injury or worse from rail activities (this includes spray drift from water blasting which can be a risk to electrified lines);
b. the risk of injury (or death) to people from rail activities is also present where there are not electrified lines. Trains are large, travel at speed, and cannot quickly stop;
c. the potential for physical encroachment by ladders / scaffolding etc into the rail corridor;
d. items from adjoining land inadvertently falling into the rail corridor, such as items dropped from scaffolding, ladders or windows; and
e. safety issues for rail employees who need to remove obstructions, as well as train drivers and other people on trains if the obstruction is not removed in time

This assessment focuses on maintenance activities and falling objects as a result of building proximity.

2.3 Existing approaches to issue

It is common for District Plans to include provisions which limit uses of land to protect the operation of infrastructure beyond the designation boundary and also to provide safe and healthy environments for people. For example, a national grid corridor overlay is included in a range district plans[7] which restricts activities within a specified spatial extent of Transpower's network (around both pylons and lines). Airports and ports are another common infrastructure type which have restrictions on activities and/or required mitigation for certain activities included in District Plans for surrounding private land[8].

[4] Section 4.
[5] Section 5.
[6] Sections 6, 7 and 8.
[7] For example, Chapter D26 of the Auckland Unitary Plan.
[8] For example, Chapters D24 Aircraft Noise Overlay and D25 City Centre Port Noise Overlay of the Auckland Unitary Plan.

In addition to setbacks for infrastructure, setbacks for managing other environmental effects are also common. Examples include building setbacks (by yard and height in relation to boundary controls) between business (particularly industrial) zones and residential or open space zones.

KiwiRail commonly seeks a 5 metre setback for buildings and structures from the rail corridor boundary during plan change and review processes. A number of District Plans[9] include setback controls. The plan provisions are a permitted activity standard (meeting a setback). Where the permitted activity standard is not met a restricted discretionary activity status is triggered with matters of discretion, requiring engagement with KiwiRail to consider whether the encroachment can be safely accommodated and consideration of the safety of the rail network.

The proposed provisions are set out in full In **Attachment 1**.

2.4 Other Options

Where building owners are unable to complete maintenance within their site boundaries, as a land owner and requiring authority, other potential methods available to KiwiRail to manage effects (not including district plan provisions) include:

a. increasing the width of the KiwiRail designation;
b. rail corridor fencing; and
c. managing access to the rail corridor via corridor access request processes.

For the reasons detailed in **Attachment 4**, these options are considered less effective than the district plan provisions proposed.

3. Section 32 Requirements

Under the RMA, a section 32 evaluation must:

a. examine whether the proposed objectives are the most appropriate way to achieve the purpose of the RMA (s32(1)(a));

b. examine whether the proposed provisions are the most appropriate way to achieve the objectives by identifying other reasonably practicable options, assessing their efficiency and effectiveness and summarising the reasons for deciding on provisions (s32(1)(b));

c. relative to considering the efficiency and effectiveness of the provisions in achieving the objective, include an assessment of the benefits and costs of the effects anticipated from implementing the provisions (s32(2)); and

d. contain a level of detail that corresponds to the scale and significance of the environmental, economic, social, and cultural effects that are anticipated from implementing the proposal (s32(1)(c)).

[9] For example, Christchurch City District Plan Rule 14.4.2.7 *Minimum building setbacks from internal boundaries and railway lines* requires 4m setback

For plan changes, the proposal is to be evaluated against both the objectives of the proposed plan change and the objectives of the existing plan (s32(3)). Each of these matters is assessed in this report (other than s32(3)).

4. Objectives Assessment

Section 32(1)(a) of the RMA requires an examination of whether a proposed objective is the most appropriate way to achieve the purpose of the RMA. The purpose of the RMA is set out in Part 2, Section 5 of the Act.

> *5 Purpose*
> *(1) The purpose of this Act is to promote the sustainable management of natural and physical resources.*
> *(2) In this Act, sustainable management means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while—*
> *(a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*
> *(b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and*
> *(c) avoiding, remedying, or mitigating any adverse effects of activities on the environment.*

Section 5 of the Act specifically enables *people and communities to provide for their social, economic, and cultural well-being and for their health and safety*. The rail network is a significant *physical resource* which makes an essential contribution to the social and economic wellbeing of communities through the movement of people and goods across the country. The sustainable management purpose of the RMA also requires adverse effects to be avoided, remedied or mitigated. These can include potential adverse effects on peoples' health and safety.

The proposed objective will assist with achieving the *sustainable management* purpose of the RMA.

KiwiRail has prepared an objective and policy for inclusion in district plans (included in Attachment 1) to address the interface between the rail corridor and adjoining sites. It is anticipated the proposed objective and policy would be included within the District Wide Matters - Urban Form Chapter of the plan.

An assessment of the proposed objective against RMA section 5 is set out in Table 1, below.

Table 1: Assessment of Objective under Section 5	
Proposed Provision	**Reason**
Objective 1: Protect communities and infrastructure by mitigating: a. the adverse health and safety impacts associated with accessing the rail corridor; and b. risk of disruptions to the safe and efficient operation of regionally significant rail infrastructure. Policy 1 Require buildings and structures adjoining the rail corridor designation boundary to be setback to provide for the health and safety of people and communities and the safe and efficient operation of rail infrastructure.	Section 2.2 of this report describes health and safety effects where buildings are located on/in close proximity to the rail designation boundary. The objective (and supporting policy) is the most appropriate way to achieve the purpose of the RMA as it will enable buildings and structures to be maintained from within their own sites and therefore minimise health and safety effects associated with entering the rail corridor and provide for the safe and efficient operation of rail as a physical resource. Not having such an objective would not ensure sufficient consideration is given to these important matters. No other objective obviously appears to be a more appropriate way of achieving these outcomes.

The balance of Part 2 of the RMA provides the framework for the sustainable management of natural and physical resources. Section 6 lists matters of national importance that shall be recognised and provided for, section 7 lists other matters that all persons exercising functions and powers under the RMA shall have particular regard to and section 8 addresses matters relating to the principles of the Treaty of Waitangi. No relevant matters in sections 6 or 8 have been identified. The proposed objective has been assessed against the following provisions of section 7 in Table 2.

Table 2: Assessment of Objective under Part 2 Section 7	
RMA Provision	**Objective 1**
s7(b) (the efficient use and development of natural and physical resources)	Objective 1 will provide for the efficient use and development of physical resources (land and the rail network) by enabling the proximity effects of buildings and transport infrastructure to be managed appropriately. Management of this interface will protect the

	rail network and the safe and efficient movement of people, goods and services by rail.

The proposed objective addresses the identified resource management issues, is consistent with Part 2 of the Act and will result in the sustainable management of physical resources. It also appropriately reflects Council's obligations under s31 of the RMA, in particular its obligation to achieve integrated management of the effects of the use, development, or protection of land and associated natural and physical resources of the district.

The National Policy Statement – Urban Development is also a relevant consideration, given that the purpose of national policy statements under Section 45(1) of the RMA is to state objectives and policies for matters of national significance that are relevant to achieving the purpose of the Act. In this respect, national policy statements can be considered to give greater meaning to the purpose of the RMA on particular resource management issues.

Objective 1 of the NPS-UD promotes well-functioning urban environments. Policy 1 of the NPS sets out what, as a minimum, well-functioning urban environments constitute. In addition to these mandatory aspects, the safe, secure and efficient operation of rail infrastructure is considered to be an element of a well-functioning urban environment.

5. Provisions Assessment

Sections 32(1)(b) and 32(2) require assessment of the proposed plan provisions to be undertaken, specifically:

a. whether the proposed provisions are the most appropriate way to achieve the objectives by identifying other reasonably practicable options, assessing their **efficiency and effectiveness** and summarising the reasons for deciding on provisions; and
b. relative to considering the efficiency and effectiveness of the provisions in achieving the objective, include **an assessment of the benefits and costs of the effects** anticipated from implementing the provisions.

The cost and benefit assessment must identify and assess the costs and benefits associated with environmental, economic, social, and cultural effects including economic growth and employment that are anticipated to be provided or reduced. If practicable, these are to be quantified.

Section 32(2)(b) also requires an assessment of the risk of acting or not acting if there is uncertain or insufficient information. In this case, there is sufficient information about the subject to determine the range and nature of effects of the options set out and which confirms the need to act. The risk of acting or not acting does not need to be evaluated as the location of and safety requirements for the rail corridor are well understood. Not acting will increase risks to public safety as well as increasing the risk to the efficient operation of New Zealand's rail network, , due to unexpected shutdowns as a result of interference with the rail corridor.

5.1 Setback

5.1.1 Identifying reasonably practicable options

The reasonably practicable alternative options are identified as:

a. **Do nothing:** Rely on (any) yard setbacks and/or height in relation to boundary controls existing in district plans where adjoining rail designation boundary.
b. **Setback of 2.5m:** Require buildings and structures to be setback by 2.5m where adjoining rail designation boundary.
c. **Setback of 5m:** Require buildings and structures to be setback by 5m where adjoining rail designation boundary.

A. Do Nothing

A 'do nothing' option is essentially maintaining the status quo or choosing not to take any action in a given situation.

B. Setback of 2.5m

District Plans (notified and operative) include a variety of setbacks ranging from the 1m (MDRS minimum) to, for example, 4m[10]. A 2.5m setback has been selected as an indicative option to represent an option greater than MDRS but less than Option C (5m setback).

C. Setback of 5m

The Galvin Consulting Report assesses variable building heights, separation from boundaries and a common access method (scaffolding). As illustrated in Figure 1, for maintenance to be undertaken (particularly at height), there needs to be sufficient space available for access within the site boundaries. It concludes the distance from the face of the cladding is:

- 3.7 – 4.6 metres for two, three, and four-storey buildings; and
- 6.5 metres when including a zone for (some) dropped objects.

Figure 1 also shows the potential trajectory for dropped objects.

[10] For example, Operative Christchurch City District Plan Rule 14.4.2.7 *Minimum building setbacks from internal boundaries and railway lines* requires 4m setback

Figure 1: Separation and Trajectory

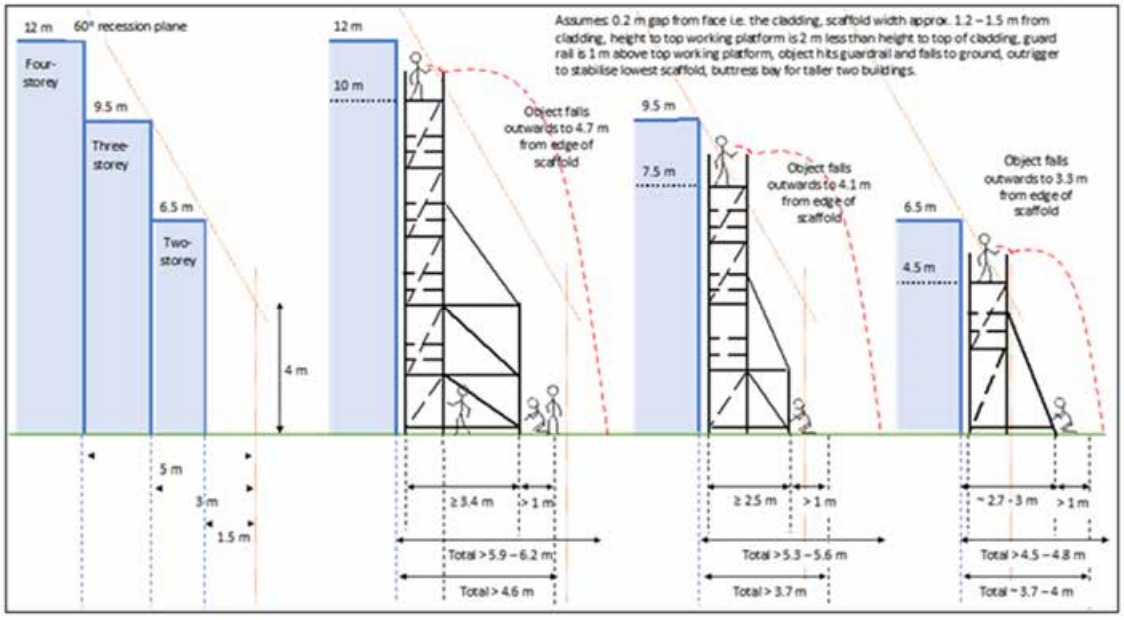

Figure 1 assumes a level site, good ground conditions and no other structures disrupting access. While the Galvin Consulting Report acknowledges other access methods are available, scaffolding has been selected as an access methodology as it is widely available (easily hired or purchased).

Figure 1 also demonstrates the variability in space required for scaffolding/drop zones for a variety of building forms. There is no 'one-distance' which reflects all circumstances. Given the range of setbacks and building form, 5m is considered to be a pragmatic approach to balance risk and impacts on land.

An assessment of the *efficiency and effectiveness* of the options assessed in terms of Sections 32(1)(b) and 32(2) is included in Table 3.

Table 3: Alternative Option Assessment			
Option	Effectiveness and Efficiency	Costs	Benefits
Option A: Do Nothing	Not effective in addressing issue as buildings could be located in positions which require access to the adjoining rail corridor to undertake maintenance. Does not address risk of dropped objects entering the rail corridor or inadvertent interference as a result of	Health and safety effects on communities as a result of conflict between transport infrastructure and people (with resultant costs). Decisions made during the design of a	No change in development yield. No costs resulting from change in building design to accommodate setback. No regulatory costs to implement.

Table 3: Alternative Option Assessment			
Option	Effectiveness and Efficiency	Costs	Benefits
	buildings/structures being located close to the rail corridor. Providing no (or insufficient) setback will not support an efficient outcome as incursions can lead to disruption / inefficient operation of the rail network and reduced health and safety of communities. Doing nothing requires no action from the territorial authority or applicant so could be efficient for authorities.	building can transfer risk (including cost) to those constructing, using and maintaining property adjacent to rail, and to those using or working on rail infrastructure and premises. Compromised rail operation and efficiency due to disruption resulting from unplanned incursions into rail corridor.	
Option B: Setback of 2.5m	More effective than Option A, however some buildings could be located in a position which requires access to the adjoining rail corridor to undertake maintenance in addition to an increased risk of dropped objects entering the rail corridor. Providing an insufficient setback will not support an efficient outcome as incursions can lead to disruption / inefficient operation of the rail network and reduced health and safety of communities. Reasonably efficient for territorial authorities, as some changes to setback provisions are required. Rules are effective in that they provide a high level of	Lower risk than option A but still risk of health and safety effects on communities as a result of conflict between transport infrastructure and people (with resultant costs). Some extra regulatory costs to implement 2.5m setback in district plans. Rules may potentially limit some activities and development. However, the Insight Economics assessment indicates a very limited range of sites will be impacted by the setback (less	No material change in development yield. Likely less costs relating from change in design to accommodate setback than Option C. Reduces health and safety effects on communities from conflict between transport infrastructure and people when compared with Option A. Reduces risk of rail operations and efficiency being compromised due to disruption resulting from unplanned incursions into rail corridor when

Table 3: Alternative Option Assessment			
Option	Effectiveness and Efficiency	Costs	Benefits
	certainty regarding the nature and scale of work and activities that can be undertaken with / without resource consent. They are also efficient as they enable a case by case assessment of the appropriateness of each proposal to be undertaken.	than 0.9%[11]) and of those 0.9% of sites, around 70% are already developed[12]. Actual cost will be low in terms of reduction of development capacity. As the provisions apply where a new building is proposed or existing building extended (on a site adjoining a rail designation boundary), costs will be low. Still risk of compromised rail operation and efficiency due to disruption resulting from unplanned incursions into rail corridor. Potential costs of applying for resource consent when setback standard is breached. Potentially some costs resulting from change in building design to accommodate setback.	compared with Option A. Provides some maintenance area available for building owners to safely undertake maintenance within site boundaries. Tailored rules, standards and assessment matters provide a clear framework to manage activities adjacent to the rail corridor and seek to strike a balance between efficient use and development and avoiding or minimising adverse effects on neighbouring areas.
Option C: Setback of 5m	Option C is effective as it: • provides a safer and more efficient rail network with reduction of the potential cost to railway operations	Some extra regulatory costs to implement 5m setback in district plans.	No material change in development yield. Minimises health and safety effects on

[11] Insight Report, Table 1: Number of Properties Adjacent to Rail Network by Territorial Authority (May 2024)
[12] Insight Report, Section 3.3

Table 3: Alternative Option Assessment			
Option	Effectiveness and Efficiency	Costs	Benefits
	that otherwise might be affected via obstructions within the railway corridor. • ensures there is sufficient space for people to safely and efficiently conduct their activities within their own land, whilst minimising the potential interference with the railway corridor. As set out in the Galvin Consulting Report, the Health and Safety at Work (General Risk and Workplace Management) Regulations 2016 (New Zealand Government, 2016) providing for separation of activities and engineering controls is more effective than administrative controls in managing risk. Reasonably efficient for territorial authorities, as some changes to setback provisions are required. Rules are effective in that they provide a high level of certainty regarding the nature and scale of work and activities that can be undertaken with / without resource consent. They are also efficient as they enable a case by case assessment of the appropriateness of each proposal to be undertaken.	Rules may potentially limit some activities and development. However, the Insight Economics assessment indicates a very limited range of sites will be impacted by the setback (less than 0.9%[13]) and of those 0.9% of sites, around 70% are already developed[14]. Actual cost will be low in terms of reduction of development capacity. As the provisions apply where a new building is proposed or existing building extended (on a site adjoining a rail designation boundary), costs will be low. Potential costs of applying for resource consent when setback standard is breached. Potentially some costs resulting from change in building design to accommodate setback.	communities from conflict between transport infrastructure and people when compared with Options A and B. Minimises risks to rail operations and efficiency being compromised due to disruption resulting from unplanned incursions into rail corridor when compared with Options A and B. Provides reasonably sufficient maintenance area available for building owners to undertake maintenance within site boundaries. Tailored rules, standards and assessment matters provide a clear framework to manage activities adjacent to the rail corridor and seek to strike a balance between efficient use and development and avoiding or minimising adverse effects on neighbouring areas. The matters of discretion for an infringement of the

[13] Insight Report, Table 1: Number of Properties Adjacent to Rail Network by Territorial Authority (May 2024)
[14] Insight Report, Section 3.3

Table 3: Alternative Option Assessment			
Option	Effectiveness and Efficiency	Costs	Benefits
			setback standards enable a dialogue to occur between landowners and KiwiRail to determine how development within the setback could proceed without compromising the safe and efficient operation of the rail corridor and health and safety of communities. This enables development to proceed on sites adjoining the rail corridor where it can be demonstrated the development can be undertaken safely.

5.1.2 Assessing reasonably practicable options

Based on the cost benefit analysis presented in Table 3:

- Option A: Will not achieve the objective and will result in adverse effects both on the health and safety of communities and on the safe and efficient operation of regionally and nationally significant infrastructure
- Option B: Would have increased health and safety effects on people and communities and on the safe and efficient operation of regionally significant infrastructure compared to Option C
- Option C: Would best achieve the outcome of the objective, with very limited costs.

6. Conclusion

The operation, maintenance and development of the rail network is critical to the safe and efficient movement of freight and passengers throughout New Zealand, and forms an essential part of the national transportation network.

In the context of work being undertaken adjacent to a railway corridor, separation of activities (designing-in an appropriate space) can be achieved through the use of a setback standard.

The proposed provisions will ensure there is sufficient space for people to safely conduct their activities within their own land, while minimising the potential interference with the railway corridor and risks to health and safety. This planning approach is appropriate to ensure the increasing growth and development around the rail network is managed in an integrated way.

Consistent with section 32 of the Act, the proposed objective and policies have been developed and analysed against Part 2 and it is considered that the proposed objective is the most appropriate way to achieve the purpose of the Act. The objective recognises the need to protect important physical infrastructure from incompatible land use and development to provide for the health and safety, and social and economic wellbeing of communities and to meet the foreseeable neds of future generations in accordance with s5(a) of the Act.

Option C (5m setback) is identified as the preferred approach to manage the potential health and safety effects, and to and provide a reasonable and appropriate balance between cost and benefit. The provisions apply only where a new building is proposed or existing building extended on a site adjoining a rail designation boundary.

Option C has been detailed and compared against alternatives in terms of their costs, benefits, and efficiency and effectiveness in accordance with the relevant clauses of section 32 of the RMA.

Option C is considered to represent the most appropriate means of achieving the proposed objective and of addressing the underlying resource management issues relating to the transport environment, human health and amenity.

There is sufficient information about the subject to determine the range and nature of effects of the options set out and which confirms the need to act. For completeness, the risk of not implementing Option C is that resource management issues relating to health and safety and protecting the operation of regionally and nationally significant infrastructure would continue to be inadequately addressed. It would also result in Council failing to comply with the provisions of Part 2 of the RMA (particularly s5(a) and s7(b).

Cath Heppelthwaite

Attachment 1: Plan Provisions (Option C)

Objective

Protect communities and infrastructure by mitigating:

a. the adverse health and safety impacts associated with accessing the rail corridor; and

b. risk of disruptions to the safe and efficient operation of regionally significant rail infrastructure.

Policy

Require buildings and structures adjoining the rail designation to be setback to provide for the health and safety of adjacent communities and efficient infrastructure operation.

Permitted Activity Standard – Building setback from Rail Designation Boundary

Buildings and structures must be set back 5 metres from the rail designation boundary.

Rule – Restricted discretionary activities

Buildings and structures not set back 5 metres from the rail designation boundary.

Matters of Discretion

Discretion is restricted to:

(a) The location and design of the building or structure as it relates to the ability to safely use, access and maintain buildings without requiring access on, above or over the rail designation boundary.
(b) The extent to which the reduced setback will compromise the safe and efficient functioning of the rail network, including rail corridor access and maintenance
(c) The outcome of any consultation with KiwiRail.

Matters of Assessment

(a) Location of the building or structure.
(b) Methods of providing for building maintenance within site boundaries on a permanent basis.
(c) The outcome of any consultation with KiwiRail.

Attachment 2: Galvin Consulting Ltd – Advice for KiwiRail on the safety implications of construction and maintenance-related activities adjacent to rail

Advice for KiwiRail on the safety implications of construction and maintenance-related activities adjacent to rail

24 July 2024

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Galvin Consulting Ltd

Table of Contents

1 Introduction

Design decisions begin early in a construction project, and include the location and layout of a development. Proximity of buildings to boundaries can impede the ability of owners and others to undertake construction and maintenance within the site. Allowances need to be made to provide adequate space for people, plant and equipment, and temporary structures to undertake work. This is particularly the case when adjacent to an operating railway.

This report outlines activities undertaken inside and adjacent to the rail corridor, and significant safety hazards which can arise from the interaction of these activities. The report considers scenarios for maintenance activities undertaken at height. These scenarios provide illustrations of the widths utilised by temporary structures, and space for the movement of workers and others around the structure.

The Health and Safety at Work Act 2015 requires that hazards are identified and that reasonably practicable actions address these hazards, and includes duties of designers with regards to this. The hierarchy (i.e. effectiveness) of controls are included in the Health and Safety at Work (General Risk and Workplace Management) Regulations 2016. The definition of a workplace in the Health and Safety at Work Act 2015 includes temporary workplaces such as those found on residential properties.

There are also international legislation and guidelines dealing specifically with development near rail.[1] These support taking account of particular considerations when managing the potential effects of work near rail on the rail operations, on the rail network, and on those living and working next to the railway.

[1] For example, NSW Government (2021) *State Environmental Planning Policy (Transport and Infrastructure) 2021;* Railway Association of Canada and the Federation of Canadian Municipalities (2013*) Guidelines for New Development in Proximity to Railway Operations; VicTrack Rail Development Interface Guidelines* (2019)

2 Executive Summary

Due to changes in national investment in rail and to relevant planning frameworks, the volume of activity both adjacent to and inside the rail corridor is forecast to increase. Adjacent to the corridor this includes multi-storey developments. Inside the rail corridor this includes the development of rail infrastructure as well as increased rail traffic volumes.

Safety hazards may arise from construction and maintenance activities undertaken adjacent to and inside the rail corridor. People (both workers and others) need to be protected from these hazards in accordance with applicable legislation, standards and good practice guidelines. Hazards with the potential to cause significant harm or fatalities include working at height, electricity, unstable ground, and mobile plant including rail vehicles. Events which can harm construction and maintenance workers can also damage the rail network and impact the safety of those working on or using rail.

Government entities in Victoria and New South Wales (Australia) more explicitly address works near rail and regulate certain activities. For example, the Government of New South Wales and the City of Melbourne require notification to the rail operator of certain works adjacent to rail corridors (Government of New South Wales, 2021) (City of Melbourne, 2022). Guidelines in Australia and Canada facilitate healthy and safe developments near rail.

In New Zealand, there is a lack of situational awareness with respect to rail i.e. people are not aware of the safety hazards presented by rail operations and how their work may affect rail operations and the network. This issue is demonstrated by incidents observed by KiwiRail.

Compounding this limited awareness are particular characteristics of small businesses and DIYers who carry out construction and maintenance work.

Firstly, organisations providing construction (including maintenance) services are predominantly small businesses (97.9% in 2020) (Ministry of Business, Innovation & Employment, 2022), and they commonly lack formal governance arrangements, are resource constrained, and have owners who do not seek specialist advice or know where to access it (Small Business Council of New Zealand, 2019). ACC explains that DIYers have a high incidence of injuries, they tend to rush (ACC, n.d.), and WorkSafe does not expect them to have a detailed knowledge of construction risks (WorkSafe New Zealand, 2019).

Secondly, there are limited legislative and regulatory regimes governing these types of activities.

- The Health and Safety at Work Act 2015, section 34 requires Persons Conducting a Business or Undertaking (PCBUs)[2] (e.g. organisations and in some circumstances homeowners (WorkSafe New Zealand, 2019)) to consult with other PCBUs when their duties overlap (New Zealand Government, n.d.). For example, a building company operating near the railway would be expected under the legislation to consult with KiwiRail as a PCBU also having duties in respect of the railway. This consultation can be used to identify hazards and manage risks in a design or during physical works. However, the Act does not provide any specific actions required to be undertaken to manage risks. There is a reliance on organisations and other PCBUs being aware of their statutory obligations, the risks, and being motivated to make arrangements with the other party/parties.

[2] Refer section 17 under the Health and Safety at Work Act 2015 for the full definition of PCBU.

- The New Zealand Building Code does not specify physical design features (including location) for buildings to ensure construction and maintenance work can be conducted safely. It also does not prescribe how maintenance is to be carried out (e.g. utilising certain plant and/or equipment) (Ministry of Business, Innovation & Employment, 2020). However, the Building Code does require regular maintenance as an ongoing requirement.
- In addition to the Building Code maintenance requirements, warranties for building elements such as wall cladding, and most house insurance policies require maintenance to be undertaken (Insurance Council of New Zealand, 2019).

Decisions made during the design of a building can transfer risk (including cost) to those constructing, using and maintaining property adjacent to rail, and to those using or working on rail infrastructure and premises. For example, a site configuration that locates a building very close by an operational rail corridor, compared to designing the site with a sufficient setback to allow for safe, efficient movement.

The Health and Safety at Work (General Risk and Workplace Management) Regulations 2016 (New Zealand Government, n.d.) considers that providing for separation of activities and engineering controls are more effective than administrative controls in managing risk. An example of administrative controls is individual awareness and use of spotters to ensure there is no person interacting with a safety hazard and causing an event e.g. a spotter watching for an impact with an electrical line, or arrival of a train on a live track. This is not deemed as effective as carrying out the work safely beyond the movement of people, plant or equipment that could come into conflict with the activity. That is, designing a physical environment for safe work is more effective than relying on controls to manage poor design.

In the context of work being undertaken adjacent to a railway corridor, separation of activities (designing-in appropriate space) can be achieved through a setback.

To establish a reasonable setback (of a building from the rail corridor), a variety of access methods have been considered. Scaffold is a common method (readily available and suitable/flexible) of accessing a building for maintenance. Accordingly, it is reasonable to consider scaffold when assessing access methods for maintenance activities. There are different configurations for accessing buildings using scaffold. The freestanding options for scaffold need to be assessed, not only the most narrow options. This is because a number of factors may limit the ability of a structure to be stabilised using other methods.

Designing for adequate space for work around buildings also needs to include the movement of people and recognise the context; work adjacent to a railway presents particular hazards, risks and working requirements.

The assessment summarised in this report for scaffold, including the motion of people around these structures, concludes the distance used from the face of the cladding is:

- 3.7 – 4.6 metres for two, three, and four-storey buildings; and
- 4.2 – 6.5 metres when including a zone for (some) dropped objects.

Provisions that require engagement with KiwiRail where encroachment of a building setback is proposed ensure that KiwiRail can provide input into whether the encroachment can be safely accommodated. This includes KiwiRail's knowledge of its current and future rail operations and network for a particular location. Engagement enables hazards to be identified, and risks assessed

and managed as part of the development's design in relation to physical works. Maintenance work and the setback are the focus of this report; controls directly associated with construction and demolition are not included in its recommendations.

In conclusion, an adequate building setback provision is a prudent control, particularly for property adjoining a railway corridor, and is consistent with principles in the Health and Safety at Work Act 2015.

3 Scope of report

3.1 Scope

The purpose of this report is to inform KiwiRail's review of appropriate building setbacks adjacent to the rail corridor.[3] KiwiRail requested advice on the appropriate setback distance to allow for construction and maintenance activities to be undertaken safely adjacent to the rail corridor, in particular with respect to maintenance activities undertaken at height.

This report outlines the context in which these activities are undertaken, including the physical environment. People's awareness of the risks posed by rail and the risks they present to those within the rail corridor are also relevant.

The report includes an assessment of horizontal space (in metres) used from the cladding of a building to accommodate certain activities undertaken adjacent to the rail corridor. The assessment considers a selection of scenarios, primarily freestanding scaffold for accessing a building (but not its roof).

The advice in this report is for KiwiRail to consider alongside its knowledge of the rail operations and network.

Specific access needs for each project, and therefore the amount of space and protections required, will depend on a range of variables that will need to be considered for any particular situation. These include:

a) the physical environment, including the nature of the rail premises and infrastructure
b) the activities being undertaken and their sequencing
c) the capabilities of those involved in the activities, including homeowners and scaffolders
d) the forms of access being adopted
e) footprints (including overhanging/cantilevered components) of temporary structures, plant, and equipment when established
f) movement of materials, plant, equipment, and people during activities, including: transport/mobilisation, construction, installation, commissioning, operation and use, maintenance, repair, decommissioning, demolition, dismantling
g) the potential for, and nature of, falling objects (including debris) during (f)
h) the risk to people and property from falling objects

3.2 Limitations

The report and assessment has been undertaken on a desktop basis, in reliance on relevant literature, and advice from various subject matter experts. A specific set of access scenarios has been assessed for activities expected to occur adjacent to the rail corridor, in order to provide an illustration of widths needed to accommodate these activities safely.

While information from construction sector participants has been sought in addition to referenced material, the results presented in the report are provided on a general basis, for the purposes of

[3] References to rail corridor in this report are references to the area within the boundary of designations for railway purposes contained within district plans in New Zealand.

plan provisions being applied at a district level, as opposed to definitive guidance for the specific projects.

This report excludes health hazards due to rail operations including noise, vibration and particulates, and it is not a comprehensive study of safety hazards. Tilt slab construction/modern methods of construction are not included in the analysis below as they are variable and the focus of this report is primarily on maintenance activities.

The author has relied on and referenced a range of documents in the preparation of this report; these are listed in Appendix 1 Bibliography.

The author acknowledges and is grateful to have received advice regarding scaffold, from certified scaffolder Wain Chambers, Senior Industry Co-ordinator, Scaffolding, Access & Rigging NZ Inc (SARNZ).

4 Activities within the rail corridor

New Zealand's rail network is used by trains carrying freight, commuters and tourists. The volume and nature of traffic on the individual railway lines differs, depending on its location. KiwiRail operates trains as required to meet demand, and this can result in changes to the timing, frequency, or length of trains passing along the route. KiwiRail manages a variety of rail infrastructure and premises. Part of the North Island's network is electrified using overhead line equipment (Figure 1). Signalling equipment is critical for KiwiRail's railway operations and the safety of those working on or using the railway lines.

The planning horizon for the *Government Policy Statement on Land Transport* is 10 years (New Zealand Government, 2021). Investment in KiwiRail has been significantly increased over the past several years in order to create a more resilient railway service with greater capacity.

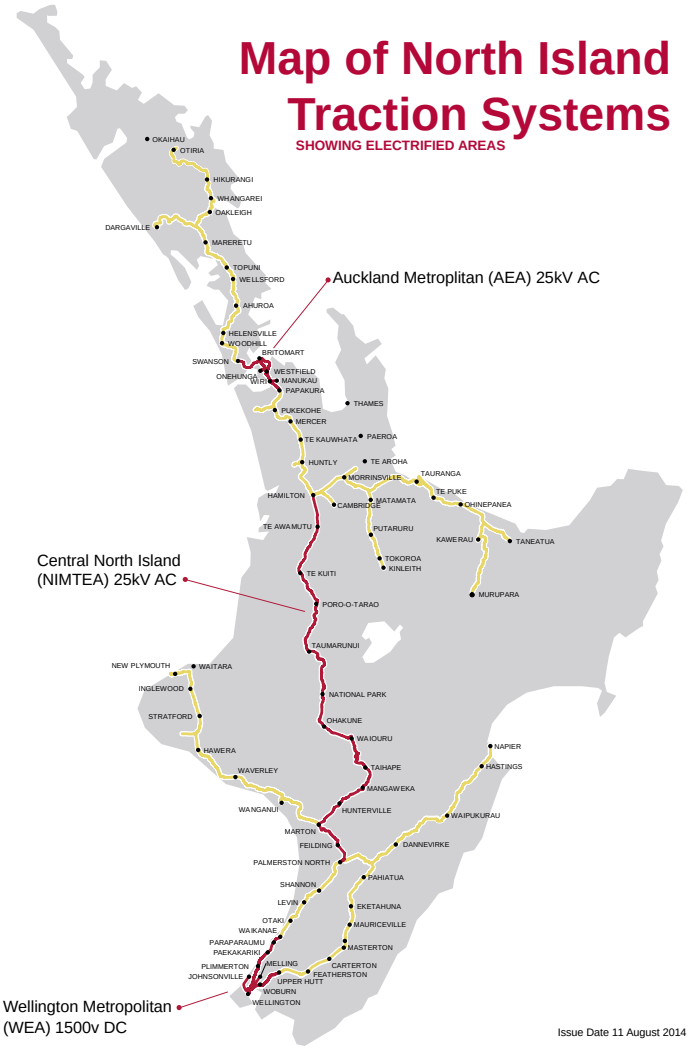

Figure 1 Electrification of rail network as at 11 August 2014 (Unknown, 2014)

KiwiRail manages its network in the context of a range of legislative, regulatory and planning frameworks including those under the Resource Management Act 1991 (RMA). KiwiRail is a requiring authority under the RMA and holds various designations within district plans. A designation is a RMA method which authorises works and activities undertaken by a requiring authority on a particular site(s), without the need for land use consent.

KiwiRail's rail designation boundaries generally encompass rail infrastructure (the railways lines and equipment) and premises as defined by the Railways Act 2005.

The areas within rail designation boundaries vary significantly in width. Sometimes the rail infrastructure, including overhead line equipment, is at the edge of the designation boundary. In other instances, the rail infrastructure is placed broadly within the centre of the designated area and is well-framed on either side by designated land (see Figure 2 and Figure 3).

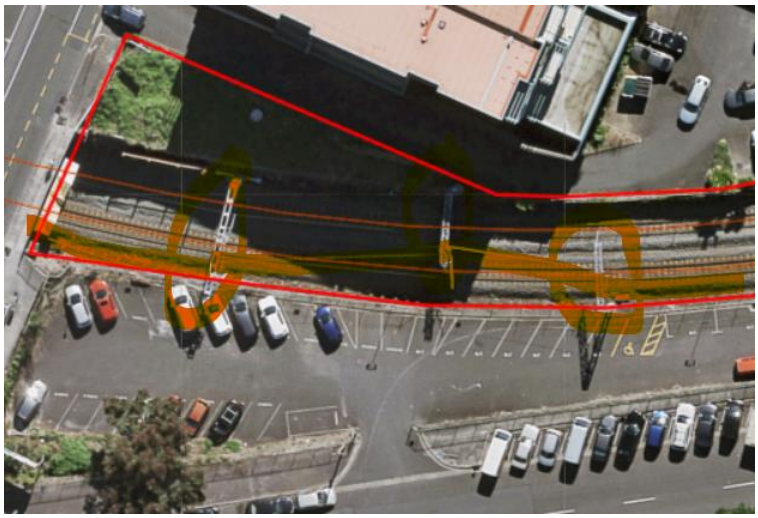

Figure 2 Enfield Street, Mt Eden, Auckland

Figure 3 West Coast Road, Canterbury

5 Activities adjacent to the rail corridor

Construction and ongoing building maintenance activities undertaken adjacent to the rail corridor can impact both the safety of people and the integrity of the rail network. People carrying out construction or maintenance activities include:

- Constructors (general contractors and specialist trades)
- Engineers and other technical advisors
- Materials suppliers
- Maintenance providers
- Operators of plant
- Property managers
- Landowners, homeowners and tenants, and their friends and families.

District plan changes to enable increased density of buildings are required under the *Resource Management (Enabling Housing Supply and Other Matters) Amendment Act 2021* and the *National Policy Statement for Urban Development*. As a consequence, it is anticipated there will be more:

- development of multi-storey buildings adjacent to the railway network;
- demand for access services (e.g. scaffold) for these higher residential buildings, both in their construction, and throughout the life of the structure, including maintenance. This means it is likely more work will be carried out at height by workers in the construction sector and homeowners (which includes repairs and maintenance).

People interacting with (including simply walking around) mobile plant, construction equipment and temporary structures require space. Movement of people is incorporated in Regulation 10 Duty in relation to general workplace facilities in the Health and Safety at Work (General Risk and Workplace Management) Regulations 2016:

> (1) A PCBU[4] must ensure, so far as is reasonably practicable, that—
>
> > (a) the layout of the workplace allows, and the workplace is maintained to allow, persons to enter and exit the workplace and to move within it without risks to health and safety, both under normal working conditions and in an emergency:
> >
> > (b) work areas have sufficient space for work to be carried out without risks to health and safety: (New Zealand Government, n.d.)

WorkSafe has published a Policy Clarification for people building a house or working on their own homes. If you are building a house yourself, having a house built, or doing DIY work on a rental property you own, you are a PCBU as defined in Section 20 of the Health and Safety at Work Act 2015 (i.e. you are regulated under the Act). If you are doing DIY work on your own house, you are not a PCBU (i.e. you are not regulated under the Act).

In a report published in 2022 on the New Zealand building and construction sector, MBIE stated that 97.9% businesses employed fewer than 20 people (Ministry of Business, Innovation & Employment, 2022, p. 12). The Small Business Council, in 2019, noted that these businesses commonly are operating without formal governance, they have limited resources, and their owners do not usually seek specialist advice, or know where to find this advice (Small Business Council of New Zealand,

[4] Person Conducting a Business or Undertaking as defined in HSWA 2015

2019). These characteristics affect their capacity to meet obligations under the Health and Safety at Work Act 2015, and their understanding of specific contexts such as working near railways.

Construction activities typically involve building contractors and multiple specialist trades; these trades are generally subcontracted. The activities to complete the exterior of a building may include: initial siteworks, laying the foundations, completing the framework and external drainage, roof and wall cladding and windows.

After a building is complete, maintenance is an ongoing requirement. Under the Health and Safety at Work Act 2015, section 39 (2), a PCBU that makes design decisions[5] needs to consider all foreseeable activities associated with a structure "such as inspection, cleaning, maintenance, or repair", and any building must be designed without risk to those who will interact with it, so far as is reasonably practicable (New Zealand Government, n.d.).

Clause B2 Durability of the Building Code requires a building to be designed for a minimum of 50 years, with some building elements requiring a life of 15 or 5 years. These elements need maintenance, repair, or replacement throughout a building's life. Clause E2 External Moisture provides the nature of this maintenance in general terms, stating (emphasis in original):

> Regular maintenance of a *building* will include:
> a) Washing exterior surfaces,
> b) Inspecting surfaces and junctions, and repairing or replacing items when necessary, in order to preserve the *weathertightness* of the *building*.
> c) Maintaining clearances between *cladding* and external ground or paving…
> e) Maintaining finish coatings especially for *stucco*, *EIFS* and fibre cement *claddings*. (Ministry of Business, Innovation & Employment, 2020)

The Building Research Association of New Zealand (BRANZ) notes that, in addition to the legal requirement in the Building Code for maintenance of properties, many warranties for materials also demand specific maintenance (Building Research Association of New Zealand). Most house insurance policies exclude gradual damage, which can be caused by deferred maintenance (Insurance Council of New Zealand, 2019). A selection of well-known products and the maintenance required for these is provided in Table 6, in Appendix 3.

BRANZ provides a general maintenance schedule for homeowners on their *Maintaining My Home* website and a number of activities that require working at height are scheduled yearly, including inspections and cleaning of the roof, gutters, walls and windows. Wall repainting is scheduled every 8-10 years, roof repainting or recoating every 8-15 years (Building Research Association of New Zealand). Repairs are to be carried out as needed. Specialist services do exist for cleaning guttering, and these can use equipment that remove the need to work from height. Whether homeowners choose to use these services or complete the works themselves is unpredictable.

[5] WorkSafe's Guide to Health and Safety by Design "'designer' means any person who prepares or modifies a design, or arranges for or instructs a person under their control to do so." (2018, p 7)

6 Understanding of rail operations and network

In New Zealand, there is a lack of situational awareness with respect to rail i.e. people are not aware of

a) the safety hazards presented by rail operations – the TrackSAFE Foundation[6] was established due to this issue, and
b) how their work and other activities may affect rail operations and the rail network.

The following comments were noted in discussion with the KiwiRail Corridor Team:

> *"Contractors bid for work without factoring in the rail corridor that restricts the windows that work can be done in. When KiwiRail become aware of the work, the contractors often find it will go well over the project timeline accepted by the client, as they need to work to KiwiRail's schedule and not theirs."*

> *"The majority of contractors working adjacent to the electrified areas do not complete any inductions and are not aware of the high voltage system nor the minimum approach distances."*

The photographs (Figure 4, Figure 5) below show a site where the scaffold and scrim (the green netting) obscured the signals at a level crossing – the alarms could not be seen by road traffic approaching the crossing. Despite requests for the scaffold to be removed, it remained in place for over a week, and a Temporary Speed Restriction (TSR) was implemented to reduce the risk of a vehicle collision.

The rail corridor is not fully fenced, and even with fencing, plant and equipment can slew over the property boundary. Without physical segregation, people tend to freely move around when carrying out their work. This is normal behaviour and is often exhibited to improve efficiency; it is described by Hollnagel in *Understanding Accidents - From Root Causes to Performance Variability*: "As far as the level of individual human performance is concerned, the local optimisation – through shortcuts, heuristics, and expectation-driven actions – is the norm rather than the exception" (Hollnagel, 2022, p. 4).

[6] The TrackSAFE Foundation NZ is a not for profit that conducts research and data analysis; and is involved in publicity, media, and education about safety around tracks and trains. TrackSAFE aims to prevent harm and reduce the number of collisions and near misses between people and vehicles and trains. https://www.tracksafe.co.nz/about

Figure 4 Scaffold obscuring signals for road traffic at a level crossing – view from rail

Figure 5 Scaffold obscuring signals for road traffic at a level crossing – view from the road

7 Working at height

Preferences and availability of plant and equipment will differ, and it is reasonable to consider the options that a scaffolder, another worker, or homeowner, may have for construction and maintenance projects. For example:

- The homeowner or their neighbour may be reluctant to give permission for the scaffolder to breach or abut cladding for the purposes of providing stability due to concerns about weathertightness or other damage. Therefore, the base must be widened to ensure its stability.
- A homeowner may purchase and use ladders and mobile scaffold from a hardware store or hire service.

7.1 Types of access for working at height

Access for working at height includes ladders (equipment), scaffold (temporary structures), elevating work platforms (mobile plant).

Only scaffold and ladders are illustrated in this report as mobile plant tends to be used on paved surfaces, such as roads and driveways.

Photographs of scaffold are supplied in section 7.3. Diagrams of scaffold are provided in Figure 9 and Figure 10, and a ladder is shown in Figure 6. All the scenarios in the diagrams assume flat, stable ground.

Minor and tower scaffold are more likely to be used for smaller, localised, shorter duration work (e.g. installing a light fitting or flashing).

Mobile scaffold has castors which allow it to be moved around the building on a smooth, level surface. Access to two, three or four-storey buildings would require bracing. The diagonal bracing, where necessary, must be re-established at each move (Scaffolding, Access and Rigging New Zealand, 2018).

Proprietary mobile towers are available at hardware stores such as Bunnings and Mitre 10 - the scaffold advisor has concerns about the quality of some of the mobile scaffold products available to the public. WorkSafe guidelines advise that mobile scaffold is prone to tipping during use (WorkSafe New Zealand, 2016). Reasons for this can include sudden stops after movement of the scaffold, the structure being narrow and lightweight, and use on inappropriate (uneven, unstable) ground. The guide for an Equiptec scaffold (a type of mobile scaffold) provides a base: height ratio is 1:3 (Equiptec, n.d.), which is the same as for required for other scaffold by WorkSafe(see section 7.3 on stabilising scaffold, below).

Ladders beyond those used to access two-storey buildings have not been illustrated as they are difficult to handle (and most people would not feel comfortable climbing up a ladder to those heights), also, they have limited application. WorkSafe states that ladders are for light work of short duration and they are to be 1 metre out for every 4 metre of height. If ladders cannot be fixed at the top and bottom, the user needs a second person to hold the ladder (WorkSafe New Zealand, 2022).

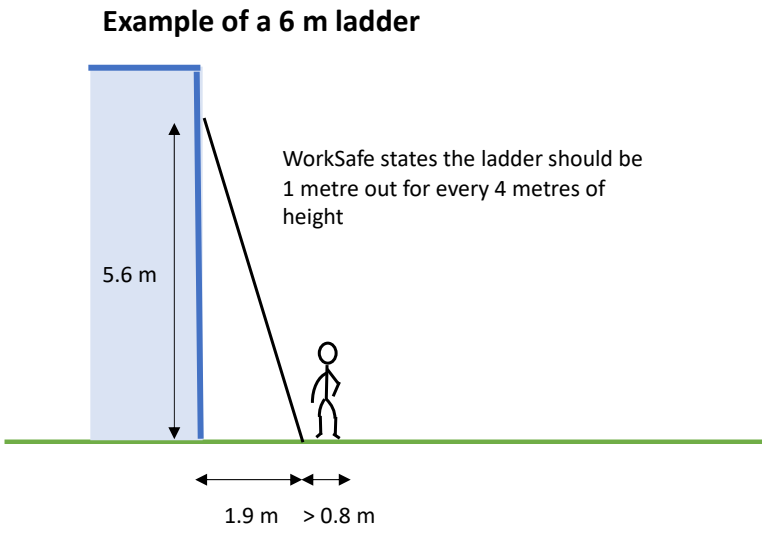

Figure 6 A ladder being used to access a two-storey building includes width of a person, forearm to forearm (Kolose, et al., 2021, p. 175)

7.2 Site-specific factors

Site specific factors may require alternative approaches to (a) the design of the temporary works and (b) the activities - its installation, use, reconfiguring, and dismantling; as well as the design of the permanent building project. The WorkSafe good practice guide for *Scaffolding in New Zealand* (WorkSafe New Zealand, 2016) includes considerations for site assessments and a selection of these are included below:

- Design of the building to be accessed (existing or to be constructed) and adjacent buildings
- Ground conditions: A slope/uneven ground and/or unstable/poor ground conditions
- Environmental loads: e.g. funnelled wind
- Method(s) to be used for stabilising
- Space to erect and store scaffold materials
- Transport of equipment and materials to storage area and final site [impeded access results in additional manual handling, time and cost]
- Pedestrians
- Proximity to electrical conductors or cables; potential for contact with these during any activities

7.3 Stabilising scaffold

Stabilising elements may add width to a scaffold. Stabilising elements are required for scaffold when the height of the highest working platform is more than three times the base width. This is referred to as the "minimum tip factor ratio" by WorkSafe (WorkSafe New Zealand, 2016, p. 51). Stabilising will be necessary for a scaffold to access the full height of a two-storey building. Options for this include:

- tying-in (attaching) the scaffold to the building to be worked on (including 'reveal ties');
- outriggers and buttress bays; and
- butting up to adjacent buildings.

The choice of methodology - which stabilising elements to use - depends on site-specific factors including the design of the building and its surrounding buildings, and other matters such as available materials, and the competency of, and decision making by, the scaffolder and/or engineer.

For **tying-in**, although scaffolders can use openings e.g. windows to create 'reveal ties', these are only allowed to make up 50% of the total ties for the scaffold (WorkSafe New Zealand, 2016, p. 70). The preferred method is to bolt into the structure. However, breaching the cladding is not recommended due to the effect it may have on weathertightness; and monolithic cladding is particularly problematic in this regard.

An example of an **outrigger** (the diagonal element) is shown in Figure 7, and it can be seen that bracing and sole plates also protrude beyond the bay width. A **buttress bay** is shown in Figure *8*.

Butting up to adjacent buildings is not usual practice and is not recommended by SARNZ, as it uses the neighbouring building and can damage that building. The scaffold relies on the other building(s) for stability and may stress its external cladding or structure. Permission to use this method is required from the owner of the neighbouring building.

Figure 7 Photograph scaffold with outriggers, credit: Wain Chambers

Figure 8 Photograph of a scaffold with buttress bay, credit: Wain Chambers

7.4 Falling or dropped objects

Falling or dropped objects are a significant and ongoing issue for the construction sector. They are explicitly addressed in the Health and Safety at Work (General Risk and Workplace Management) Regulations 2016. An exclusion zone is provided for in these regulations (New Zealand Government, n.d.) with different controls that can be adopted e.g. toe boards, catch fans (WorkSafe New Zealand, 2016). These controls are typically prompted by an awareness of pedestrians in the vicinity of the temporary works.

Attempting to retrieve objects from the rail corridor places people at risk of being hit by a train, and KiwiRail has concerns regarding other effects of falling or dropped objects, including the impacts on its levels of service that can be provided when there is an interference with rail operations.

The Dropped Objects Prevention Scheme[7] has developed the *Dropped Objects Exclusion Zone Tool* to help determine the width of an exclusion zone, and it has been used to determine the trajectory on the dropped item (using the 75th percentile i.e.75% of steel objects are predicted to land within this distance, see the Appendix for outputs). This tool is a guide only (DROPS Online: Dropped Objects Prevention Scheme Global Resource Centre). Advice from SARNZ is that exclusion zones are typically 3 – 4 metres wide from the base of the scaffold.

Figure 9 shows scaffold providing access to different heights of buildings, and includes an object dropped by a person on the top working platform with the object deflecting off the top rail, which is one metre above the working platform. Distances shown from the building originate from the

[7] The Dropped Objects Prevention Scheme is a worldwide initiative focused on preventing dropped objects.

cladding, not the framing lines of the building. WorkSafe's *Scaffolding in New Zealand* states the distance from face needs to be as close as practicable, ideally less than 300mm. A gap any wider requires full edge protection (guardrails) (WorkSafe New Zealand, 2016).

7.5 Diagrams of scaffolds and falling object zones

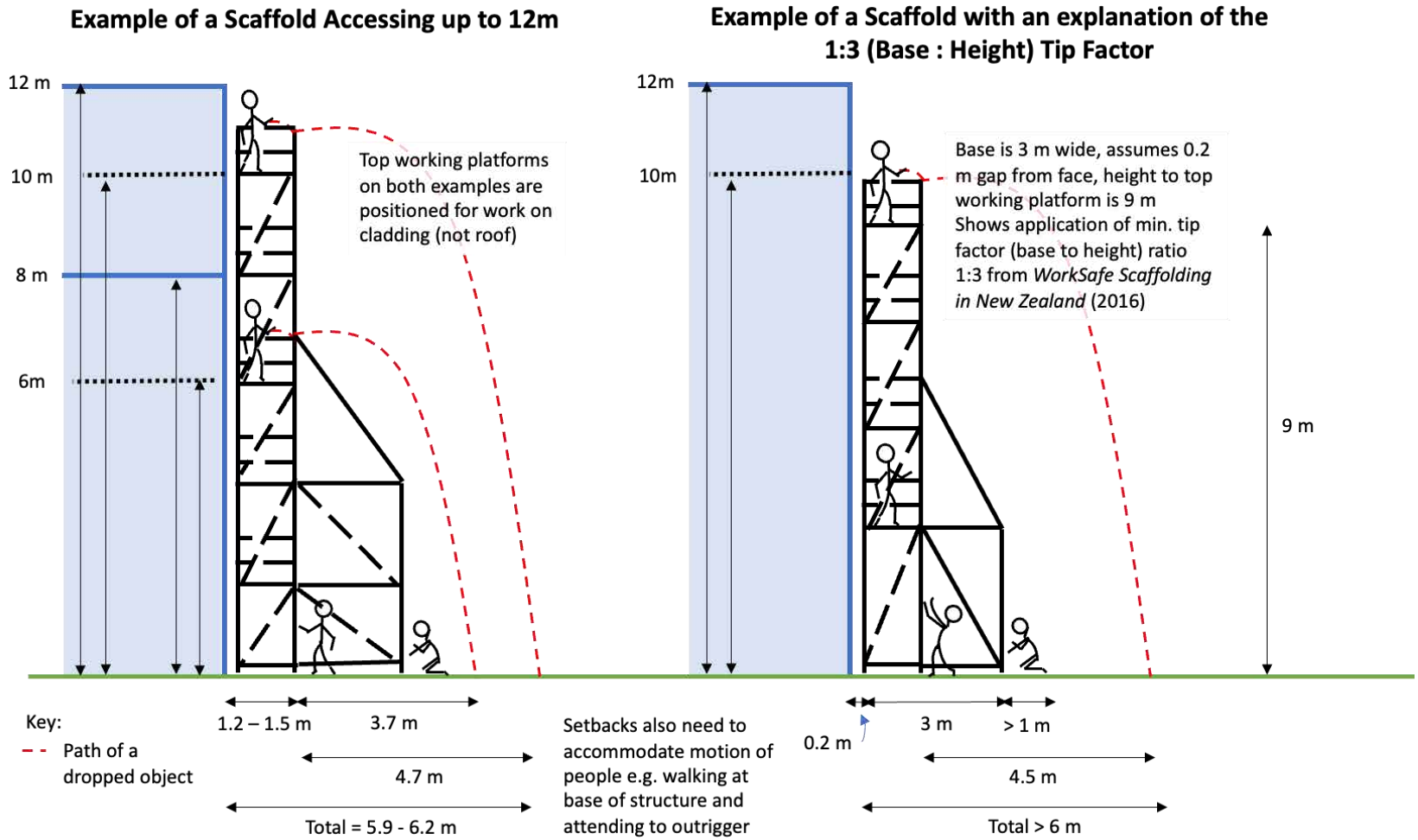

Figure 9 Distances from cladding to periphery of structures, space for people to work/move and predicted zones for dropped objects

8 Additional hazards associated with work adjacent to rail

8.1 Electricity

Figure 1 shows the extent of KiwiRail's electrified rail network. The New Zealand Electrical Code of Practice for Electrical Safe Distances, NZECP 34:2001, sets "safe distance requirements for the construction of buildings and other structures near existing conductors, to prevent inadvertent contact with or close approach to conductors", avoiding electrocution (or damage to equipment) (Ministry of Consumer Affairs, 2001, p. 8).

For 25 kV, which is the voltage of the majority of the electrified rail network, the minimum distance to the side of conductors to a building under normal conditions is 8.5 metres. This safe distance is applied without the need to take engineering advice and obtain approval of the electric line owner (Ministry of Consumer Affairs, 2001).

8.2 Mobile Plant

When loads or components of a machine move above the rail corridor, there is the potential for a collision with rail infrastructure including electrified lines. The risk of a collision with a rail vehicle depends on factors including the volume of rail traffic and the length of time the machine is operating on the site. If the KiwiRail Corridor Team is notified of construction adjacent to rail, their considerations include:

- The construction worker's operation of a crane and its capacity to slew across KiwiRail's rail operational area (this operational area is generally five metres beyond the track, or eight metres from overhead line equipment). KiwiRail asks for slew (horizontal movement) restrictions, requesting operators to lock the machine's ability to slew in certain areas while rail traffic is operating, or to stop works if they cannot lock its motion. KiwiRail verifies these mitigations on site.
- The constructor's use of plant that has the potential to foul the track, for example, if the plant being used can change shape from its work position and foul the track even if there is no intention to do so.
- Construction activities with potential to foul the track, such as erection and propping of concrete panels/lifting structural steel [as these could inadvertently fall on to the track].

Telehandlers and diggers are common plant on smaller building sites. Plant have different ranges of motion (see Table 1 for an example) and their loads add to spatial considerations. Specific project risk assessments and plans would identify the areas of influence of the plant and their loads. Knowledge of managing constrained sites and rail hazards are needed for an appropriate plan. However, whether work proceeds safely often rests on the judgement of the operator of the plant rather than the implementation of a plan with additional/multiple controls e.g. lift advisor.[8]

[8] *Pers. comm.* M. Riding, ConstructSafe

Table 1 Example working area of a machine without a load

Machine	Width beyond front wheels	Height
Telescopic forklift's/telehandler's boom[9]	3 m	11 m
	7 m	5 m

8.3 Excavation and earthworks

Excavation and earthworks include any soil or rock removal that creates a void, preparation and filling of foundations, and filling and construction of retaining walls. Poorly designed and executed excavation and earthworks may cause subsidence, deterioration of existing structures, and stress changes in soil and rock. These issues can negatively impact the rail network and increase safety risks (VicTrack, 2019). A small distortion (misalignment) of the track may result in a derailment. The National Corridor Manager states that:

> *"Monitoring rail track formation is crucial when undertaking works for settlement issues that may result in geometry exceedance. Here are a few reasons why it is important:*
>
> *1. Safety: Monitoring the rail track formation helps ensure the safety of train operations. Settlement issues can lead to track misalignment, which can increase the risk of derailments or accidents. By monitoring the track formation, any potential geometry exceedance can be identified and addressed promptly, reducing the risk of safety incidents.*
>
> *2. Infrastructure integrity: Settlement issues can affect the integrity of the rail infrastructure. Excessive settlement can cause track misalignment, uneven surfaces, or uneven load distribution, leading to accelerated wear and tear on the track components. By monitoring the track formation, any settlement-related issues can be detected early, allowing for timely repairs or adjustments to maintain the integrity of the rail infrastructure.*
>
> *In summary, monitoring rail track formation during works for settlement issues is essential for ensuring safety, maintaining infrastructure integrity, enhancing passenger comfort, optimizing operational efficiency, and achieving cost-effectiveness in rail operations."*

KiwiRail regularly monitors track and uses parameters such as

- Twist: The variation in cross level over a base length of four metres.
- Top: The longitudinal level of the running surfaces of the rail measured on both rails.
- Cant: The height of one rail above another.

Geometry exceedances are measured from highest to lowest priority in five categories. As shown in Table 2, the track only needs to be a little out of alignment before train speeds may need to be reduced until the track is fixed. (KiwiRail, 2017)

Table 2 KiwiRail's geometric parameters – examples of actions required for twist, top and cant for lines with the highest speed category

Action required	Maintenance tolerances		
	Twist	Top	Cant

[9] Lull *Model 1044C-54 Series II Operator & Safety Manual* (2009, p. 40)

P1 - Apply immediate 25 km/h Temporary Speed Restriction (TSR) and repair within 48 hours.	Greater than 24 mm	Greater than 22 mm	Greater than 24 mm
P2 - Apply immediate 40 km/h TSR and repair within seven days.	18 – 23 mm	19 – 21 mm	19 – 23 mm
P3 - Consider need for TSR and repair within four weeks.	16 - 17 mm	16 - 18 mm	17 - 18 mm
P4 - Consider need for TSR and repair within 26 weeks.	14 - 15 mm	13 - 15 mm	15 - 16 mm
P5 - Repair within 52 weeks.	12 - 13 mm	10 - 12 mm	13 - 14 mm

Higher buildings have increased foundation requirements; and ground conditions will vary from project to project, throughout New Zealand. An example of excavation controls (New South Wales and Victoria, Australia) is provided in Table 3, below.

Table 3 Excavation when approval is required by the rail operator, in New South Wales and Victoria

	When approval is required by rail operator	
Document Title	**Depth of excavation**	**And distance from rail corridor***
State Environmental Planning Policy (Transport and Infrastructure) 2021, NSW (Government of New South Wales, 2021)	> 2 m	≤ 25 m
VicTrack Rail Development Interface Guidelines, Victoria (VicTrack, 2019)	Any excavation	Any development adjacent to rail corridor

*The rail corridor comprises land and infrastructure, including maintenance access tracks either side of any supports for signalling or electricity, formation under the railways tracks and the railway tracks themselves, or land approved for development by Government.

The *New Zealand Electrical Code of Practice for Electrical Safe Distances*, NZECP 34:2001, sets minimum safe distances for excavation near overhead electric line supports, and content from this standard is included in Table 4 below. Prior written consent of the pole or tower owner is required for certain excavations. Architects and others can lack of awareness of the requirements in this document; compliance to all the design regulations and guidance that applies is not a given (Hackitt, 2018).

Table 4 Excavation when approval is required by electrical line support (pole or tower) owner (Ministry of Consumer Affairs, 2001)

Depth of hole	Distance to pole or stay wire	Distance to visible foundation of tower
> 300 mm	Within 2.2 m	Within 6 m
> 750 mm	2.2 – 5 m	-
> 3 m	-	6 – 12 m
Or any excavation that creates an unstable batter	Within 8 m	-

8.4 Demolition

During demolition, plant or materials may strike electrified line or foul the railway track, and demolition also may affect ground stability. The *VicTrack Rail Development Interface Guidelines* state that any demolition on land adjacent to the rail corridor requires approval from VicTrack and the Accredited Rail Operator, and the application is to include a demolition management plan (VicTrack, 2019).

9 Controls (hazard mitigation), including setbacks

Physically separating workers and others from hazards, and adopting design features/engineering controls are both considered more effective than administrative controls. That is, it is preferable to manage risk in design. This is explained as the "Hierarchy of control measures" in regulation 6 of the Health and Safety at Work (General Risk and Workplace Management) Regulations 2016 (emphasis in bold added)*:*

> (3) The PCBU must minimise [if they cannot eliminate] risks to health and safety, so far as is reasonably practicable, **by first taking 1 or more of the following actions** that are the most appropriate and effective taking into account the nature of the risk:
>
> (a) substituting with a lower risk activity or substance:
> **(b) isolating people from the hazard/preventing people being exposed to the risk:**
> **(c) applying engineering control measures.**
>
> (4) If a risk then remains, the PCBU must minimise the remaining risk, so far as is reasonably practicable, by implementing administrative controls.
>
> (5) if a risk then remains, the PCBU must minimise the remaining risk by ensuring the provision and use of suitable personal protective equipment (PPE). (New Zealand Government, n.d.)

Section 34 of the Health and Safety at Work Act 2015 states that a PCBU (an organisation) must consult other PCBUs with same duty e.g. when they have a shared or adjacent work area, or during design (Galvin & Donnelly, 2022). *Work health and safety consultation, cooperation and coordination: Code of Practice* by Safe Work Australia (WorkSafe New Zealand's Australian equivalent, the Health and Safety at Work Act 2015 was heavily based on Australian legislation) comments on the usefulness of written arrangement to clarify parties' roles and responsibilities (Safe Work Australia, 2023). Formal mechanisms/triggers are important when people or organisations have a lack of awareness of how their work could present risks to other organisations and there are other barriers that discourage engagement.

The New Zealand Building Code, the Health and Safety at Work Act 2015 and the Health and Safety at Work Act Regulations do not specify engineering controls for access to ensure a building is able to be maintained in a safe manner. If hazards associated with maintenance are not identified and managed appropriately in design, including the location of the building on the property, the risk is transferred to those downstream, with potential cost and safety implications for KiwiRail, its workers and their customers, property owners, constructors, occupants, maintenance workers and others.

Managing risk that has been designed into a system

When there is inadequate width for the activities adjacent to rail infrastructure, or activities could impact rail operations, KiwiRail, as an Access Provider, relies on notifications that trigger their processes including: Permit to Enter, Electrical Access Permit and/or Track Access Request. Reliance on the homeowner or contractor to come forward or KiwiRail workers to observe potentially risky work contributes to this being a weak control.

Designing-in safety i.e. mitigating hazards in design

KiwiRail's knowledge of current and future operations and the network is an important input for the design process where planned/future work adjacent to rail may have effects beyond the shared

property boundary. A review of a development's design may result in KiwiRail accepting the design, or it may request conditions.

When considering building maintenance, any setback distance between the building and the boundary with the railway needs to be adequate to keep its effects within the adjacent site to avoid impacting the safety of people and the operating railway. Figure 10 has been prepared considered the following factors:

a. ongoing maintenance requirements under the Building Code and BRANZ recommendations;
b. human behaviour;
c. common types of access methods (scaffold and ladders) to buildings of the specified size/location and scaffold stability requirements;
d. falling/dropped objects;
e. size and location of buildings adjacent to the rail designation boundary (including as provided for by the Resource Management (Enabling Housing Supply and Other Matters) Amendment Act 2021);

The diagrams illustrate a range of 3.7 to 4.6 metres for a person to construct scaffold, enabling access for maintenance of wall cladding (not roof cladding) and 4.5 to 6.2 metres allow for (some) falling objects (see 7.4 Falling or dropped objects). This assumes level, stable ground conditions.

A building setback provision does not directly address other risks identified in section 8; however, it can be helpful in mitigating some risk. Where a proposed building obtains consent to encroach into a setback, it will provide KiwiRail with visibility of construction work and hazards that could impact the rail operations and network.

Table 5 Summary of widths needed for standalone scaffold from Figure 10

Scenario	**Two-storey**	**Three-storey**	**Four-storey**
Person installing scaffold with outrigger (two-storey) or buttress bay	~ 3.7 – 4 m*	> 3.7 m	> 4.6 m
Person dropping an object from scaffold	> 4.5 – 4. 8 m	> 5.3 – 5.6 m	> 5.9 – 6.2 m
Person using a ladder for access	> 2.7 m	-	-

* For accessing the full height of a two-storey building, the outrigger protrudes more than the buttress bay illustrated for accessing the full height of a three-storey building. See also note with figure.

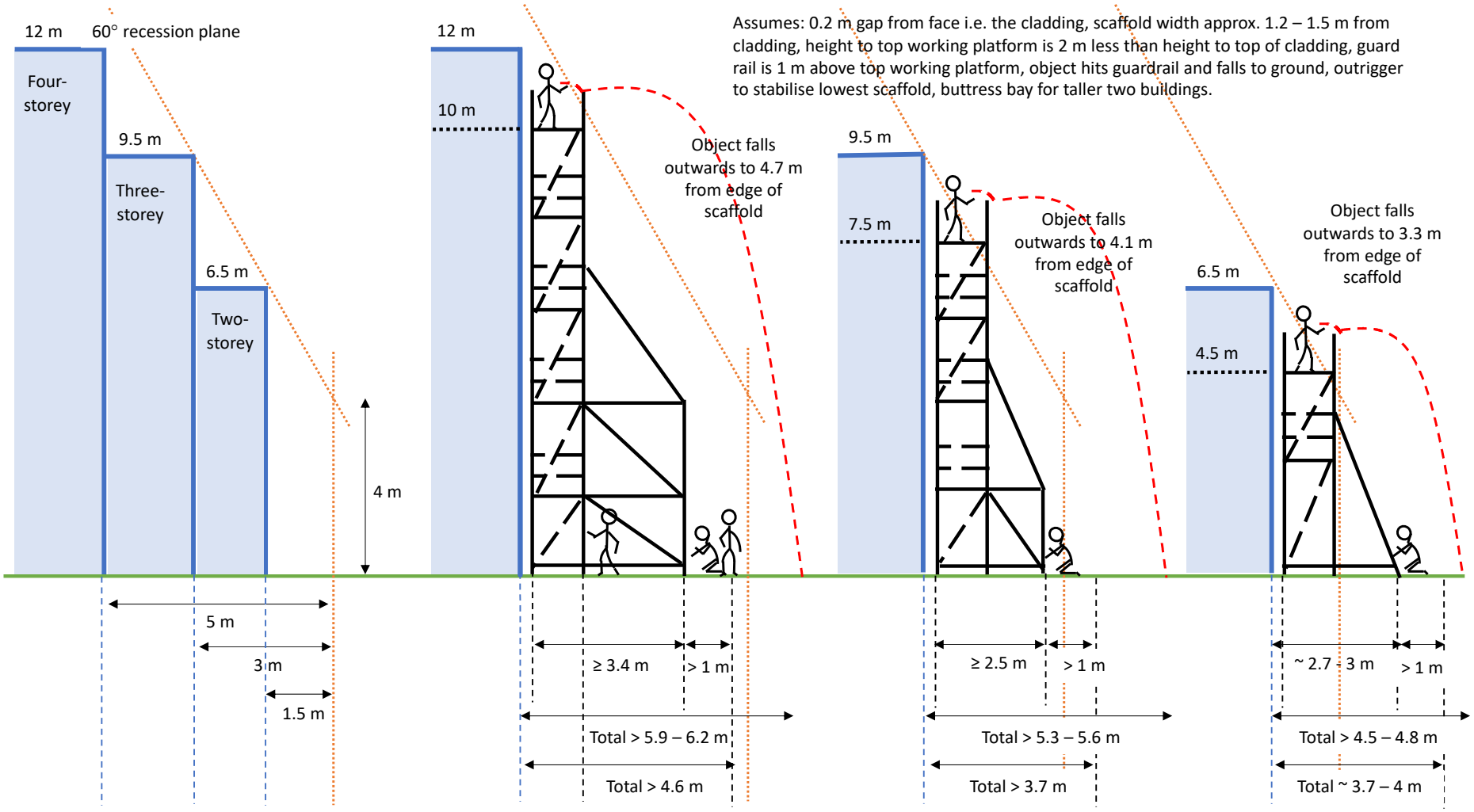

Figure 10 Diagram showing building meeting the 4m + 60 °recession plane and setbacks for four, three and two-storey buildings, the two-storey structure has a 4m raker because this is a common component utilised by scaffolders

International Examples

Countries including Australia and Canada consider development adjacent to rail premises and infrastructure by factoring in distances from assets, and prompt engineering assessments that may result in the introduction of particular design features (such as setbacks).

The City of Melbourne in Victoria, Australia, requires the rail operator's approval for any excavations and earthworks, and demolition, where these are undertaken adjacent to their railway corridors (defined as land and infrastructure including a maintenance access track). This requirement is contained in the *Code of Practice for Building, Construction and Works,* a document which "regulates the conduct of all works that affect public space, ensuring the safety and amenity of our community and the protection of municipal assets". It states:

> You must have a permit to undertake works that could impact land and assets managed by VicTrack, generally any works activities occurring within 5 m of a rail or tram corridor. (City of Melbourne, 2022, p. 40)

The Government of New South Wales requires, in planning legislation, that any excavation greater than two metres deep within 25 metres horizontal distance of a corridor is to be approved by the rail operator (Government of New South Wales, 2021).

Construction and demolition activities adjacent to rail merit further consideration in New Zealand, given the increased potential for multi-storey development and the consequences of poorly managed works.

10 Conclusion

This report has outlined activities within and adjacent to the rail corridor including the increasing volumes of both. It is noted there Is limited awareness of the rail operations and network.

Building maintenance is an ongoing requirement: it is legislated under the Building Code, necessary for warranties of building elements, and to avoid gradual decline generally excluded in insurance.

Working at height is necessary to conduct maintenance. Scaffold is commonly used for accessing cladding and other elements of a building, and there are various ways to stabilise the structure, with multiple factors influencing its installation. Diagrams of freestanding scaffold against buildings are provided, with zones for dropped objects. These illustrate the widths utilised for work.

Construction works near rail introduce further hazards, including electricity, mobile plant, excavation and earthworks, and demolition. A building setback does not directly address construction or demolition effects.

Construction and maintenance next to a rail corridor require particular consideration. Both Australia and Canada have guidelines for these works in this environment, and Australia regulates some activities.

The Health and Safety at Work Act 2015 states that certain controls are more effective than others - it is better to manage risk during design, and consider the location of a building and engineering controls rather than relying on permits and legal deterrents.

In designing activities adjacent to the rail corridor, a setback is an appropriate tool to separate activities and manage risks of interference with the rail corridor. This report has considered a

variety of access methods to determine an appropriate setback distance for inclusion in district plans around New Zealand.

Appendix 1 Bibliography

WorkSafe, the regulator for the Health and Safety at Work Act 2015, describes the first step in the design process as "Identify solutions from regulations, good practice guidance and recognised standards". Drawing on these documents is considered necessary to determine appropriate and suitable design solutions. WorkSafe has various resources to assist people to comply with the Act: Good practice guidelines (GPGs) "Provide clear good practice guidance for certain work activities" [10].

Industry standards: The development and publication of standards is carried out by Standards New Zealand, a business unit within the Ministry of Business, Innovation and Employment (MBIE). Standards can be:

> incorporated into non-regulatory material as examples of leading practice or guidance for industry… promoted as a means of dealing with legal liability issues, for example, compliance with… standards may be cited in court as proof that all reasonable steps were taken[11].

Other references that contain good practice include industry guidance e.g. guidance produced by industry bodies, such as Scaffolding, Access and Rigging New Zealand (SARNZ) or Engineering New Zealand (ENZ). International guidelines can also be useful references as New Zealand does not always have applicable, specific guidance.

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[10] Description of resources from WorkSafe's fact sheet *What resources are available to help?* (2013)
[11] https://www.standards.govt.nz/about/explaining-standards/regulations-and-standards/

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Appendix 2 Outputs from *Dropped Objects Exclusion Zone Tool*

Outputs from *Dropped Objects Exclusion Zone Tool* for the paths on the diagrams of scaffold.

Inputs		
STEP 1: Select Metric or Imperial		Metric
STEP 2: Input Height of Object	(meters)	11.5
STEP 3: Input Height of Deflection	(meters)	11.0
Approximate Outputs (Distance to strike the ground)		
100th Percentile Distance	(radius in meters)	5.0
75th Percentile Distance	(radius in meters)	4.7
50th Percentile Distance	(radius in meters)	3.7
25th Percentile Distance	(radius in meters)	2.1

Inputs		
STEP 1: Select Metric or Imperial		Metric
STEP 2: Input Height of Object	(meters)	7.5
STEP 3: Input Height of Deflection	(meters)	7.0
Approximate Outputs (Distance to strike the ground)		
100th Percentile Distance	(radius in meters)	4.0
75th Percentile Distance	(radius in meters)	3.7
50th Percentile Distance	(radius in meters)	2.9
25th Percentile Distance	(radius in meters)	1.7

Inputs		
STEP 1: Select Metric or Imperial		Metric
STEP 2: Input Height of Object	(meters)	10.5
STEP 3: Input Height of Deflection	(meters)	10.0
Approximate Outputs (Distance to strike the ground)		
100th Percentile Distance	(radius in meters)	4.8
75th Percentile Distance	(radius in meters)	4.5
50th Percentile Distance	(radius in meters)	3.5
25th Percentile Distance	(radius in meters)	2.0

Inputs		
STEP 1: Select Metric or Imperial		Metric
STEP 2: Input Height of Object	(meters)	9.0
STEP 3: Input Height of Deflection	(meters)	8.5
Approximate Outputs (Distance to strike the ground)		
100th Percentile Distance	(radius in meters)	4.4
75th Percentile Distance	(radius in meters)	4.1
50th Percentile Distance	(radius in meters)	3.2
25th Percentile Distance	(radius in meters)	1.8

Inputs		
STEP 1: Select Metric or Imperial		Metric
STEP 2: Input Height of Object	(meters)	6.0
STEP 3: Input Height of Deflection	(meters)	5.5
Approximate Outputs (Distance to strike the ground)		
100th Percentile Distance	(radius in meters)	3.6
75th Percentile Distance	(radius in meters)	3.3
50th Percentile Distance	(radius in meters)	2.6
25th Percentile Distance	(radius in meters)	1.5

Appendix 3 Building Elements and their maintenance requirements

Table 6 Building elements and their maintenance requirements

Building element	Most common product types and examples of these	Maintenance requirements (where available in product/company documentation)		
		Clean	**Re-coat**	**Inspections**
Roof cladding[12]	Metal sheet e.g. Colorsteel Endura[13]	Rainwashing & every three months clear garden detritus off the roof and clear gutters	Every 15 years, or as required	At least twice a year
Wall cladding[12]	Timber weatherboard e.g. Southern Pine Products[14]	Every 12 months	Every 10 years, or as required	Inspect after cleaning (every 12 months)
	Fibre-cement weatherboard and Non-weatherboard fibre-cement e.g. HardieTM Plank Weatherboard[15] and AxonTM Panel	Every 6 - 12 months Use low pressure water and a brush. Refer to your paint manufacturer for washing down requirements.	Refer to paint manufacturer for re-coating requirements.	*Regular inspection… of the cladding joints, sealants, nail head fillers*
	Metal e.g. Colorsteel Endura[13]	Every 12 months	Assume as above	Assume as above
	Exterior insulation and finish systems (EIFS) e.g. Caviteclad[16]	At least annually Mould and algae must be removed. This can be done by scrubbing with detergent or spraying with a proprietary cleaner.	*5 to 8 yearly intervals or sooner if required to maintain weathertightness.*	*Regular checks, at least annually, must be made of the system to ensure that the weather resistant coating is maintained watertight, and that the sealant, flashings, and other joints continue to perform their function* and are watertight.

[12] https://www.branz.co.nz/pubs/research-reports/sr465/
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[16] https://www.specialized.co.nz/file/caviteclad-installation-manual/open https://www.specialized.co.nz/file/file56df3a0d7f518/open

Building element	Most common product types and examples of these	Maintenance requirements (where available in product/company documentation)		
		Clean	**Re-coat**	**Inspections**
Gutters, down pipes, overflow pipes	PVC (Vinyl)[17]	*Regularly clear the inside of the spouting of leaves, silt, or other debris to reduce the risk of blockage and overflow.* (Not in warranty.)		
Windows[18]	Aluminium[19]	Every three months *A soft brush with warm water and a mild household detergent are recommended.*	Powder coated and anodised joinery have warranties of 10-20 years. Joinery can be re-coated.	
	uPVC[20]	At least once every two months		
Paint	Resene[21]	Every 12 months	Acrylic system on weatherboards lasts for 7–10 years. An oil-based or alkyd system may only last 4–6 years. *5–7 years and 1–5 years respectively on window sills and other slanted surfaces with greater exposure to… sun.*	
	Dulux[22]	Every two years *Apply [prepared house wash] to the entire painted area with a soft bristle brush, broom or soft cloth, you will need ladders, scaffolding and a long-handled applicator to reach some of the higher parts of your home's*	~ 8 years (UK), NZ sites do not specify re-painting requirements.	

[17] From *Marley Rainwater Systems Maintenance Schedule* at https://www.marley.co.nz/products/rainwater/spouting/stormcloud/
[18] https://www.wganz.org.nz/guides/joinery-materials/#:~:text=New%20Zealand%20window%20and%20door,is%20also%20reusable%20and%20recyclable.
[19] https://nzwindows.co.nz/wp-content/uploads/2022/07/Vantage-Care-Maintenance-and-Warranty.pdf
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[21] https://www.resene.co.nz/homeown/problem-solver/maintaining_exterior_painted_surfaces.htm
[22] https://www.dulux.co.nz/how-to/general/how-to-care-for-dulux-paint/
https://www.duluxdecoratorcentre.co.uk/product/paint/exterior-paints/exterior-trim/dulux-trade-weathershield-exterior-high-gloss

Building element	Most common product types and examples of these	Maintenance requirements (where available in product/company documentation)		
		Clean	**Re-coat**	**Inspections**
		exterior, under eaves, along fascias, etc.		

Attachment 3: Insight Economics - High Level Assessment of Proposed Building Setbacks Adjacent to the Rail Network

INSIGHT | ECONOMICS

Draft Report: 24 July 2024

High-Level Assessment of Proposed Building Setbacks Adjacent to the Rail Network

Prepared for:
KiwiRail Holdings Limited

Authorship

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Contents

About the Author

This report was written by Fraser Colegrave, who founded Insight Economics in 2013.

He has 27 years commercial experience, the last 24 of which he has worked as an economics consultant. During that time, he has successfully led more than 600 consulting projects.

Fraser holds a first-class honours degree in economics from the University of Auckland (1996).

His main fields of expertise are land-use and property development. He has worked extensively in these areas for many of the largest companies in New Zealand. In addition, he regularly advises local and central Government on a range of associated policy matters, and therefore understand the issues from multiple perspectives.

Current and recent clients include: Auckland Airport, Argosy Property, Christchurch City Council, Crown Infrastructure Partners, Foodstuffs, Fulton Hogan, Infinity Group, Kiwi Property, Kmart, the Ministry of Transport, Neil Group, New Zealand Productivity Commission, Ngai Tahu, Queenstown Airport, Tauranga City Council, and Woolworths.

Over the last 15 years, Fraser has helped secure plan changes and/or resource consents for dozens of major projects providing more than 40,000 dwellings in both brownfield and greenfield areas.

Since 2014, he has performed numerous forensic examinations of the housing and business capacity assessments completed for or by Councils under the National Policy Statement on Urban Development 2020 (NPS-UD), and accordingly has a high level of expertise with the concepts and policy framework of the NPS UD.

Recently, Fraser has been closely involved with the intensification planning processes for various Tier 1 areas, including Tauranga City, Western Bay of Plenty District, Christchurch City, Selwyn District, Waimakariri District, and Queenstown-Lakes District.

In his previous role at Covec Limited, Fraser completed a wide range of transport-related assessments for various central Government agencies and therefore has a sound understanding of the sector and its vital contribution to economic prosperity. His work included the development of detailed fleet models to test different policy options, and initiatives to encourage more environmentally friendly mode choices.

More generally, Fraser has provided expert evidence on various economic matters at more than 120 hearings before Councils, Independent Hearing Panels, the Land Valuation Tribunal, the Environment Court, Boards of Inquiry, the Family Court, and the High Court of New Zealand.

1. Introduction

1.1 Background

KiwiRail is responsible for the development and operation of New Zealand's rail network. To ensure that the rail network remains free to grow and operate without undue disruption, and to ensure the safety of those who work within the rail corridor and neighbouring occupants, KiwiRail seeks a five-metre setback for new buildings and structures, or alterations to existing ones, adjacent to the rail corridor. This high-level report briefly considers the likely economic effects of the proposal.

1.2 Strategic Context

New Zealand, like all developed nations, is highly dependent on trade. This trade creates a massive freight task, with approximately 280 million tonnes moved around NZ annually.[1] While rail plays a key role in the freight sector, particularly for certain goods like timber, dairy, and meat[2], most of the national freight task is performed by diesel trucks. These generate harmful emissions, including CO_2, and are therefore the target of a concerted effort to decarbonise the transport fleet. For example, the New Zealand freight and supply chain strategy seeks to move 20% more freight by 2035 while generating 25% lower emissions, including via modal shifts to rail.

In parallel, the New Zealand Government has recognised the need to maximise the value of its existing investments in the rail network, including making rail a more attractive mode for freight. Previously, investment in the rail network lacked a long-term view about its role in the transport system. This caused short-term thinking and investment decision-making, so a new approach was needed.[3]

The New Zealand Rail Plan[4] was developed in 2021 to articulate the investment needed to achieve identified priorities for rail. In June 2021, the Rail Network Investment Programme (RNIP) was created to fund various planks of the Rail Plan that will help renew the network, restore it to a resilient and reliable state, and support freight and passenger rail growth and productivity.[5]

1.3 Structure of Report

The remainder of this report is structured as follows.

- Section 2 describes the problem at hand plus KiwiRail's proposed solution.
- Section 3 considers the likely effects on development capacity under the NPS UD.
- Section 4 describes the economic value of protecting rail's growth and operation.
- Section 5 summarises and concludes.

[1] https://www.transport.govt.nz/assets/Uploads/Freight-and-supply-chain-issues-paper-full-version.pdf

[2] https://www.kiwirail.co.nz/our-business/freight/

[3] https://www.transport.govt.nz/area-of-interest/infrastructure-and-investment/the-new-zealand-rail-plan/

[4] ibid

[5] ibid

2. About the Proposed Setbacks

2.1 Problem Statement

New Zealand's rail network spans nearly 4,000 kilometres of track, which runs through various rural and urban communities. If sufficient space is not provided on adjoining land for certain activities (particularly property repairs and maintenance), they cannot be completed without encroaching onto the rail corridor, including the risk of dropped objects falling onto the track and disrupting operations.

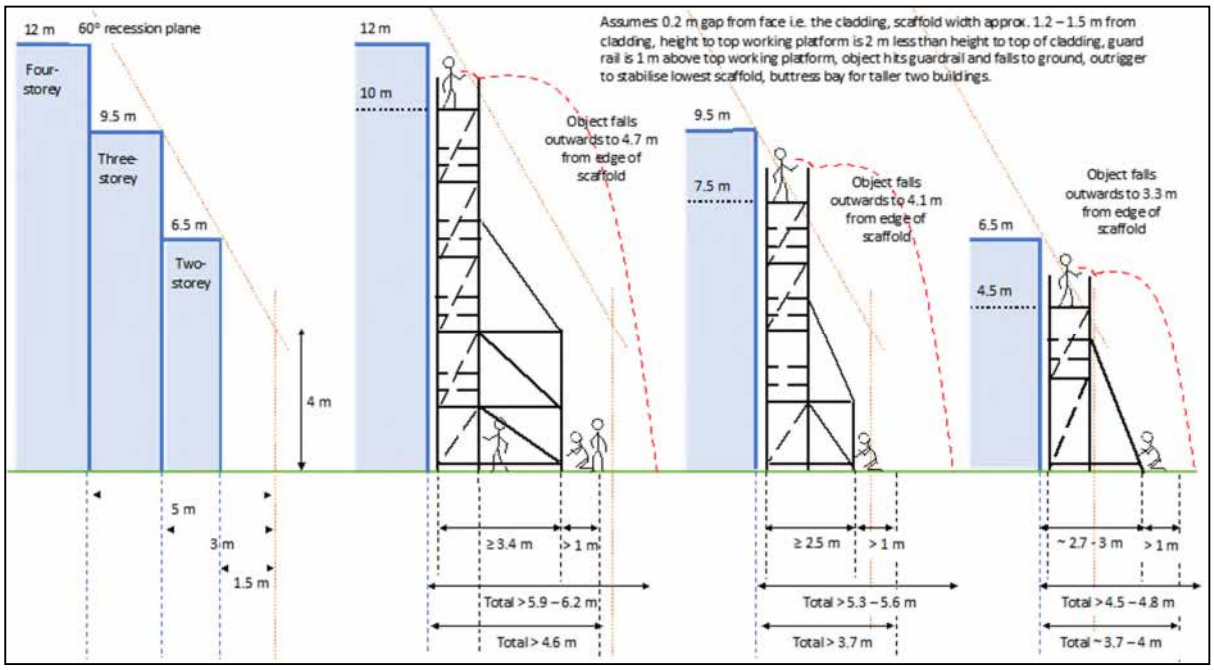
2.2 KiwiRail's Proposal

To ensure a safe distance for repairs and other maintenance activities on properties adjacent to the railway corridor, and to protect it from unforeseen hazards, KiwiRail seeks a five-metre setback for new buildings and structures, or alterations to existing ones, adjacent to the rail corridor. The rationale for this is illustrated in the diagram below, which demonstrates the space required to:

1. Install and move a basic/common scaffold structure for maintenance purposes and

2. Avoid dropped objects falling on the track from different building heights and varying scaffolding configurations.

Figure 1: Illustration of Dropped Object Paths from Different Height Buildings/Scaffolding



The diagrams above show that 3.7 to 4.6 metres is required to construct scaffolding of different sizes, with 4.5 to 6.2 metres required to enable access for maintenance of wall cladding (not roof cladding) and to allow for (some) falling objects. These diagrams assume level, stable ground conditions.

While the proposed five-metre setback may not fully protect the network from dropped object risks (with some potentially falling further), KiwiRail consider it to strike a good balance between protecting the rail network and preserving the property rights of landowners. Accordingly, five metre setbacks are preferred by KiwiRail.

2.3 Likely Situation Otherwise (aka the Counterfactual)

It is important to note that, absent the five-metre setback proposed, most sections would be required to set new buildings back from the rail network to some degree anyway under district planning rules. For example, I understand that the Medium Density Residential Standards (MDRS) impose a one-metre default setback. In lower density residential zones, though, larger setbacks are common, while some zones – like centres – may have no setback requirements at all.

Accordingly, the practical impact of KiwiRail's proposed relief is the difference between the proposed five-metre setback and the one that would apply otherwise, which is known as the counterfactual.

In this report, we assume that a one-metre setback would apply by default, so the impact of KiwiRail's relief is the difference between that and the larger five-metre setback proposed.

3. Impacts on Development Capacity

3.1 Introduction

Having set the scene, we now consider potential impacts on development capacity. This is a key consideration given the strongly enabling ethos of the NPS-UD and the need to ensure 'at least' sufficient capacity 'at all times.'

3.2 Number of Properties Affected

To put the issue in context, we used GIS to identify properties adjacent to the rail corridor in each territorial authority, which we then expressed as a percentage of all land parcels in each area. While the results vary, overall, only 0.9% of New Zealand properties are adjacent to the rail network. Accordingly, **99.1% of properties are unaffected**. Table 1 presents the details by territorial authority.

Table 1: Number of Properties Adjacent to Rail Network by Territorial Authority (May 2024)

TA Name	Total Land Parcels	Adjacent Properties	Adjacent Share of Total
Ashburton District	27,400	84	0.3%
Auckland	579,800	3,409	0.6%
Buller District	18,100	326	1.8%
Carterton District	8,300	166	2.0%
Central Hawke's Bay District	14,900	239	1.6%
Christchurch City	183,200	1,353	0.7%
Clutha District	41,900	593	1.4%
Dunedin City	85,800	1,028	1.2%
Far North District	61,400	129	0.2%
Gisborne District	37,300	350	0.9%
Gore District	12,700	126	1.0%
Grey District	17,700	621	3.5%
Hamilton City	64,500	276	0.4%
Hastings District	43,500	383	0.9%
Horowhenua District	24,900	349	1.4%
Hurunui District	18,400	290	1.6%
Invercargill City	33,300	518	1.6%
Kaikoura District	5,300	367	6.9%
Kaipara District	28,500	258	0.9%
Kapiti Coast District	29,500	408	1.4%
Kawerau District	3,400	2	0.1%
Lower Hutt City	46,700	625	1.3%
Manawatu District	26,800	53	0.2%
Marlborough District	42,200	473	1.1%
Masterton District	20,100	251	1.2%
Matamata-Piako District	23,100	332	1.4%
Napier City	29,400	920	3.1%
New Plymouth District	49,500	402	0.8%
Otorohanga District	11,300	145	1.3%
Palmerston North City	41,300	464	1.1%
Porirua City	23,500	271	1.2%
Rangitikei District	18,600	509	2.7%
Rotorua District	35,800	105	0.3%

TA Name	Total Land Parcels	Adjacent Properties	Adjacent Share of Total
Ruapehu District	19,800	622	3.1%
Selwyn District	47,400	241	0.5%
South Taranaki District	27,700	361	1.3%
South Waikato District	15,400	382	2.5%
South Wairarapa District	12,300	124	1.0%
Southland District	57,400	463	0.8%
Stratford District	10,800	462	4.3%
Tararua District	26,300	268	1.0%
Taupo District	29,100	1	0.0%
Tauranga City	62,000	522	0.8%
Timaru District	35,300	340	1.0%
Upper Hutt City	19,800	384	1.9%
Waikato District	54,500	807	1.5%
Waimakariri District	38,500	377	1.0%
Waimate District	10,900	95	0.9%
Waipa District	32,400	156	0.5%
Wairoa District	11,700	299	2.6%
Waitaki District	32,500	653	2.0%
Waitomo District	12,500	170	1.4%
Wellington City	74,800	924	1.2%
Western Bay of Plenty District	34,300	340	1.0%
Westland District	16,800	295	1.8%
Whakatane District	22,600	215	1.0%
Whanganui District	29,700	522	1.8%
Whangarei District	60,100	840	1.4%
New Zealand Total	**2,718,800**	**25,688**	**0.9%**

3.3 Impacts on Adjacent Properties

We now consider potential impacts on the 0.9% of New Zealand properties that are adjacent to the rail network. According to our GIS analysis, 70% of these properties are already developed, with only 30% being vacant. Given that some vacant properties represent public open spaces and other non-developable land types, not all will be developed over time. As a result, the number of developable sites affected by the proposed setback will be only a small fraction of the 0.9% flanking the rail network in the first place. For example, assuming – just for arguments sake – that *all* vacant land along the rail network is developable, it represents less than 0.3% of total NZ properties.

However, even for that 0.3%, the proposed setback may not materially affect yields. In practice, it depends on how easily the proposed building's bulk and location (B&L) could be reconfigured to account for the larger setbacks proposed by KiwiRail. If B&L can be readily changed to comply while still achieving the same overall site yields, the proposal will again have no effect.

To test this working assumption, I considered a handful of "representative development examples" with KiwiRail and its advisors to examine the potential impacts of larger setbacks on likely site yields. In virtually all cases, we found workable B&L tweaks that would preserve yields while maintaining the proposed five metre setback. In one case, for example, it simply meant reorienting the dwelling away from the track and swapping front yard space for backyard space. However, there was no impact on overall yields.

3.4 Summary and Conclusion

The discussion above has shown that:

1. 99.1% of properties will not be affected by the proposed setback because they are not adjacent to the rail network.

2. Of the 0.9% that are adjacent, only 30% are vacant (but not all of those are developable).

3. The true number of affected properties is therefore only a fraction of the 0.9%.

4. Finally, many prospective developments along the rail corridor can likely be reconfigured to comply with the proposed five-metre setback without foregoing yields.

Accordingly, overall, the proposal will have immaterial impacts on development capacity.

4. The Value of Network Protection

4.1 Introduction

Development yields aside, the primary economic effect of the proposal will be to preserve the safe and ongoing operation of the rail network. This section briefly discusses that.

4.2 The Value of Rail to New Zealand

The New Zealand rail network delivers significant value to its freight and passenger customers, and also generates significant benefits for all New Zealanders. These wider benefits are far-reaching, but the most significant are lower road congestion, fewer road accidents, and lower carbon emissions that result from less road traffic.

In 2021, Ernst & Young were commissioned by the Ministry of Transport to evaluate the value of rail to New Zealand.[6] Their study built on an earlier analysis from 2016 and considered the benefits of (i) national freight rail, and (ii) passenger rail in Auckland and Wellington.[7] Two scenarios were modelled. The first assumed that all rail services were cancelled, with all rail freight and passengers shifted to the road network. The second scenario also assumed that all rail services were cancelled and shifted to the road network, but with 20% higher rail traffic to capture the impacts of projected future growth. For both scenarios, the value of rail equals the costs of road traffic avoided.

The table below summarises the study's estimates of rail's benefits for the first scenario, where rail volumes match today. In short, the value of rail is estimated to be $1.7 to $2.1 billion per annum.

Table 2: Estimated Annual Value of Rail to New Zealand

Benefit	**Low Estimate**	**High Estimate**
Time (congestion) savings	$939	$1,054
Reduced air pollution	$170	$474
- NOx emissions	$92	$394
- SOx emissions	**<$1**	<1
- Brake & tire (PM10)	$21	$22
- Exhaust (PM2.5)	$57	$58
Reduced fuel use	$211	$222
Reduced GHG emissions	$178	$182
Maintenance benefits	$104	$107
Safety	$94	$98
- Death	$63	$65
- Serious injuries	$25	$27
- Minor injuries	$5	$6
Totals	**$1,695**	**$2,137**

In the words of the Ernst & Young study, as demonstrated above, rail transportation provides the largest benefits to the road sector and society through:

[6] Ernst & Young, the Value of Rail in New Zealand, 2021.

[7] i.e. it excluded inter-island ferries and long-distance passenger rail services, which are also operated by KiwiRail.

- Time and congestion savings (49% - 55% of benefits)
- Reduced air pollution (10% - 22% of benefits)
- Reduced fuel use and maintenance costs (14% of benefits)
- Reduced greenhouse gas (GHG) emissions (9% to 10% of benefits).

To continue realising rail's substantial value to New Zealand, as per above, and to maximise its potential to limit growth in road traffic over time, the network must be available for operations 24/7 just like the road network.

5. Summary and Conclusion

Rail is an important part of New Zealand's current transport mix. It provides significant value to New Zealand. However, encroachment – including dropped objects – from neighbouring properties could affect the efficient operation of rail and limit its contribution to long-term economic prosperity. KiwiRail's proposal recognises this and seeks appropriate precautions that also recognise the property rights of adjacent landowners.

Overall, I consider KiwiRail's proposal to strike an appropriate balance between those competing interests. It is unlikely to have any material impacts on development capacity, while helping to protect the value of rail to New Zealand. Accordingly, I support it on economic grounds.

Attachment 4: Other Options Considered

For completeness, other methods (outside of District Plan controls) have also been considered. These include:

a. increase in designation width;
b. fencing of the urban rail network; and
c. providing for building maintenance via access from the rail corridor.

Increase Designation Width

KiwiRail could increase the width of its designation to manage health and safety effects. This would require a range of applications for new or altered notices of requirement and KiwiRail to demonstrate (among other things):

a. the designation was required for a 'project or work' (Section 168(2)(a));
b. adequate consideration has been given to alternative sites, routes, or methods where the requiring authority does not have an interest in the land sufficient for undertaking the work (Section 171(1)(b)(i)); and
c. that the work / designation are reasonably necessary for achieving the objectives of the requiring authority (Section 171(1)(c).

Should a designation be confirmed it imposes limitations on what works a person may undertake on the designated land without written approval of the requiring authority (Section 176(1)(b)). This adds a layer of control over land which would not exist under the preferred option of district plan standards.

Further, the requiring authority may be required (by the Environment Court) to acquire land subject to a designation (Section 185) where certain 'tests' are met. This creates a significant and ongoing financial obligation on the requiring authority as it is unpredictable when / if land owners would seek acquisition.

Discussions with KiwiRail indicate that it does not consider an increase in designation width would be "reasonably necessary" (per s171(1)(c) of the RMA) to justify designating all land within 5 metres of the rail corridor nor would it meet the sustainable management purpose of the RMA.

Overall, applying a designation is considered to be a disproportionately restrictive approach to managing this issue. Alternative methods are considered available (ie. plan provisions) with a lower impact on enjoyment of land than a designation. The proposed provisions will be more efficient and effective than designating a wider corridor to provide a setback as it provides flexibility of use by resource consent in situations where building within the setback is acceptable. Applying a wider designation means land will not be available for use (without approval of the requiring authority) for purposes other than for rail.

Fence/Physical Barrier

Fencing the rail corridor boundary throughout urban areas of the district to prevent access potentially reduces 'casual' encroachment but does not solve the issue of insufficient space for

building owners to undertake maintenance within their own site boundaries. It is likely that it will not manage the effects of falling objects entering the rail corridor.

Fencing also has a range of significant costs which (as well as the establishment costs for building the fences) include ongoing maintenance (damage/graffiti) and visual amenity impacts.

Access Requests for Adjoining Building Maintenance

KiwiRail manages requests for access to its rail corridor via a formal permit and Track Access Request process (TAR)[15]. A permit provides a permission to enter whereas a TAR sets the specific parameters of entry.

KiwiRail has advised that the majority of these requests come from utility operators who wish to access the utilities located within the rail corridor, for example, telecommunications, electricity, water / wastewater etc. It is uncommon for private landowners to request a permit/TAR to access to the corridor.

In KiwiRail's experience, adjacent landowners do not contact KiwiRail for permission before undertaking building maintenance activities, primarily because:

a. landowners do not perceive their encroachment into the rail corridor to be a concern;
b. KiwiRail land is perceived to be public property;
c. landowners are unaware that they should be seeking permission; or
d. there are concerns or uncertainty about process and costs of seeking permission (or that it may be declined).

Regardless of whether land owners seek approval, if buildings are built too close to the rail corridor, then landowners will not be able to maintain them without entering the rail corridor.

In the event there is a request to access the rail corridor, and this required KiwiRail to alter or suspend its services, this would be a cost for the landowner and also for KiwiRail in terms of the impacts on its services.

Setting plan provisions which effectively require permission to access the rail corridor to undertake maintenance and other activities is also poor and uncertain planning. Plan provisions should provide for landowners to be able to use and maintain their properties within their own property, rather than having to encroach onto the rail corridor.

Allowing for building setbacks which ensure encroachment onto adjoining sites to undertake maintenance not required are more appropriate, and safer, method of addressing this issue.

[15] https://www.kiwirail.co.nz/our-network/access-our-network/permit-to-enter/permits-and-tars-portal/

Attachment C: Standard Railway Noise and Vibration Reverse Sensitivity Provisions and Section 32 Report dated 16 August 2023 prepared by Louise Taylor and Lisa Thorne

Taylor. Planning

KiwiRail Holdings Limited

Standard Railway Noise and Vibration Reverse Sensitivity Provisions and Section 32 Report

16 August 2023

Report Authors: Louise Taylor and Lisa Thorne

Supporting clients to solve their resource management challenges.

taylorplanning.co.nz

Contents

KiwiRail Holdings Limited Section 32 Analysis of Rail Noise and Vibration Provisions

1. Introduction

KiwiRail Holdings Limited (**KiwiRail**) is the State-Owned Enterprise responsible for the construction, maintenance and operation of New Zealand's rail network. The rail network is critical to the safe and efficient movement of freight and passengers throughout New Zealand, and forms an essential part of the national transportation network and the wider supply chain.

KiwiRail is a network utility operator, and the Requiring Authority for railways throughout New Zealand. KiwiRail's rail network operates over 3500km of rail network and infrastructure, used by more than 900 freight trains every week, operating between Whangarei and Bluff. The rail network is utilised to carry imported and exported goods from New Zealand ports, timber and forestry products, bulk good such as dairy products and steel, domestic goods between cities, and domestic passengers, and demand for this service is expected to continue to grow. Passenger rail is also a growing source of traffic for the rail network. While passenger rail volumes are currently only located in New Zealand's main cities, expansion of passenger rail inter-regionally is a growing focus of national transport strategy.

This mix of freight and passenger rail traffic is critical to New Zealand's decarbonisation and public transport goals currently and into the future. For this reason, the rail network is recognised as nationally significant, and is often classified as regionally and/or nationally significant infrastructure in District Plans.

This report has been prepared in accordance with the requirements of s32 and Schedule 1 of the Resource Management Act 1991 (**Act**). It assesses and supports the inclusion of District Plan land use provisions to appropriately manage noise and vibration effects on sensitive activities in the vicinity of the rail network. In some cases, the provisions may require amendment to reflect the structure and style of the District Plan drafting (for example, utilising existing definitions, objectives or policies relating to the transport network or Activities Sensitive to Noise).

1.1 Value of Rail

The rail network is a significant contributor to the movement of freight within New Zealand, carrying 16% of total national freight, 25% of exports, and 18 million tonnes of freight every year. The 2021 Value of Rail in New Zealand report[1] found that the total value of rail in New Zealand was estimated to be between $1.70 billion - $2.14 billion each year, from:

- reduced greenhouse gas emissions and air pollution, by reducing 2.5 million tonnes of CO_2 emissions each year;
- time savings and reduced congestion; reducing cars and trucks on road, avoiding 26 million car trips a year in Auckland and Wellington alone, and removing 24,000 trucks from the road;
- improved road safety, including fewer injuries and fatalities, with 288 fewer injuries and fatalities each year; and
- lower road maintenance costs for taxpayers and greater fuel savings, saving between $310-$329 million each year.

Rail is an energy efficient mode of transport, and generates 70% fewer emissions than heavy road freight transport. KiwiRail is a leader in low emissions freight transport, supporting the national transition to net zero carbon by 2050. To achieve this, KiwiRail's Sustainability Strategy 2022-2025 contains specific carbon emission reduction objectives. With New Zealand's freight market projected to grow by 30% by 2030, rail will play an increasing part in handling the increase, providing greater resilience to the transport network, and reducing carbon emissions.

Acknowledging the benefits of rail (as outlined briefly above) and the role rail will play in decarbonising the freight network, the New Zealand Government has, to an extent not seen in a generation, chosen to fund, via the National Land Transport Fund, rail infrastructure, to ensure rail can scale effectively and efficiently to the needs of passengers and freight. Investment in rail (including new and improved infrastructure and rolling stock – locomotives, wagons and carriages) since 2019 now exceeds $8b.

Given the nationally significant benefits and savings to the New Zealand economy, the greenhouse gas emission reductions, and air pollution reductions associated with rail freight, the adverse effects of failing to protect the rail network from reverse sensitivity are significant. At a national

[1] Ernst and Young, The Value of Rail in New Zealand, Report for the Ministry of Transport, February 2021

scale, for illustrative purposes, every 1% reduction in rail traffic caused by reverse sensitivity may equate to costs in the range of approximately $17 to $21 million per annum.

1.2 Proposed Provisions

KiwiRail proposes to introduce a suite of provisions to the District Plan to appropriately protect the railway network from reverse sensitivity by avoiding and mitigating adverse health and amenity effects associated with railway noise and vibration where sensitive uses locate in proximity to the railway corridor[2]. As outlined in further detail below, similar provisions are already included in numerous operative plans throughout New Zealand.

These proposed provisions are provided in full in **Appendix 1** and are summarised below:

- Insert a new objective and two policies providing for the importance of the rail network and the potential for reverse sensitivity effects when activities sensitive to noise are in close proximity; [if needed, depending on nature of plan change or proposed district plan, including any existing policies which are in place regarding management of reverse sensitivity or activities sensitive to noise near infrastructure / industry]
- Insert a new definition for 'Activity Sensitive to Noise' In the Definitions Section (if required);
- Insert new vibration alert layer to District Plan maps;
- Insert new 100m rail corridor buffer to District Plan maps (called "Rail Noise Control and Vibration Alert Area") to which the rules below will apply:
- Insert new rules and standards for noise and vibration in the vicinity of the railway corridor:
    - Railway noise standards for Activities Sensitive to Noise within 100m of a rail network boundary (i.e. within the Rail Noise Control and Vibration Alert Area); and
    - Construction design standards for indoor noise control for Activities Sensitive to Noise within 100m of a rail network boundary (i.e. within the Rail Noise Control and Vibration Alert Area).
- Require resource consent for a Restricted Discretionary Activity where these standards are not met. Provide matters of discretion by which resource consent applications will be assessed against.

[2] "Railway Corridor" means the area captured within the KiwiRail designation.

- Include an advice note that applies within the Rail Noise Control and Vibration Alert Area, and which alerts the plan user that activities within this Area may be subject to vibration effects from rail activities. No standards or other rules apply in relation to vibration.

1.2 Supporting Information and Assessment

The development of these provisions and the assessment in this Section 32 Report is informed by:

- an expert Noise and Vibration Memorandum by Stephen Chiles, dated July 2023, and attached as **Appendix 2**; and
- an expert Economic Assessment of Options to Manage Rail Noise and Vibration Effects (Economic Assessment) by Insight Economics, dated July 2023, and attached as **Appendix 3**.

The Noise and Vibration Memorandum characterises the noise and vibration associated with the operation of the rail network, and analyses the adverse health effects associated with rail noise and vibration both internationally and in New Zealand. It includes an assessment of appropriate levels for exposure to railway sound and vibration in the New Zealand context to avoid or mitigate sensitivity to rail noise and vibration in proximity to the KiwiRail network. This has informed the preparation and analysis of the proposed provisions, and particularly the appropriateness of the proposed Rail Noise Control and Vibration Alert Area and associated setbacks, acoustic standards, and the consideration of vibration standards.

The Economic Assessment analyses the economic costs and benefits associated with the proposed provisions against a 'do nothing approach', and KiwiRail proposed provisions approach (being option G in this report), and a 100m setback approach (being Option E in this report). This includes the economic costs and benefits of health and amenity effects, building design/location, policy implementation, administration and compliance, opportunity costs of potentially forgoing noise sensitive development, and compromised rail operation and efficiency as a result of reverse sensitivity. The Economic Assessment quantifies an estimate of the net costs and benefits per kilometre of track, which confirms that the preferred option has the highest net economic benefit of the three options assessed.

1.3 Requirements of Section 32 of the Act

This report provides an evaluation of the proposed objective and options to achieve the objectives in accordance with section 32 of the Act. Under the Act, a section 32 evaluation must:

- Examine whether the proposed objectives of the proposal are the most appropriate way to achieve the purpose of the Act (s32(1)(a));

- Examine whether the proposed provisions are the most appropriate way to achieve the objectives by identifying other reasonably practicable options, assessing the efficiency and effectiveness of options and summarising the reasons for deciding on provisions (s32(1)(b));
- Relative to considering the efficiency and effectiveness of the provisions in achieving the objective, include an assessment of the benefits and costs of the effects anticipated from implementing the provisions (s32(2));
- Contain a level of detail that corresponds to the scale and significance of the environmental, economic, social, and cultural effects that are anticipated from implementing the proposal (s32(1)(c)); and
- Where amendments are sought to a plan change that is already proposed or a plan which already exists, evaluate the proposal against both the objectives of the proposal and the objectives of the existing plan or plan change (s32(3)). As this assessment applies to District Plans generally, additional evidence is likely to be required in terms of s32(3) for specific plans or plan changes.

Each of these matters is assessed in this report (other than s32(3)), and on that basis the proposed provisions are considered the most appropriate way to achieve the sustainable management purpose of the Act.

2. Resource Management Issue

2.1 Operational Rail Noise

Railway noise levels are dependent on the type and condition of train and traffic volumes, speeds, track geometry and condition, and terrain and other factors. When considering railway noise levels the assumed railway traffic volumes are also important. With full geospatial details and information on railway activity, various standard acoustics computer modelling packages can be used to predict railway noise levels, depending on the situation. However, there is currently no standardised approach to this modelling for railway sound in New Zealand, nor consistent use of a particular method.

In 2009 KiwiRail commissioned Marshall Day Acoustics to provide a recommended method for the prediction and control of rail noise. The recommendations of Marshall Day Acoustics have provided the basis for the methods developed and considered in this report. This is assessed and explained in greater detail in the Noise and Vibration Memorandum provided at Appendix 2 to this report.

The method proposed by Marshall Day Acoustics, and outlined in detail in the Noise and Vibration Memorandum uses a 1 hour averaging method, to appropriately capture the noise maximums likely from the rail network. Specifically, it utilises the following assumed noise levels from rail activities at certain distances:

> *The following provides an illustration of typical railway sound levels based on an assumption of approximately two freight train movements in a one-hour period, in a flat area without screening. This is based on data summarised by Marshall Day Acoustics. More recent (unpublished) measurements for various New Zealand train types confirm these sound levels are in a realistic range.*

Distance from track	Sound level
10 metres	71 dB $L_{Aeq(1h)}$
20 metres	68 dB $L_{Aeq(1h)}$
30 metres	66 dB $L_{Aeq(1h)}$
40 metres	64 dB $L_{Aeq(1h)}$
50 metres	62 dB $L_{Aeq(1h)}$
60 metres	60 dB $L_{Aeq(1h)}$
70 metres	59 dB $L_{Aeq(1h)}$
80 metres	58 dB $L_{Aeq(1h)}$
90 metres	56 dB $L_{Aeq(1h)}$
100 metres	56 dB $L_{Aeq(1h)}$

Table 1: Typical rail sound levels (Noise and Vibration Memorandum)

The Noise and Vibration Memorandum sets out that internal sound levels with windows ajar for ventilation will typically be around 15 dB less than the above external levels.

2.2 Reverse Sensitivity

Reverse sensitivity is the susceptibility of lawfully established effects-generating activities (which cannot internalise all of their effects) to complaints or objections arising from the location of new sensitive activities nearby those lawfully established activities.

In the context of the railway corridor, this can adversely affect the 3500km of rail network throughout New Zealand, where activities that are sensitive to noise and vibration establish in close proximity to the rail corridor without suitable mitigation. The rail corridor is existing, fixed in place, and actively used for rail services (freight and/or passenger).

Without appropriate land use controls in place to manage health and amenity effects and the resulting reverse sensitivity effects associated with new or altered land uses in the vicinity of the railway corridor, sensitive activities can be adversely affected by rail noise and vibration, and this has adverse reverse sensitivity effects on the efficient operation of the rail network.

The rail network is usually identified as “regionally significant infrastructure” or similar definition in District Plans, which makes clear its importance to the District, Region and in some cases Country in terms of transportation of freight, passengers and associated resilience.

The Economic Assessment quantifies the net benefits and costs on rail operations under a ‘do nothing’ scenario (being Option A in this report). The net costs related to impacts on rail operation are estimated as $97,000 per kilometre of track. Conversely, the Economic Assessment confirms

there will be 0$ net costs to rail operation resulting from the proposed provisions.

2.3 Health Effects of Rail Noise

Where noise effects from the railway corridor are not appropriately managed by land use controls, health and amenity effects can arise for Activities Sensitive to Noise located on land near the railway network throughout New Zealand.

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. This has been documented by authoritative bodies such as the World Health Organisation[3] (**WHO**), including a publication by WHO Europe in October 2018 (**2018 WHO Guidelines**), which set out guidelines for managing environmental noise[4]. These WHO publications are underpinned by robust scientific research.

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 noise 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 noise exposure to below a range of guideline values.

The Noise and Vibration Memorandum provides an analysis of the WHO Guidelines and applicability of those guidelines to New Zealand. Research published in 2019[5] specifically addresses 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 North Island Main Trunk in South Auckland, including the section through Drury. The survey was based on the questions and methods set out in the international technical specification ISO/TS 15666[6], which is the same approach used in most international studies. The research found that international noise response curves are generally applicable to the New Zealand context, although potentially New Zealanders may be slightly more noise sensitive.

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

[4] World Health Organisation, Environmental noise guidelines for the European region, 2018.

[5] 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/

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

Although there is current New Zealand and international research that may further refine the understanding of health effects associated with exposure to railway noise, the memorandum sets out that the existing 2018 WHO Guidelines already establishes there are adverse health effects that warrant intervention.

KiwiRail employs various other mechanisms to reduce rail noise and vibration from the railway corridor. These include the installation of ballast mat, rail grinding and tamping, ballast cleaning and replacement, and automated monitoring of rolling stock wheel condition. In terms of track condition, KiwiRail has comprehensive procedures including measurement of track condition/ geometry with a specialist survey vehicle several times a year, and maintenance systems acting on that data.

As explained by Dr Chiles in the Noise and Vibration Memorandum, noise attenuation walls are rarely available for mitigation purposes as typically the rail corridor is elevated and therefore such a wall would need to be unreasonably high to provide benefit. Therefore, not all noise and vibration effects can be completely internalised within the KiwiRail designation boundaries. These effects are the result of normal rail operation and maintenance and cannot be solely attributed to defects in track or rolling stock, and form part of the existing environment.

For new buildings and alterations or additions to existing buildings near to the railway network, it is relatively straight-forward to control internal noise through building location, design and systems (such as using acoustic insulation and mechanical ventilation). In most cases, it is practical to achieve acceptable internal noise levels using such measures. Therefore, with careful design of building location, orientation and materials, and/or the use of new or existing barriers such as acoustic walls and/or bunds, or locating new dwellings behind existing dwellings or landforms on a site, the adverse effects of noise can be appropriately avoided and/or mitigated.

The Noise and Vibration Memorandum sets out that in the New Zealand context:

> *…railway sound level criteria of 35 dB LAeq(1h) inside bedrooms and 40 dB LAeq(1h) inside other habitable spaces have previously been applied for protection from health effects. These values are slightly higher (more lenient) than the 2018 WHO Guidelines for regular sound events but would be more stringent for infrequent events. This comparison relates only to average sound levels, but corresponding relationships with health effects for different frequencies of railway events are uncertain/unknown. Therefore, currently there is not an evidence base available that would support significantly more or less stringent railway sound criteria than 35 dB LAeq(1h) inside bedrooms and 40 dB LAeq(1h) inside other habitable spaces for*

protection of health.

The provisions proposed by KiwiRail is consistent with this approach, and adapted for the New Zealand context as an integral part of KiwiRail's broader noise management activities. The internal noise levels are therefore adopted in the proposed provisions, which provide a suite of options for compliance including building location, orientation and materials, and/or the use of barriers such as acoustic walls and/or bunds.

2.4 Effects of Rail Vibration

Norwegian Standard NS 8176[7] provides a summary of annoyance and disturbance relationships associated with vibration from land-based transport. These relationships demonstrate that adverse effects occur at vibration exposures typically found around existing rail networks. The primary issue relates to people in buildings being disturbed due to feeling vibration. Furthermore, the same vibration can cause buildings to radiate noise inside. As for managing sound, routine track and rolling stock (wheel) maintenance can contribute to reducing vibration at source.

Vibration can vary 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.

The Noise and Vibration Memorandum sets out that:

> *Adverse effects of railway vibration can include annoyance and sleep disturbance for building occupants and damage to buildings. Damage to buildings (even cosmetic damage) occurs at greater vibration magnitudes than those which can cause annoyance.*
>
> *Internationally, there has been less research into transportation vibration effects on people compared to research on transportation sound effects. However, the evidence that does exist on adverse health effects caused by railway vibration indicates they are material, and as such the relative paucity of research is not an indicator of the degree of effects. There is international research ongoing in this area. Research is also investigating health effects arising from the combination of railway sound and vibration.*

[7] Norwegian Standard NS 8176:2017 Vibration and shock - Measurement of vibration in buildings from land based transport. and guidance to evaluation of its effects on human beings.

In analysing the standards currently adopted nationally and internationally for assessing vibration effects, the Noise and Vibration Memorandum assesses vibration levels measured from different sources in New Zealand, and concludes that,

> *There is a knowledge gap as to the actual likelihood of cosmetic damage from railway vibration in New Zealand. However, all potential criteria for vibration effects on people are substantially more stringent, such that for buildings containing sensitive activities, cosmetic building damage might not require separate consideration.*

For new buildings and alterations or additions to existing buildings near to the railway network, as with railway noise, vibration can be controlled through building location, and design. Therefore, with careful design of building location, orientation and materials, the adverse effects of vibration can be appropriately avoided and/or mitigated.

However, the exact design requirements to ensure compliance with appropriate vibration levels depend significantly on site-specific factors, including ground condition / soil type, topography or other environmental features. The level of controls required and the associated cost of implementing such controls can therefore differ significantly on a site-to-site basis.

Without further research into the requirements and cost of implementing such controls on a district-wide basis, there is insufficient existing data to confirm appropriate district-wide provisions which require physical controls for vibration.

For this reason, KiwiRail has instead pursued a "Rail Vibration Alert Layer" be added to the District Plan maps. Such alert layers ensure landowners and occupiers are aware that vibration effects may be present in this location (100m from the rail corridor). They can then make their own design and location decisions should they wish to mitigate such effects. This enables behaviour change and appropriate notice to landowners, while avoiding uncertain costs of controls at this time.

2.4 Economic Effects

The Economic Assessment estimates the likely costs and benefits of 3 options: Option 1 to 'do nothing' (Option A in the s32 assessment below), Option 2 being the proposed provisions (Option G in the s32 assessment below), and Option 3 being a 100m setback option (per kilometre of rail track) (Option E in the s32 assessment below). The net costs and benefits of each option based on the assumptions set out in the Economic Assessment are summarised below.

Costs/Benefits per km of Track	Option 1	Option 2	Option 3
Amenity & health benefits	-$4,665,600	$0	$0
Impacts on rail operation	-$97,000	$0	$0
Policy compliance costs	$0	-$1,728,000	$0
Housing market impacts	$0	$0	-$28,800,000
Option Net Benefits/Costs	**-$4,762,600**	**-$1,728,000**	**-$28,800,000**

Table 2: Estimated net benefits and costs per kilometre of track (Economic Assessment)

The Economic Assessment notes there are different economic costs associated with the assessed options, and that when compared to a 'do nothing' or set back approach, the proposed approach has the lowest economic cost.

"Doing nothing" (Option 1/Option A) has a higher economic cost, primarily related to impacts on amenity and health, with some costs to rail operations. The Economic Assessment sets out that it is impossible to accurately assess the extent to which reverse sensitivity would disrupt the rail network and the consequential impacts on the economy. However the Economic Assessment sets out for illustrative purposes, at a national scale, "*every 1% reduction in rail traffic caused by reverse sensitivity from new Activities Sensitive to Noise establishing nearby would cost approximately $17 to $21 million per annum*".

A 100m setback (Option 3/Option E) while avoiding any economic impacts on rail and human health, "*will have the greatest impacts on housing supply because it sterilises the use of land for Activities Sensitive to Noise within 100 metres of the rail network*". The housing market costs associated with the loss of developable land are analysed in the Economic Assessment, and estimated net costs for a conservative typical mixed residential and non-noise sensitive activity scenario are approximately $28,800,000 per kilometre of track.

The proposed approach (Option 2/Option G) is assessed in the Economic Assessment as having no economic impacts associated with human health and rail operation effects. However there will be policy, administrative, and compliance costs estimated at approximately $1,728,000 per kilometre of track for a conservative typical mixed residential and non-noise sensitive activity scenario. These costs include the upfront costs to comply with the noise standards (acoustic assessment and the mitigation measures themselves), conservatively estimated as being $3000 (for an acoustic assessment), plus 3% of the building value for the associated mitigation to achieve compliance.

Although this places some cost burden on those establishing activities sensitive to noise in the vicinity of the rail network, these are largely one-off upfront costs which are a small proportion of

the total build cost. Additionally, these costs are significantly lower than the costs to health associated with no mitigation, and significantly lower still than the opportunity costs to the housing market of prohibiting the activity in the vicinity of the rail network.

2.5 Duty to Avoid Unreasonable Noise

Section 16 of the Act requires that:

> *"Every occupier of land… shall adopt the best practicable option to ensure that the emission of noise from that land or water does not exceed a reasonable level"*, and
>
> "*A national environmental standard, plan, or resource consent made or granted for the purposes of any of sections 9, 12, 13, 14, 15, 15A, and 15B may prescribe noise emission standards, and is not limited in its ability to do so by subsection*".

KiwiRail is a responsible infrastructure operator that endeavours to avoid, remedy or mitigate the adverse rail noise and vibration it produces, through its ongoing programme of upgrade, repairs and maintenance work to improve track conditions.

As discussed above, KiwiRail employs various mechanisms to reduce rail noise and vibration from the railway corridor. These include the installation of ballast mat, rail grinding and tamping, ballast cleaning and replacement, and automated monitoring of rolling stock wheel condition. KiwiRail has comprehensive procedures including measurement of track condition/geometry with a specialist survey vehicle several times a year, and maintenance systems acting on that data.

Not only is this important to KiwiRail as part of being a good neighbour, but it is also under a statutory obligation to use the best practicable option to avoid unreasonable noise (s16) and to avoid, remedy or mitigate adverse effects on the environment (s17).

The proposed provisions complement the above measures undertaken by KiwiRail in respect of its responsibilities under s 16 of the Act - to mitigate the remaining adverse effects that remain following the responsible management of noise and vibration by KiwiRail. They apply only to those developments which are bringing new or expanded sensitive activities to the existing activity operated by the KiwiRail – they do not impose new obligations on already established activities. As set out in the Economics Report, the provisions are also likely to result in a range of ancillary benefits to those dwellings where they are incorporated, including warmer, drier, and quieter homes that are also worth more.

Given the responsibility for the new activity lies with the neighbouring landowners, and the benefits

which come from the controls accrue to the new landowners, including in respect of overall property value, it is considered appropriate that the costs are assumed by those landowners. This is discussed further below in respect of Option H.

3. Approach to Issue

Mapping, land use rules and standards to avoid or mitigate adverse noise and vibration effects on sensitive activities are critical to protect sensitive activities from these effects. These standards are also fundamental to managing the potential for reverse sensitivity effects on the railway network as a result of this sensitivity. The location of incompatible sensitive activities in proximity to rail infrastructure can lead to noise and vibration effects on and complaints from sensitive users, affecting both the occupants in these areas, and affecting KiwiRail.

There are many examples in NZ district plans which seek to control the location and design of sensitive activities such as housing, healthcare and education facilities where such activities seek to locate near existing sources of noise and/or vibration. These include roads, railways, airports, ports, quarries, industrial sites, industrial and business zones, gun clubs and motorsport facilities. For sensitive activities near existing railways, examples of second-generation operative district plans containing controls include: Christchurch, Dunedin, Tauranga, Hamilton, Palmerston North and Hutt City. All these existing plans control land use standards to manage the adverse effects of noise and/or vibration.

The proposed provisions require that noise and vibration sensitive activities that may establish in proximity to the rail network are appropriately designed and sited to reduce the noise effect to an acceptable level. This will ensure that adverse effects on human health and amenity are appropriately managed, protects public health, provides certainty to those developing land adjacent to the rail corridor of the permitted standards, and protects nationally and regionally significant rail infrastructure from reverse sensitivity.

The proposed provisions are set out in full In **Appendix 1** and are summarised briefly below.

3.1 New Definitions

KiwiRail seeks the following definitions be added to the Definitions Section (if a suitably similar definition is not already in place in the District Plan):

Activity Sensitive to Noise: means any residential activity (including student or retirement accommodation), visitor accommodation, educational facility, child care facility, healthcare activity, and places of worship/marae.

3.2 New Objective and Policies

Insert a new objective and two policies providing for the importance of the rail network and the potential for reverse sensitivity effects when activities sensitive to noise are in close proximity:

- The Objective is to '*Ensure adverse reverse sensitivity, health and wellbeing effects arising from the development of Activities Sensitive to Noise adjacent to the railway network are appropriately avoided or mitigated'.*
- The policies are to:
    - '*Avoid reverse sensitivity effects on the ongoing and future operation and development of the railway network by ensuring new Activities Sensitive to Noise are designed or located to meet appropriate acoustic design standards'*; and
    - '*Manage effects on the health and wellbeing of communities through the design and location of Activities Sensitive to Noise adjacent to the railway network to meet appropriate acoustic design standards'*.

Where plans include existing objectives and/or policies which appropriately capture the matters above, or which could be amended or added to in order to integrate the objectives above, then this may be appropriate to ensure greater integration of the provisions into the particular plan.

3.3 New Rules and Standards

KiwiRail seeks the following rules and standards be added to the District Plan:

- For all zones at any point within 100 meters from the legal boundary of the KiwiRail Rail Corridor Designation (**Rail Noise Control and Vibration Alert Area**), all new buildings or alterations to existing buildings containing an Activity Sensitive to Noise, must meet:
    - Specified Internal noise standards ranging from:
        - 35 dB LAeq(1h) for sleeping spaces, lecture rooms/theatres, music studios, assembly halls, and places of worship and marae,
        - 40 dB LAeq(1h) for all other habitable rooms, and education teaching areas, conference rooms, drama studios and sleeping areas, and overnight medical care and wards, and

        - 45 dB LAeq(1h) for libraries, and health clinics, consulting rooms, theatres and nurses' stations; or

    - The nearest exterior façade of the building accommodating the activity is at least 50m from the railway network and is protected by a specified noise barrier, or

    - It can be demonstrated by way of prediction or measurement that the noise at all exterior façades of the listed activity is no more than 15 dB above the relevant noise levels; and

    - For buildings which require windows to be closed to achieve the noise standards, mechanical ventilation standards must be met; and

    - A report is submitted to the council demonstrating compliance with the above rules prior to the construction or alteration of any building containing an activity sensitive to noise using specified assumptions.

- Require resource consent for a Restricted Discretionary Activity where these standards are not met. Provide matters of discretion by which resource consent applications will be assessed against which limit the assessment of effects to the extent of non-compliance, effects on health and wellbeing, reverse sensitivity effects, and the outcome of any consultation with KiwiRail.

- Include an advice note that applies within the Rail Noise Control and Vibration Alert Area, and which alerts the plan user that activities within this Area may be subject to vibration effects from rail activities. No standards or other rules apply in relation to vibration.

4. Assessment of Objective

Section 32(1)(a) requires an assessment of whether the proposed objective is the most appropriate way to achieve the purpose of the Act. The purpose of the Act is set out in Section 5 as:

(1) The purpose of this Act is to promote the sustainable management of natural and physical resources.

(2) In this Act, sustainable management means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while—

(a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

(b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and

(c) avoiding, remedying, or mitigating any adverse effects of activities on the environment.

An assessment of the provisions against the proposed Objective against section 5 is set out in the table, below.

Table 3: Assessment of Objective under Section 5 of the Act

Proposed KiwiRail Provisions	Reason for Objective
Objective Ensure adverse reverse sensitivity, health and wellbeing effects arising from the development of Activities Sensitive to Noise adjacent to the railway network are appropriately avoided or mitigated. Policy Avoid reverse sensitivity effects on the ongoing and future operation and	The objective and supporting policies enable communities to provide for their health and wellbeing, and protects the railway network from reverse sensitivity. Where located in close proximity to the railway corridor, activities sensitive to noise are appropriately designed and sited so that adverse effects on health and wellbeing are appropriately managed, and railway infrastructure is appropriately protected from reverse sensitivity.

development of the railway network by ensuring new Activities Sensitive to Noise are designed or located to meet appropriate acoustic design standards. Policy Manage effects on the health and wellbeing of communities through the design and location of Activities Sensitive to Noise adjacent to the railway network to meet appropriate acoustic design standards.	This enables people to provide for the economic and social use of sites adjacent to the railway corridor, and to meet the reasonably foreseeable needs of the activity, while ensuring that adverse noise and vibration effects are avoided and mitigated. It is therefore considered that the proposed objective is the most appropriate way to achieve the purpose of the Act.

5. Assessment of Proposed Noise and Vibration Provisions

Sections 32(1)(b) and 32(2) require an assessment of the proposed provisions to be undertaken to test their appropriateness and efficiency and effectiveness. This must include:

- whether the proposed provisions are the most appropriate way to achieve the objectives by identifying other reasonably practicable options, assessing their efficiency and effectiveness and summarising the reasons for deciding on provisions; and
- relative to considering the efficiency and effectiveness of the provisions in achieving the objective, include an assessment of the benefits and costs of the effects anticipated from implementing the provisions.

The cost and benefit assessment must identify and assess the costs and benefits associated with environmental, economic, social, and cultural effects including economic growth and employment that are anticipated to be provided or reduced. If practicable, the Act requires that these be quantified.

Section 32(2)(b) also requires an assessment of the risk of acting or not acting if there is uncertain or insufficient information. In this case, it is acknowledged that the costs of implementing the insultation measures will vary on a site by site basis, and the scale will depend on factors such as extent of area affected and density of housing. However, there is considered to be sufficient information about the effects of noise and vibration on health and amenity and reverse sensitivity to the rail corridor, to determine the range and nature of effects of the options. No assessment of the risk of acting or not acting is necessary.

5.1 Identification of Reasonably Practicable Options

KiwiRail have considered a range of potential options. This includes 'doing nothing', a number of existing approaches, the proposed provisions, and other regulatory methods and mechanisms available. These are summarised below:

Option A - Do nothing:
No or limited railway noise and vibration provisions in the District Plan. This may include no specific noise and vibration rules, standards or mapping overlays, but may include consideration of reverse sensitivity effects when assessing the adverse effects of any resource consent application, depending on the existing objectives, policies and rules in the District Plan.

This includes subdivision, use or development within the vicinity of the railway corridor if the District Plan provides sufficient direction to do so.

Option B – Rail operator reduces noise and vibration emissions:
The rail operator ensure that noise and vibration emissions are reduced to the extent that Activities Sensitive to Noise within 100m of the rail corridor achieve the recommended noise and vibration levels without needing to undertake any specific insulation, ventilation or construction design standards.

Option C - Noise barriers:
Acoustic walls or bunds installed by the applicant or the rail operator with no other noise or vibration management methods.

Option D - Construction design standards:
A table which specifies minimum construction materials and standards necessary to achieve internal acoustic levels within buildings, with no other noise or vibration management methods.

Option E - Setbacks:
Requiring Activities Sensitive to Noise to be set back 100m from the railway corridor with no other noise or vibration management methods.

Option F - Internal acoustic standards:
Require internal acoustic and ventilation rules and standards for noise-sensitive activities, but provide no other options to achieve compliance.

Option G – Combination of rules and standards (Proposed provisions):
Within 100m of the railway corridor, provide several options to achieve compliance with internal acoustic levels – within 50m of the rail corridor buildings are designed to meet specified Internal noise levels, or must meet a 50m setback, or where the noise at exterior façades is measured or predicted to be no more than 15 dB above the relevant noise level. Buildings must also meet mechanical ventilation standards and reporting standards. Includes an advice note to alert plan users that Activities Sensitive to Noise within the Rail Noise Control and Vibration Alert Area may be subject to vibration effects.

Option H – Proposed provisions funded by rail operator:
Within 100m of the railway corridor, via a mapped Rail Noise Control and Vibration Alert Area, the same options to achieve compliance would be available - buildings are designed to meet

specified Internal noise levels, or must meet a 50m setback, or noise at exterior façades is no more than 15 dB higher. Buildings must also meet mechanical ventilation standards and reporting standards, and there is an advice note regarding vibration effects. However, the difference is that KiwiRail would fund the achievement of these standards.

Option I - Landscaping:
Landscape planting to provide acoustic mitigation, with no other noise or vibration management methods.

Option J - National regulation:
This may include changes to the Building Act or Building Code or introduction of a National Planning Standard or National Environmental Standard. The Building Act and Code currently provides specifications to manage inter-tenancy noise (eg noise between residential apartments within the same building with shared tenancy walls). However, it does not require the management of internal noise where noise is generated from outside a building (e.g. rail noise from an adjacent rail corridor).

Option K Reverse sensitivity covenant:
A plan provision which requires a covenant whereby property owners agree not to complain about noise and vibration effects on sensitive land uses. This is often referred to as a 'no complaints' covenant.

An assessment of these options in accordance with Sections 32(1)(b) and 32(2) of the Act is provided below.

5.2 Assessment of Reasonably Practicable Options

Table 4: Assessment of Reasonably Practicable Options

Option A - Do nothing

No or limited railway noise and vibration provisions, but this option may include consideration of reverse sensitivity effects when assessing a resource consent application for subdivision, use or development within the vicinity of the railway corridor.

Effectiveness and Efficiency	**Costs**	**Benefits**
Doing nothing requires no action from the territorial authority or applicant so could be considered efficient. It is considered to be the least effective option as it will place no limit on the establishment of Activities Sensitive to Noise in the vicinity of the railway corridor. This will result in an increase in exposure of sensitive activities to the adverse effects of rail noise and vibration.	Doing nothing will result in the establishment of Activities Sensitive to Noise in the vicinity of the railway corridor without being appropriately designed and sited. This will result in an increase in exposure of sensitive activities to the adverse effects of rail noise and vibration, resulting in adverse health and amenity effects for people, and adverse reverse sensitivity effects on rail activity. These costs are analysed in the Economic Assessment, and estimated net costs to health and amenity are approximately $4,665,600, estimated net costs to rail operation is approximately $97,000, with these costs totalling approximately $4,762,600 per kilometre of track.	There will be no additional regulatory cost or costs to landowners and occupiers in terms of compliance or building cost increases. There will be no administration and regulatory costs to the territorial authority as there will be no associated resource consenting or monitoring and compliance.
Is doing noting reasonably practicable? No - it will not achieve the objective and will result in adverse health and wellbeing effects, and adverse reverse sensitivity effects.		

Option B - Rail operator reduces noise and vibration emissions

The rail operator ensure that noise and vibration emissions are reduced to the extent that Activities Sensitive to Noise within 100m of the rail corridor achieve the recommended noise and vibration levels without needing to undertake any specific insulation, ventilation or construction design standards.

Effectiveness and Efficiency	**Costs**	**Benefits**
This option would not be efficient or effective as, given mitigation measures to minimise rail noise and vibration are unable to comprehensively control these effects, this would significantly curtail the reasonable operation of the existing rail network, and would eliminate the opportunity for any growth in rail traffic over time, resulting in an inefficient use of infrastructure. This would then have consequences for the delivery of freight and passenger transport, and may compromise the achievement of emissions reduction targets by increasing the reliance on road freight.	This option would likely be cost prohibitive to KiwiRail given the impacts on its operations. There may be an environmental cost associated with an increase in emissions associated with having to rely on alternative transport methods.	There are no potential benefits to KiwiRail associated with this option. There would be health and amenity benefits associated with the reduction of rail noise and vibration for Activities Sensitive to Noise within the vicinity of the rail corridor. There may be benefits to landowners to maximise development potential for Activities Sensitive to Noise within the vicinity of the rail corridor.
Is doing noting reasonably practicable? No – this option would places significantly curtail rail the efficient use and development of rail infrastructure.		

Option C - Noise barriers

Acoustic walls or bunds installed by the property owner or by the rail operator.

Effectiveness and Efficiency	Costs	Benefits
This option is effective and efficient when it integrated into the design of a new development in some instances. Acoustic walls may be able to be retrofitted in some instances. However it is not always practical because the height of the barrier required to achieve compliance would be very high (often in excess of 3.8m) and is therefore either impracticable or not consentable/difficult to consent. Most locations have practical limitations to install noise barriers. Limitations include the typical raised nature of rail lines (and train engines above these) above surrounding land, or from undesirable ground conditions and a lack of physical corridor which may necessitate property purchase due to the wider	There is a monetary cost of the installation of acoustic walls by KiwiRail. However this is not typically done by KiwiRail given the practical limitations set out in the efficiency and effectiveness review. Acoustic walls can be visually dominant and result in significant shading and shadowing, and can block view and outlook, given the heights required to achieve acoustic compliance. For these reasons the amenity and construction costs may in some circumstances be greater than the health and amenity effects they seek to mitigate. Walls and bunds also may reduce passive surveillance of surrounds and do not reduce vibration effects which would still need to be manged in a different way. If the permitted standards	Acoustic walls and bunds can provide noise reduction for single storied buildings. They also assist in visually screening development from the rail corridor, reducing the perception of noise, however they are often not practical or consentable, and can result in other health and amenity effects.

area of land required for the foundations of the noise barriers which require a wide base (which may result in the removal of adjacent activities) or for the physical space required for any bund. Whether bunds or acoustic walls are used, these may not often be effective for buildings of more than one storey.	are not met, then there will be costs borne by the applicant to prepare a resource consent application, costs to the territorial authority to assess the application, and costs to KiwiRail as a submitter to the application.	
Is the proposed approach reasonably practicable? In some circumstances acoustic walls and bunds can manage the adverse effects of noise on Activities Sensitive to Noise, and will protect KiwiRail railway infrastructure from reverse sensitivity. However, they are difficult to retrofit to existing situations, are often impractical for new situations, and can result on other adverse health and amenity effects.		

Option D - Construction design standards

A table which specifies minimum construction materials and standards necessary to achieve internal acoustic levels.

Effectiveness and Efficiency	**Costs**	**Benefits**
This option is somewhat effective and efficient. It is a relatively common approach	There will be additional compliance costs during building consent and building	Construction standards provide certainty as to outcome and design

to managing the adverse effects of noise in District Plan. However, it can have some limitations in terms of effectiveness as it essentially 'locks in' the standards to those at the time of writing the provisions. This means as construction standards improve and change over time, the standards in the plan remain static. This can result in future activities needing to obtain a resource consent where the standards are not met - even where the noise and vibration effects are appropriately managed. The Noise and Vibration Memorandum also sets out that in the Christchurch District Plan, although multiple compliance options were included for mitigating road and rail noise in buildings, including design standards, that on review of the controls the Council found that in most cases site-specific assessment associated with meeting internal acoustic standards was selected. This was presumably as despite any	construction when compared with Option A. Building and compliance design costs will be borne by the applicant and compliance confirmation costs will be borne by the territorial authority and/or the applicant. If the permitted standards are not met, then there will be costs borne by the applicant to prepare a resource consent application, costs to the territorial authority to assess the application, and costs to KiwiRail as a submitter to the application. Construction standards can often be complex, and typically require technical expertise on behalf of applicant and regulatory authority if there is any deviation from the standards in the schedule. This can Impose additional monetary and time costs. Construction standards often lack the flexibility to accommodate individual site circumstances. This may occur If the topography of the site removes or reduces the	specifications, and the associated costs can be estimated. Where compliance with the standards is demonstrated, an acoustics specialist does not need to be engaged by any party. Compliance can simply be demonstrated on building plans at the time a building consent is lodged.

specialist assessment costs the site-specific assessment provided a more efficient solution. This option is therefore considered to be less efficient than the preferred options.	need for all construction design standards to be met. As the standards are essentially 'locked in' to the plan, it requires a plan change to update them. The same requirements apply regardless of the level of external noise exposure. This means that some buildings will have more treatment and associated costs than is necessarily needed to achieve adequate indoor noise levels. Conversely, some buildings with the higher external noise exposure might not have adequate treatment.	
Is the proposed approach reasonably practicable? Somewhat - construction standards are a common regulatory approach to manage the adverse effects of noise and vibration for Activities Sensitive to Noise, and will protect KiwiRail railway infrastructure from reverse sensitivity. However, achieving compliance can be complex, and it is less preferred in practice than the acoustic standards in Option F, and there are limitations to this approach.		

Option E - Setbacks

Building or activity setback for Activities Sensitive to Noise of 100m from the railway corridor with no other noise or vibration management methods.

Effectiveness and Efficiency	Costs	Benefits
This option is effective as it is a simple method to minimise noise and vibration. However, it is not an efficient use of land. This approach is efficient for large rural sites where there is flexibility to locate Activities Sensitive to Noise away from the railway corridor.	The costs of requiring effective setbacks is the loss of developable land for Activities Sensitive to Noise within the vicinity of the railway corridor. The housing market costs associated with the loss of developable land are analysed in the Economic Assessment, and estimated net costs for a conservative typical mixed residential and non noise sensitive activity scenario are approximately $28,800,000 per kilometre of track. This also imposes a maintenance burden on the landowner as the person responsible for maintaining the large setback areas. If the permitted standards are not met, then there will be costs borne by the applicant to prepare a resource consent application, costs to	This is a simple approach that can work well for large rural sites where setback areas can continue to be used for agricultural purposes. However this approach remains open to rural sites as a method of management under other controls (including noise provisions). Setbacks effectively minimise noise, vibration and amenity effects.

	the territorial authority to assess the application, and costs to KiwiRail as a submitter to the application.	
Is the proposed approach reasonably practicable? Yes - it provides a tried and tested regulatory approach to effectively manage the adverse effects of noise and vibration on Activities Sensitive to Noise, and will protect KiwiRail railway infrastructure from reverse sensitivity. However, it is only efficient and effective for large rural sites, and there are high opportunity costs to the housing market.		

Option F – Acoustic Standards

Require internal acoustic rules and standards for noise-sensitive activities, but provide no other options to achieve compliance.

Effectiveness and Efficiency	**Costs**	**Benefits**
Acoustic standards are reasonably efficient and are common in a number of District Plans to manage noise effects of different activities including road, rail and aircraft noise. Territorial authorities typically require certification that the standard is met as part of the building consent application processing. Compliant buildings would not require a resource	There will be additional compliance costs during building consent and building construction when compared with Option A. Building and compliance design costs will be borne by the applicant and compliance confirmation costs will be borne by the territorial authority and/or the applicant. If the permitted standards are not met, then there will be	Acoustic standards which require Activities Sensitive to Noise to meet internal noise standards provide flexibility to the applicant to determine how they wish to meet the standards. This can be achieved using different options. Provides health and amenity benefits for new and expanded sensitive activities locating adjacent to the rail corridor, without unduly constraining development of

consent. Internal acoustic standards are not effective if there are opening windows. Any standards therefore require internal ventilation standards to be included alongside insulation controls.	costs borne by the applicant to prepare a resource consent application, costs to the territorial authority to assess the application, and potentially costs to KiwiRail as a submitter to the application depending on the potential level of reverse sensitivity effect. These policy, administrative and compliance costs for a conservative typical mixed residential and non noise sensitive activity scenario are analysed in the Economic Assessment, and estimated net costs are approximately $1,728,000 per kilometre of track.	Activities Sensitive to Noise near the rail corridor. Acoustic insulation also provides energy savings to occupiers and is likely to be capitalised in the value of the property. Avoids reverse sensitivity impacts on KiwiRail from increased numbers of sensitive activities locating adjacent to the rail corridor.
Is the proposed approach reasonably practicable? Yes – as addressed in full above it provides for a tried and tested regulatory approach to effectively manage the adverse effects of noise and vibration on Activities Sensitive to Noise, and will protect KiwiRail railway infrastructure from reverse sensitivity.		

Option G – Proposed Approach: Combination of new rules and standards for Activities Sensitive to Noise

Within 100m of the railway corridor, provide several options to achieve compliance with internal acoustic levels – within 50m of the rail corridor buildings are designed to meet specified Internal noise levels, or must meet a 50m setback, or where the noise at exterior façades is measured or predicted to be no more than 15 dB above the relevant noise level.

Buildings must also meet mechanical ventilation standards and reporting standards. Includes an advice note to alert plan users that Activities Sensitive to Noise within the Rail Noise Control and Vibration Alert Area may be subject to vibration effects.		
Effectiveness and Efficiency	**Costs**	**Benefits**
The provisions are effective as, depending on the activity and site circumstances, they provide several options for compliance. This option is efficient as it provides a range of options to achieve compliance. The standards are efficient as development meeting these standards will not require a require a consent and can be advanced as a permitted activity, which strikes an appropriate balance between enabling development and managing adverse effects. The standards are also efficient as they align with the rules in other District Plans - providing a nationally consistent approach and improving administration for KiwiRail and organisations operating nationally such as housing, healthcare and	There will be additional compliance costs during building consent and building construction when compared with Option A. Building and compliance design costs will be borne by the applicant and compliance confirmation costs will be borne by the territorial authority and/or the applicant. If the permitted standards are not met, then there will be costs borne by the applicant to prepare a resource consent application, costs to the territorial authority to assess the application, and costs to KiwiRail as a submitter to the application depending on the potential level of reverse sensitivity effect. These policy, administrative and compliance costs are analysed in the Economic Assessment, and for a	There will be an improvement in human health and amenity outcomes compared to Option A as there will be a reduction in the number of sensitive activities exposed to unacceptable levels of noise and vibration. It therefore enables Activities Sensitive to Noise to establish in the vicinity of the railway corridor where adverse effects can be effectively managed. This provides for the efficient use and development of land in accordance with section 7(b) of the Act. The range of permitted standards provides a flexible compliance pathway for applicants. It provides a range of potential responses to achieve compliance. This option also provides a comprehensive regulatory approach which recognises the actual spatial extent of railway corridor noise and vibration - and only limits

education providers. The noise and vibration provisions do not apply to existing activities so there are no additional constraints on developed sites where redevelopment is not anticipated. The provisions provide clear and specific matters of discretion which gives greater certainty to developers (and the Council) over the matters that will be assessed if resource consent is required.	conservative typical mixed residential and non noise sensitive activity scenario, the estimated net costs are approximately $1,728,000 per kilometre of track.	activities which are adversely affected by operating outside these parameters.
Is the proposed approach reasonably practicable? Yes - it provides for a range of tried and tested regulatory approaches to effectively manage the adverse effects of noise and vibration on Activities Sensitive to Noise, and will protect KiwiRail railway infrastructure from reverse sensitivity.		

Option H - Proposed provisions funded by rail operator

Within 100m of the railway corridor, via a mapped Rail Noise Control and Vibration Alert Area, the same options to achieve compliance would be available - buildings are designed to meet specified Internal noise levels, or must meet a 50m setback, or noise at exterior façades is no more than 15 dB higher. Buildings must also meet mechanical ventilation standards and

reporting standards, and other than an advice note, there are no vibration standards. However, the difference is that KiwiRail would fund compliance with these standards.		
Effectiveness and Efficiency	**Costs**	**Benefits**
This option is efficient as it provides a range of options to KiwiRail to achieve compliance. This option is not effective as putting the onus on KiwiRail to fund any compliance costs could perversely incentivise landowners to develop closer to the rail corridor than they would if the measures were self-funded. This could increase the costs of compliance as higher standards of insultation could be required, and it would result in more Activities Sensitive to Noise establishing in closer proximity to the rail corridor.	The policy, administrative and compliance costs are analysed in the Economic Assessment, and for a conservative typical mixed residential and non noise sensitive activity scenario, the estimated net costs are approximately $1,728,000 per kilometre of track. A large portion of these costs would be borne by KiwiRail.	The same benefit outlined in Option G apply, noting that benefits accrue to the landowner and occupier without any cost to them, despite their choice being to locate near a railway corridor.
Is the proposed approach reasonably practicable? No – this option could result in considerable cost to KiwiRail, of a level that would mean the implementation of the provisions is not feasible, and could perversely incentivise Activities Sensitive to Noise to establish in closer proximity to the rail corridor than they would otherwise.		

Option I - Landscaping Planted buffers to provide acoustic mitigation.		
Effectiveness and Efficiency	**Costs**	**Benefits**
This option is not effective or efficient, as dense landscaping in excess of tens of metres in width would be needed to provide noise reduction. Seasonal variations in terms of leaf density and weather induced variations may impact vegetation quality.	The costs of requiring effective landscape mitigation setbacks is the loss of developable land within the vicinity of the railway corridor. This also imposes a maintenance burden on the landowner as the person responsible for maintaining the large planted areas. If the permitted standards are not met, then there will be costs borne by the applicant to prepare a resource consent application, costs to the territorial authority to assess the application, and costs to KiwiRail as a submitter to the application.	Provides the benefit of added visual screening.
Is the proposed approach reasonably practicable? No – landscape planting is not an efficient or effective option.		

Option J - National Regulation

This may Include changes to the Building Act or Building Code or the introduction of a National Planning Standard or National Environmental Standard.

Effectiveness and Efficiency	Costs	Benefits
This option is likely to be the most efficient and effective compared to all other options. Unfortunately, although a nationally consistent approach would have a number of benefits, it is outside the Schedule 1 process of the Act and ultimately relies on political will.	Not applicable.	Not applicable.
Is the proposed approach reasonably practicable? No - not within scope.		

Option K - Reverse Sensitivity Covenant

A plan provision which requires a covenant requiring the property owners agree not to complain about noise and vibration effects on sensitive land uses.

Effectiveness and Efficiency	Costs	Benefits
This option is not effective and efficient, because it addresses the ability to complain about noise and vibration, rather than deal with those effects directly. Although this may avoid complaint regarding noise and vibration, Activities	There are legal costs associated with the covenant preparation and registration process. These costs will be borne by both the landowner and the territorial authority. This option provides for poor health and amenity outcomes as the actual	A covenant is a legally binding agreement between the property owner and the territorial authority, and is generally simple to understand. A covenant is likely to be a more cost effective approach compared to the other

Sensitive to Noise will still be affected by noise and vibration, resulting in adverse health and amenity effects for the occupants of these buildings and areas. A provision which requires a covenant is not efficient as it requires every individual site seeking to establish or add to a building to go through a covenant registration process against that individual parcel of land. In time, this can become difficult for a territorial authority to administer as it is not obvious whether or not a covenant applies to a record of title without searching that record of title individually.	effects of railway noise are not appropriately avoided or mitigated. If the permitted standards are not met, then there will be costs borne by the applicant to prepare a resource consent application, costs to the territorial authority to assess the application, and costs to KiwiRail as a submitter to the application.	options (excluding 'do nothing'), as It requires no additional building or design controls, or landscaping or noise barriers.
Is the proposed approach reasonably practicable? No - a reverse sensitivity covenant standard is not an efficient or effective option.		

6. Assessment Summary

Table 5: Assessment Summary

Reasonably Practicable Option	Assessment Summary
Option A - Do nothing: No or limited provisions.	Not reasonably practicable.
Option B – Rail operator reduces noise and vibration emissions: To the extent that no noise or vibration effect is generated on nearby Activities Sensitive to Noise.	Not reasonably practicable.
Option C – Noise barriers: Acoustic walls or bunds.	Not reasonably practicable.
Option D – Construction design standards: A table of minimum design requirements and construction materials to meet noise levels.	Somewhat reasonably practicable, but no favoured by plan users.
Option E - Setbacks: Building or activity setback of 100m with no other noise or vibration management methods.	Preferred methods - these methods can effectively manage the adverse effects of noise and vibration on Activities Sensitive to Noise and will protect KiwiRail railway infrastructure from reverse sensitivity. The most appropriate method to use is dependant on the site context.
Option F – Internal acoustic standards: Require internal acoustic rules and standards for noise-sensitive activities, but provide no other options to achieve compliance.	
Option G – Combination of rules and standards (Proposed provisions): New rules and standards for Activities Sensitive to Noise Within 100m of the railway corridor, provide several options to achieve compliance with internal acoustic levels – within 50m of the rail corridor buildings are designed to meet specified Internal noise levels, or must meet a 50m setback, or where	Most preferred method – Combines several of the methods above to provide options to effectively manage adverse noise effects and vibration and protect KiwiRail railway infrastructure from reverse sensitivity.

the noise at exterior façades is measured or predicted to be no more than 15 dB above the relevant noise level. Buildings must also meet mechanical ventilation standards and reporting standards. Includes an advice note to alert plan users that Activities Sensitive to Noise within the Rail Noise Control and Vibration Alert Area may be subject to vibration effects.	
Option H - Proposed provisions funded by rail operator: As above but funded by KiwiRail.	Not reasonably practicable.
Option I – Landscaping: Landscaping to provide acoustic mitigation.	Not reasonably practicable.
Option J - National Regulation: Changes to the Building Act or Code or new National Planning or Environmental Standards.	An out-of-scope potential long term solution.
Option K - Covenant: A 'no complaints' covenant provision.	Not reasonably practicable.

7. Conclusion

The operation, maintenance and development of the rail network is critical to the safe and efficient movement of freight and passengers throughout New Zealand, and forms an essential part of the national transportation network and the wider supply chain. KiwiRail's proposed provisions to the District Plan enable Activities Sensitive to Noise to be developed in the vicinity of the railway corridor where adverse noise and vibration effects can be effectively managed through a range of standards. The proposed provisions will mitigate health and amenity effects on new and altered Activities Sensitive to Noise that seek to establish within 100 metres of the railway corridor. This will ensure that the continued operation of nationally and regionally significant infrastructure of the rail corridor will be appropriately protected from reverse sensitivity, and neighbouring communities will experience positive health and amenity outcomes.

Consistent with section 32 of the Act, the proposed objective and policies have been developed and analysed against Part 2 and it is considered that the proposed objective is the most appropriate way to achieve the purpose of the Act.

The proposed provisions have been assessed against a number of alternative options in terms of their costs, benefits, and efficiency and effectiveness in accordance with the relevant clauses of section 32 of the Act.

The proposed provisions are considered to represent the most appropriate means of achieving the proposed objective. The provisions are also the most appropriate way of addressing the underlying resource management issues relating to managing the adverse effects of noise and vibration of surrounding land uses, and minimising reverse sensitivity effects to protect the railway network. Adopting the proposed provisions will maintain and enhance the continued use of Railway infrastructure while enabling the efficient subdivision, use and development of land in its vicinity, and providing for health and amenity outcomes.

Appendix 1: Proposed Provisions

Model District Plan Provisions

1. **Definitions**

Noise sensitive activity [if required]
Means any residential activity (including student or retirement accommodation), visitor accommodation, educational facility, child care facility, healthcare activity, and places of worship/marae.

The following provisions should be co-located together in a district -wide chapter (preferable noise and infrastructure) rather than applied on a zone by zone basis.

2. Objective

Ensure adverse reverse sensitivity, health and wellbeing effects arising from the development of noise sensitive activities adjacent to the railway network are appropriately avoided or mitigated.

3. Policies

Avoid reverse sensitivity effects on the ongoing and future operation and development of the railway network by ensuring new noise sensitive activities are designed or located to meet appropriate acoustic design standards.

Manage effects on the health and wellbeing of communities through the design and location of noise sensitive activities adjacent to the railway network to meet appropriate acoustic design standards.

4. Rules/Standards

4.1 Noise and vibration

E. Activities sensitive to noise within 100m of [KiwiRail Rail Corridor Designation]:

<table>
<tr><th></th><th colspan="3">Activity sensitive to noise near a railway network</th><th></th></tr>
<tr><td>All zones – at any point within 100 metres from the legal boundary of [KiwiRail Rail Corridor Designation] (Rail Noise Control and Vibration Alert Area)</td><td colspan="3">Activity status: Permitted

Indoor railway noise
1. Where any activity listed in Table 1 is located within the Rail Noise Control and Vibration Alert Area:
(a) the entire room or space shall be designed, constructed and maintained (including in any alterations) to achieve indoor design noise levels in Table 1; or

[RULEXX] Table 1
<table>
<tr><th>Building type</th><th>Occupancy/activity</th><th>Maximum railway noise level LAeq(1h)</th></tr>
<tr><td rowspan="2">Residential
[note definition in the plan must be broad enough to cover all types of residential activities – or other types of</td><td>Sleeping spaces</td><td>35 dB</td></tr>
<tr><td>All other habitable rooms
[note this may require the definition from the National</td><td>40 dB</td></tr>
</table></td><td>Activity status when compliance with standards 1, 2 or 3 not achieved: Restricted discretionary

Matters of discretion are restricted to:
1. The extent of non-compliance with the noise and vibration standards.
2. Effects on the health and wellbeing of people.
3. The reverse sensitivity effects on the rail network, including the extent to which the activity will unduly constrain the ongoing operation, maintenance and upgrade of the rail network.
4. The outcome of any consultation with KiwiRail.</td></tr>
</table>

residential activities not addressed within it will need to be added to this table]	*Planning Standards to be added if this is not already defined in the District Plan]*		Notification: Application for resource consent under this rule shall not be notified or limited notified unless KiwiRail is determined to be an affected person determined in accordance with section 95B of the Resource Management Act 1991 or the Council decides that special circumstances exist under s 94A(4) of the Resource Management Act 1991.
Visitor Accommodation	Sleeping spaces	35 dB	
	All other habitable rooms	40 dB	
Education Facility	Lecture rooms/theatres, music studios, assembly halls	35 dB	
	Teaching areas, conference rooms, drama studios, sleeping areas	40 dB	
	Libraries	45 dB	
Health	Overnight medical care, wards	40 dB	
	Clinics, consulting rooms, theatres, nurses' stations	45 dB	
Cultural	Places of worship, marae	35 dB	

(b) the nearest exterior façade of the building accommodating the activity listed in Table 1 is at least 50 metres from the legal boundary of the [KiwiRail Rail Corridor Designation], and there is a solid building, fence, wall or landform that completely blocks line-of-sight from all parts of doors and windows, to all points 3.8 metres above railway tracks; or

(c) it can be demonstrated by way of prediction or measurement that the noise at all exterior façades of the listed activity is no more than 15 dB above the relevant noise levels in Table 1.

Mechanical ventilation

2. If windows must be closed to achieve the design noise levels in clause 1(a), the building is designed, constructed and maintained with a mechanical ventilation system that:

(a) For habitable rooms for a residential activity or visitor accommodation activity, achieves the following requirements:

i. provides mechanical ventilation to satisfy clause G4 of the New Zealand Building Code; and

ii. is adjustable by the occupant to control the ventilation rate in increments up to a high air flow setting that provides at least 1 air change per hour; and

iii. provides relief for equivalent volumes of spill air;

iv. provides cooling and heating that is controllable by the occupant and can maintain the inside temperature between 18°C and 25°C; and

	v. does not generate more than 35 dB $L_{Aeq(30s)}$ when measured 1 metre away from any grille or diffuser. (b) For other spaces, is as determined by a suitably qualified and experienced person. **Report required** 3. A report is submitted to the council demonstrating compliance with clauses (1) to (2) above (as relevant) prior to the construction or alteration of any building containing an activity sensitive to noise. Compliance with 1(a) and (c) must be confirmed by a Registered Acoustician and when doing so railway noise must be assumed to be 70 $L_{Aeq(1h)}$ at a distance of 12 metres from the track, and must be deemed to reduce at a rate of 3 dB per doubling of distance up to 40 metres and 6 dB per doubling of distance beyond 40 metres. Note: The Rail Noise Control and Vibration Alert Area identifies the vibration-sensitive area within 100metres each side of the [KiwiRail Rail Corridor Designation]. Properties within this area may experience rail vibration effects. No specific district plan rules or notification requirements apply in relation to vibration controls as a result of this Rail Noise Control and Vibration Alert Area.	

Insert mapping overlay which identifies a 100m buffer on each side of the [KiwiRail Rail Corridor Designation] called “Rail Noise Control and Vibration Alert Area” to which the above rules will apply.

Appendix 2: Acoustics Advice

Chiles Ltd

Project: **Land use controls for railway sound and vibration**

Report: **Acoustics advice**

Client: KiwiRail

Reference: 130418h

Date: 19 July 2023

Author: Stephen Chiles

Contents:

1. Introduction

1.1. KiwiRail is undertaking an analysis of potential controls for existing/permitted railway sound and vibration from its national network, affecting new and altered sensitive land uses nearby. Chiles Ltd has been engaged by KiwiRail to provide advice on associated acoustics details to inform that analysis. This report sets out: effects of sound and vibration on people and buildings, indicative sound and vibration levels at different distances from railway tracks, methods to reduce sound and vibration, and recommendations for land use controls.

1.2. In normal acoustics usage the term "noise" describes unwanted airborne "sound", although some people use the words interchangeably. However, under the Resource Management Act (RMA) "noise" is defined as including vibration; presumably ground-borne. Notwithstanding that in practice "noise limits" in rules and conditions under the RMA refer exclusively to airborne sound. The term sound has been used in this report to distinguish airborne sound from ground-borne vibration in an RMA context where both are defined as noise.

1.3. A fundamental input when assessing railway sound and vibration is the type, volume and timing of railway traffic to be assumed on a particular section of the network. For comparison, when considering roads in New Zealand, road traffic volumes often gradually increase or remain steady, such that acousticians can sometimes use existing measured road traffic volumes as a reasonable baseline for future design. However, for railways in New Zealand, railway traffic volumes and times can change significantly, such that existing railway traffic may not be a reliable baseline when considering effects associated with new neighbouring houses that will exist for many decades. Therefore, appropriate assumptions for railway traffic types, volumes and times are an essential input that should be considered alongside the following acoustics information in this report.

1.4. Both sound and vibration have complex varying characteristics which are only approximated by metrics representing levels as a single number. There are compromises with whichever metrics are used. In the case of railway sound and vibration in New Zealand the choice of metrics is particularly challenging because often there are a relatively small number of intense events. In this situation, use of average values might under-represent adverse effects and use of maximum values might over-represent effects. The extent of under or over representation varies depending on the rail traffic in any location, which in turn relates to the comment above on railway traffic volumes. Metrics and objective analysis can still be valuable to focus interventions in the most effective places, but the limitations of the metrics require consideration when evaluating potential land use controls. This issue is discussed further in section 4.

2. Effects of sound

2.1. The World Health Organisation ("WHO") has periodically reviewed and collated evidence of health effects caused by environmental sound including from railways.[1] The most recent publication was by WHO Europe ("2018 WHO Guidelines"),[2] which was based on systematic

[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.

reviews of a large number of published studies. There have been numerous other discrete studies of these issues, but the 2018 WHO Guidelines provides a robust synthesis of available information and its findings with respect to railway sound appear to be widely accepted.

2.2. From preceding studies, the 2018 WHO Guidelines found moderate quality evidence that railway sound causes adverse health effects in that it increases the risk of annoyance and sleep disturbance in the population. Various other potential health effects were examined but evidence was not available to determine a relationship for them with railway sound. Based on the information available the 2018 WHO Guidelines made "strong" recommendations that external railway sound levels should be reduced below 54 dB L_{den} and 44 dB L_{night}. The 2018 WHO Guidelines found there was insufficient evidence to recommend one type of intervention over another to reduce levels.

2.3. The above 2018 WHO Guidelines recommendations are in terms of long-term (annual) average sound levels. One of the metrics relates just to the night period (L_{night}) and the other (L_{den}) is for a 24-hour average including penalties for sound occurring in the evening (+5dB) and at night (+10dB). By necessity, this use of long-term averages is a pragmatic approach given that potential health effects generally relate to exposure over extended periods and are determined from consideration of the community/population rather than specific individuals. Other research into health effects, such as relating to awakenings from sleep, has previously referenced maximum sound levels, but sleep disturbance as a health effect is only assessed in terms of average levels in the 2018 WHO Guidelines.

2.4. The 2018 WHO Guidelines were based on international research from a wide range of countries. There was no available data from New Zealand at that time. Subsequent research published in 2019 specifically addressed the applicability of international data on railway sound annoyance of the New Zealand population.[3] This included a survey of people living in the vicinity of the North Island Main Trunk line in South Auckland, using the same general methodology as most international studies. The research found that international noise annoyance response curves are generally applicable for the New Zealand population.

2.5. There is current New Zealand and international research that may further refine the understanding of health effects caused by railway sound. However, the existing 2018 WHO Guidelines already establishes there are adverse health effects that warrant intervention.

2.6. In New Zealand, railway sound criteria have commonly been defined in terms of one-hour average levels (see section 4). Values of 35 dB $L_{Aeq(1h)}$ inside bedrooms and 40 dB $L_{Aeq(1h)}$ inside other habitable spaces have previously been applied for protection from health effects. Accounting for the different metrics, these values are slightly higher (more lenient) than the 2018 WHO Guidelines for regular sound events but would be more stringent for infrequent events. This comparison relates only to average sound levels, but corresponding relationships with health effects for different frequencies of railway events are uncertain/unknown. Therefore, currently there is no evidence base available that would support significantly more or less

[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/

stringent railway sound criteria than 35 dB $L_{Aeq(1h)}$ inside bedrooms and 40 dB $L_{Aeq(1h)}$ inside other habitable spaces for protection of health.

2.7. There is a lack of information on the combination of indoor and outdoor living conditions in relation to health effects. Even if indoor conditions are controlled, there may still be residual health effects arising from outdoor conditions. In a New Zealand context, based on criteria applied for other sources, reasonable conditions in outdoor living spaces might be achieved with railway sound levels of 55 dB $L_{Aeq(1h)}$.

3. Effects of vibration

3.1. Adverse effects of railway vibration can include annoyance and sleep disturbance for building occupants and damage to buildings. Damage to buildings (even cosmetic damage) occurs at greater vibration magnitudes than those which can cause annoyance.

3.2. Internationally, there has been less research into transportation vibration effects on people compared to research on transportation sound effects. However, the evidence that does exist on adverse health effects caused by railway vibration indicates they are material, and as such the relative paucity of research is not an indicator of the degree of effects. There is international research ongoing in this area. Research is also investigating health effects arising from the combination of railway sound and vibration.

3.3. Norwegian Standard NS 8176[4] summarises research of human response to transportation vibration and provides exposure response curves in terms of the percentage of people who would perceive or experience degrees of annoyance from vibration. The current version of the standard (2017) discusses the inherent uncertainty in the data, including that it does not account for varying traffic volumes, although notes no other studies addressing that factor were found.

3.4. NS 8176 defines four categories of vibration exposure in residential buildings, with Class A representing the best vibration conditions and Class D (or below) representing the worst. The Class C criterion has previously been applied in New Zealand for habitable spaces in new buildings. This corresponds to a vibration level at which about 20% of people would be expected to be highly or moderately annoyed by vibration. The Class C criterion is defined as a $v_{w,95}$ of 0.3 mm/s (vibration metrics are explained in section 4).

3.5. For vibration effects on buildings, a ppv criterion of 5 mm/s is often used in New Zealand as a threshold at which there is potential for cosmetic damage to new buildings. While the 5 mm/s ppv criterion has been taken from guidance in an overseas standard, it does not relate specifically to railway vibration and is generally regarded as a cautious value. There is a knowledge gap as to the actual likelihood of cosmetic damage from railway vibration in New Zealand. However, all potential criteria for vibration effects on people are substantially more stringent, such that for buildings containing sensitive activities, cosmetic building damage might not require separate consideration.

[4] Norwegian Standard NS 8176:2017 Vibration and shock - Measurement of vibration in buildings from land-based transport, vibration classification and guidance to evaluation of effects on human beings

4. Methods

Sound level metrics

4.1. As discussed in section 1, for railway lines with intermittent traffic in New Zealand, use of an average sound level over any time period can cause inconsistencies between the level and the corresponding human response or health effect.

4.2. The noise provisions which have been sought by KiwiRail in plan changes around New Zealand to date have adopted a one-hour average ($L_{Aeq(1h)}$) for railway sound in their standards. This approach was initially proposed by Marshall Day Acoustics in a review undertaken in 2009 of appropriate noise criteria for district planning rules.[5] This report considered the utilisation of one-hour averaging as against broadscale setbacks and average / maximum or day / night averages. The one-hour average allows for a degree of averaging compared to single events, but still represents periods of activity when disturbance from railway sound is occurring. In the New Zealand context an alternative metric with longer averaging times (e.g. L_{den}/L_{night}) would be likely to significantly under-represent adverse effects from maximum/event sound levels over much of the network.

4.3. Neither one-hour averages or maximum levels however have an established, researched relationship with the health effects correlated to the external long term average sound level criteria recommended by the 2018 WHO Guidelines. This represents a knowledge gap and currently necessitates a broad judgement to determine criteria using the one-hour average (or another metric like maximum levels).

4.4. As set out in section 2, the 2018 WHO Guidelines recommend annual average criteria of 54 dB L_{dn} and 44 dB L_{night} applying outside buildings. These values assume windows may be open, resulting in internal sound levels around 15 dB lower than the criteria (with windows ajar for ventilation): 39 dB L_{den} and 29 dB L_{night}. In a situation where there are regular railway sound events, it could be appropriate to directly take the long-term average L_{den} and L_{night} criteria to apply as one-hour criteria (the L_{den} would also need a -10dB adjustment if applying at night). However, for irregular or infrequent events a higher one-hour criterion could be appropriate. It might also be appropriate to adjust criteria if there are no events at night.

Vibration level metrics

4.5. Internationally there are a range of different metrics used to quantify vibration affecting humans, with no accepted standardisation for this application. The "statistical maximum value of weighted velocity" ($v_{w,95}$) metric has been used previously in New Zealand for both road and railway vibration affecting people, and has the advantage that is corresponds to the exposure response curves in Norwegian Standard NS 8176.

4.6. For vibration effects on buildings and structures, the "peak particle velocity" (ppv) metric is in widespread use in New Zealand. This metric is mandated by the Noise and Vibration Metrics National Planning Standard for construction vibration affecting structures.

[5] Marshall Day Acoustics, *Ontrack rail noise criteria reverse sensitivity guidelines*, 22/10/09

4.7. In this report, vibration is presented in terms of the $v_{w,95}$ with respect to effects on people, and in terms of the ppv with respect to effects on buildings/structures.

Railway traffic characteristics

4.8. The above railway sound levels and effects depend on the timing, type and frequency of train movements at a particular location. As discussed in section 2, the proposed one-hour average sound criteria are generally less stringent than international daily average values for lines with more frequent movements. This was acknowledged by the original Marshall Day Acoustics report, which noted the application of one-hour averages are likely insufficient for lines with greater than 20 train movements a day, and the use of day / night averages or maximum levels would be more protective.

4.9. At the other end of the spectrum, for lines with very infrequent movements the proposed one-hour average criteria might be considered too stringent. With the numerous factors involved and the underlying knowledge gaps relating to sound effects, it is not possible to precisely define a lower railway traffic volume at which one-hour average sound criteria might become unwarranted. Any such consideration should not just include current rail volumes, but potential future rail volumes to which newly established activities may be subject to in the future.

4.10. Railway vibration levels and effects also depend on the traffic characteristics. However, the vibration criteria discussed in section 3 relate to levels from individual events rather than average levels. As such, the criteria are independent of the number of movements. Under the specified standard (NS 8176) the vibration criteria relate to the type of train at a particular location that generates the highest vibration levels, which will generally be freight trains. Therefore, the proposed criteria could be applied to all lines regardless of traffic characteristics.

5. Sound levels

5.1. Different options for sound level metrics are discussed in section 4 with respect to effects and criteria. In this section, example railway sound levels are presented in terms of average values over one hour ($L_{Aeq(1h)}$).

5.2. Railway sound levels are dependent on train types/condition, traffic volumes, speeds, track geometry/condition, terrain and various other factors. As discussed above, when considering average levels the assumed railway traffic volumes are a critical input.

5.3. With full geospatial details and information on railway activity, various standard acoustics computer modelling packages are available to predict railway sound levels for a specific situation. There is currently no standardised approach to this modelling for railway sound in New Zealand or consistent use of a particular calculation algorithm. Consequently, even with the same input data, predictions are likely to vary when made by different practitioners.

5.4. The following provides an illustration of typical railway sound levels based on an assumption of approximately two freight train movements in a one-hour period, in a flat area without screening. This is based on data summarised by Marshall Day Acoustics.[6] More recent

[6] Marshall Day Acoustics, *Ontrack rail noise criteria reverse sensitivity guidelines*, 22/10/09

(unpublished) measurements for various New Zealand train types confirm these sound levels are in a realistic range.

Distance from track	Sound level
10 metres	71 dB $L_{Aeq(1h)}$
20 metres	68 dB $L_{Aeq(1h)}$
30 metres	66 dB $L_{Aeq(1h)}$
40 metres	64 dB $L_{Aeq(1h)}$
50 metres	62 dB $L_{Aeq(1h)}$
60 metres	60 dB $L_{Aeq(1h)}$
70 metres	59 dB $L_{Aeq(1h)}$
80 metres	58 dB $L_{Aeq(1h)}$
90 metres	56 dB $L_{Aeq(1h)}$
100 metres	56 dB $L_{Aeq(1h)}$

5.5. In the Marshall Day Acoustics report which generated the above levels, this sound level assumption of 2 freight train movements in a one-hour period was originally proposed as being approximately equivalent to the sound level from lines with regular passenger trains. It was not intended to apply in settings which actually experienced two freight train movements per hour across a day (as noted in section 4 above, where there were more than 20 movements a day, a one-hour average was considered inadequate to address the likely effects). Instead the intention of the average is to provide an approximation of both the effects of a single event, and a generalised average of noise from the corridor. The report considered a single measurement would enable simpler application of the rule framework by landowners (compared to an average/maximum approach which was considered to add extra complication without significant benefits in effects management given the variability of single train pass-bys).

5.6. Based on this assumption the proposed sound criteria are likely to be appropriate for all urban lines with passenger trains and any lines with at least say six daily freight movements and/or freight movements at night (including where this level of activity may be required in future). This threshold of six freight movements is tentatively suggested based on a hypothesis that the one-hour average criteria would not be unduly stringent at this frequency of effect.

5.7. Internal sound levels with windows ajar for ventilation will typically be around 15 dB less than the external levels set out above. As such, at 100 metres from a track with 56 dB $L_{Aeq(1h)}$ outside, there is still potential to exceed internal criteria of 35 and 40 dB $L_{Aeq(1h)}$ (section 2). A 35 dB internal criterion in particular could be exceeded significantly beyond 100 metres from the track, potentially to around 200 metres. However, at progressively further distances from the track the actual sound level is more likely to be affected by topography and localised screening such that there will be greater variability in sound levels.

5.8. For land use controls, the appropriate method to determine railway sound levels for a particular site (specified values, modelled, measured) depends significantly on the approach to information on train types, volumes and times. This is discussed further in section 9 with respect to recommended controls.

6. Vibration levels (ground-borne)

6.1. The following table summarises various railway vibration measurements (and associated predictions) in New Zealand from a range of sources, generally ordered from lowest to greatest magnitude (other than the first row which uses the ppv metric rather than $v_{w,95}$). Where the data relates to a private development or complaint, a generic source reference is given. Not all measured values are directly comparable due to issues such as differences in measurement positions (ground/building) that would require adjustments.

Data source	Vibration levels
Marshall Day Acoustics, *Ontrack rail noise criteria reverse sensitivity guidelines*, 22/10/09 *(secondary reporting of Marshall Day Acoustics 2006 assessment for Marsden Point)*	Based on measurements: 2 to 3 mm/s ppv at 30m 0.5 to 1 mm/s ppv at 60m
AECOM, *Bayfair to Bayview – Rail Relocation Post Construction Noise and Vibration Monitoring*, 6/3/17	Measured: 0.56 mm/s $v_{w,95}$ at 7m From measurement and distance correction: 0.19 mm/s $v_{w,95}$ at 100m 0.26 mm/s $v_{w,95}$ at 50m 0.37 mm/s $v_{w,95}$ at 25m
Marshall Day Acoustics, *Wiri to Quay Park third main rail line noise and vibration assessment*, 10/7/20	Measured: 0.6 mm/s $v_{w,95}$ at 9.5m
URS, *Maunganui-Girven Road Intersection -Rail Vibration Assessment*, 14/4/14	Measured: 26.5 mm/s^2 $a_{w,95}$ at 17m *(this $a_{w,95}$ value has different units and is not directly comparable to a $v_{w,95}$ value)* From measurement and distance correction: 0.34 mm/s $v_{w,95}$ at 100m 0.47 mm/s $v_{w,95}$ at 50m 0.67 mm/s $v_{w,95}$ at 25m
URS, *Operational noise and vibration assessment Peka Peka to North Ōtaki Expressway Project*, 12/2/13	Measured: 0.58 mm/s $v_{w,95}$ at 60m
Marshall Day Acoustics, *assessment in relation to a complaint near Hamilton*, 28/11/12	Measured (on a deck structure): 0.42 mm/s $v_{w,95}$ at 140m
Marshall Day Acoustics, *assessment for development in Napier*, 6/2/20	Measured: 1.2 mm/s $v_{w,95}$ at 10m
URS, *Ground-borne vibration measurements at Hornby, Christchurch,* 12/9/14	Measured before renewal: 2.2/2.9 mm/s $v_{w,95}$ at 8.4m Measured after renewal: 0.5/0.4 mm/s $v_{w,95}$ at 8.4m

6.2. The data in the above table illustrates the significant variation that is inherent in railway vibration. Vibration levels often vary even within a localised area and cannot be reliably predicted, such as in the same manner as airborne sound. Hence, measurements are generally required to assess ground-borne vibration.

6.3. With respect to effects on people, a vibration criterion of 0.3 mm/s $v_{w,95}$ is discussed in section 3. The measurement data shows that this criterion can routinely be exceeded at over

100 metres from railway tracks in New Zealand, but there is significant variation. Vibration levels exceeding this criterion occur beyond at least 50 metres from the track in most cases.

6.4. With respect to effects on buildings, a vibration criterion of 5 mm/s ppv is discussed in section 3. The vibration measurement data indicates that vibration levels might exceed this criterion within approximately 20 metres of the track. The implications of this are discussed further with respect to recommended controls in section 9.

7. Approaches to manage effects of railway sound

Source

7.1. Routine rolling stock and track maintenance undertaken by KiwiRail contributes to reducing sound at source. There might be incremental improvements if more stringent maintenance service standards were adopted.

7.2. Locomotives can be designed with sound reducing features, such as attenuators and silencers. Generally, these need to be integrated at the time of initial design/manufacture. Retrofitting measures to existing locomotives may be constrained and would be likely to constitute a major rebuilding. Locomotives with alternative power systems such as battery power can have reduced sound, although significant sound still arises from the track/wheel interface. Unpublished research[7] included measurements that show the sound levels set out in section 5 remain representative for the current locomotive fleet, including the newer DL class locomotives. It is understood that KiwiRail has existing workstreams to renew its rolling stock (including the locomotives) overtime. This workstream is focused on alternative power systems, and as a multi-year project to explore (and where supported) upgrades/renewals of its stock, as opposed to retrofitting of existing or old stock.

7.3. Specific sound sources such as wheel squeal, can sometimes be reduced through treatment of rolling stock.

7.4. If older track is not continuously welded, implementing this measure can reduce sound.

Pathway

7.5. Barriers such as formed by earth bunds or walls can reduce railway sound. A barrier providing effective screening could typically reduce railway sound levels by around 5 dB. However, this is often impracticable because any noise barrier would typically need to be in the order of 5 metres high to achieve effective screening of locomotive sound sources that are several metres above the tracks, which in turn are often raised above local ground level. Sound screening might also be provided by intervening buildings or the terrain. As barrier performance is limited by sound passing over the top, typical barriers generally do not provide sufficient sound reduction for receivers close to the railway (within around 50 metres).

[7] Waka Kotahi research programme. Social cost (health) of land transport noise exposure, https://www.nzta.govt.nz/planning-and-investment/research-programme/current-research-activity/active-research-projects/

7.6. Increasing the distance of the pathway reduces sound levels: i.e. separating the receiver from the source by a greater distance. As discussed previously, this measure in isolation may require separation of 100 to 200 metres.

Receiver

7.7. If habitable/sensitive spaces are orientated with no opening windows with exposure to railway sound then internal levels will be reduced. Hence the layout of a building can be used to manage railway sound. A practical approach can be to locate only ancillary, non-sensitive spaces such as garages and bathrooms on the side of the building facing the railway.

7.8. Where windows do have exposure to railway sound, closing those windows reduces internal sound levels. This typically provides a reduction in the order of 10 dB compared to when windows are open ajar for ventilation. However, if windows are required to be closed to reduce sound then an alternative (i.e. mechanical) ventilation and temperature control method is needed for occupants to maintain thermal comfort such that they have a genuine choice to leave the windows closed. For two older roading projects (SH20 Mt Roskill and SH1 Plimmerton) Waka Kotahi installed ventilation systems in 35 and 57 houses respectively with the intention that it would allow windows to be kept closed to reduce road-traffic noise.[8] However, those systems only provided ventilation and not temperature control (e.g. cooling) and for both projects residents reported the temperature being uncomfortable with windows closed. Therefore, if closed windows are to be considered as a noise reduction measure, temperature control should be included in any alternative ventilation system.

7.9. If greater reductions are required than can be achieved just by building layout or closing windows, then the building fabric can be upgraded. This typically requires thicker and/or laminated glazing of windows and in some cases additional/thicker layers of plasterboard wall/ceiling linings.

8. Approaches to manage effects of railway vibration

Source

8.1. As for managing sound, routine track and rolling stock (wheel) maintenance contributes to reducing vibration at source. Again, there might be incremental improvements if more stringent maintenance service standards were adopted. It is understood based on evidence previously provided by KiwiRail that it endeavours to undertake current maintenance best practice where practicable, and continues to invest in ongoing upgrades of its maintenance abilities. This includes the recent commissioning of a new wheel maintenance facility at its Hutt Workshops, which should contribute to improved wheel servicing and repair. In terms of track condition, KiwiRail has comprehensive procedures including measurement of track condition/geometry with a specialist survey vehicle several times a year, and maintenance systems acting on that data.

8.2. There are several different methods to treat railway track to reduce vibration. These include resilient clips fastening the rails to sleepers, resilient material under the sleepers or ballast, and

[8] Waka Kotahi, State highway guide to acoustic treatment of buildings, 2015

tracks directly or on ballast on concrete slabs, "floating" on resilient or spring vibration bearings. These vibration treatments are generally "built into" the overall track formation, particularly for the better performing options. Some treatments can increase the height of the track, having implications on clearances from bridges and overhead structures. As such, these measures are most commonly used for new tracks when the treatments can be integrated into and constructed as part of the overall design (e.g. on the Auckland City Rail Link). Retrofitting treatments over a wide area would require a major rebuilding of the tracks, beyond standard upgrading or maintenance.

Pathway

8.3. There are no standard pathway controls to reduce vibration. In some instances, depending on the dominant propagation route in the specific location, in-ground barriers can reduce vibration propagation. In addition to practical/space constraints (where the corridor is too narrow to construct an in-ground barrier), this is generally not something that could be applied broadly along a rail corridor as it would require analysis and design for specific locations.

8.4. Again, increasing the distance of the pathway reduces vibration levels: i.e. separating the receiver from the source by a greater distance.

Receiver

8.5. Depending on the specific propagation paths, use of different building foundation types (e.g. pile/pad) can result in reduced vibration entering a structure. Likewise, propagation through a structure will alter depending on its design (e.g. concrete/steel).

8.6. Buildings can be built on vibration bearings to reduce vibration from the foundations entering the building. (Some types of vibration bearing are similar to earthquake bearings.) Individual spaces within a building could be constructed as separate structures mounted on vibration isolators, but this is unlikely to be a practical solution in most cases compared to isolating the entire building.

9. Recommended land use controls

Form of controls

9.1. Extensive and widespread mitigation at source would generally only give relatively small incremental improvements and/or would require renewal/replacement of a substantial proportion of track and rolling stock. While (as set out at 7.2 above) there are programmes being undertaken by KiwiRail to renew its existing rolling stock, this confirms any improvements are likely to be incremental as fleets are gradually renewed. There are therefore unlikely to be practicable options for extensive mitigation at source to address sound and vibration effects on new and altered sensitive land uses seeking to establish near existing railways.

9.2. In terms of sound and vibration affecting people, the most robust control would be avoidance of effects by separating sensitive activities from railways. This could be achieved by defining an area around railways where new noise sensitive activities are not allowed. However, in addition to any non-acoustic impacts of such a control, if it contributed to larger and/or more dispersed urban areas then it might in itself cause increased transportation sound and vibration as the

overall population travels greater distances. The following recommendations are therefore made on the assumption that avoidance of effects by separation alone is not a practicable option.

9.3. If new and altered sensitive activities are allowed near railways, then to manage potential health effects, controls are needed to result in appropriate design of buildings or effective screening and separation of those buildings from the railway.

9.4. Several different methods have previously been used in RMA plans. Two common approaches are:

a) setting internal sound and vibration limits; or

b) specifying building constructions directly or in terms of sound reduction performance.

9.5. The first approach requires a site-by-site assessment and tailored mitigation for each development, whereas the second approach requires the same mitigation for all developments. The first requires specialist acoustics expertise whereas the second does not if specifying building constructions directly.

9.6. The potential health effects discussed above have been shown to occur (or be more likely) above certain sound and vibration threshold levels inside buildings. As discussed previously, there are a large number of variables that determine external railway sound and vibration exposure and there are nuances with building siting/layout and design that affect the internal levels. Controls that require the same mitigation for all developments result in excess treatment in many cases and inadequate treatment for those developments most exposed (nearest to the railway). Technically, setting internal sound and vibration criteria and requiring a site-by-site assessment should be the most efficient and effective approach.

9.7. In the Christchurch District Plan, multiple compliance options were included for mitigating road and rail noise in buildings for new sensitive activities. On review of the controls the Council found that in most cases site-specific assessment was selected by developers rather than fixed mitigation (i.e. following a standard building design schedule or fixed sound reduction performance).[9] This was presumably as despite any specialist assessment costs the site-specific assessment provided a more efficient solution.

9.8. It is recommended that any land use controls should be based on achieving internal sound and vibration criteria and allowing for requirements for each site to be determined through individual assessment.

Sound and vibration criteria

9.9. For the reasons discussed previously, the following criteria are recommended to manage potential health effects. A range of sensitive activities have been included in this table, extending from the primary issue of residential units.

9.10. For all these building types the vibration criterion relating to health effects is more stringent than any separate control that might relate to building damage. For other building types a

[9] Christchurch District Plan, Plan Change 5E

separate vibration criterion is included in the table, which could be used to avoid potential building damage.

Building type	Occupancy/activity	Sound criterion $L_{Aeq(1h)}$	Vibration criterion
Residential	sleeping spaces	35 dB	0.3 mm/s $v_{w,95}$
	all other habitable rooms	40 dB	
Visitor accommodation	sleeping spaces	35 dB	
	all other habitable rooms	40 dB	
Education	lecture rooms/theatres, music studios, assembly halls	35 dB	
	teaching areas, conference rooms, drama studios, sleeping areas	40 dB	
	libraries	45 dB	
Health	overnight medical care, wards	40 dB	
	clinics, consulting rooms, theatres, nurses' stations	45 dB	
Cultural	places of worship, marae	35 dB	
All	All occupancies/activities not specified above	-	5 mm/s ppv

9.11. As discussed in section 2, reasonable conditions should be achieved in outdoor living spaces if they are subject to a sound criterion of 55 dB $L_{Aeq(1h)}$.

9.12. The sound level criteria are based on intermittent rail activity. For the assumed rail activity discussed in sections 4 and 5, controls should specify that criteria are to be achieved for external railway sound of 70 $L_{Aeq(1h)}$ at a distance of 12 metres from the track, reducing at a rate of 3 dB per doubling of distance up to 40 metres and 6 dB per doubling of distance beyond 40 metres.

Extent of controls

9.13. Setting a distance for application of controls that includes most land affected by railway sound and vibration would extend for say 200 metres from railways, and would include a substantial area towards the periphery where on closer examination of specific developments no building treatments would be required. Previously, a distance of 100 metres has been used for the application of controls for railway sound. Technically this represents a reasonable compromise if the aim is to capture the most affected sites without requiring assessment where building treatment is less likely to be required. This aligns with the assumed sound levels applied for the rail volumes and one-hour average discussed at section 5 above.

9.14. For vibration, a distance of 60 metres has been used for controls previously. On the basis of the measurement data presented above, I have recommended this be increased to 100 metres consistent with the distance used for sound.

Ventilation

9.15. Where windows are required to be closed it is recommended that a mechanical system be required to provide thermal comfort so there is a genuine choice to leave windows closed. Ventilation is outside the expertise of Chiles Ltd, but on the basis of work published by Waka Kotahi[10,11] the following system specification for residential and visitor accommodation habitable rooms may be appropriate:

i. provides mechanical ventilation to satisfy clause G4 of the New Zealand Building Code; and

ii. is adjustable by the occupant to control the ventilation rate in increments up to a high air flow setting that provides at least 6 air changes per hour; and

iii. provides relief for equivalent volumes of spill air;

iv. provides cooling and heating that is controllable by the occupant and can maintain the inside temperature between 18°C and 25°C; and

v. does not generate more than 35 dB $L_{Aeq(30s)}$ when measured 1 metre away from any grille or diffuser.

Alternative compliance pathways

9.16. Existing controls in district plans based on internal sound and vibration criteria, often include alternative compliance pathways that can be used in some cases to demonstrate that appropriate sound and vibration conditions will be achieved, without requiring specialist assessment or only requiring a reduced assessment. Essentially, these pathways allow for sites and buildings that are likely to have lower sound exposure, or that adopt conservative building designs, to face reduced assessment requirements. Alternative pathways have included:

a) Compliance with internal sound criteria demonstrated by external levels not exceeding the internal criteria by more than 15 dB (reduced assessment needed for external levels).

b) Compliance with internal sound criteria demonstrated by the building being at least 50 m from the railway and screened by a solid barrier, from all points up to 3.8 m above the tracks.

c) Compliance with internal sound criteria demonstrated by using prescribed building constructions.

d) Compliance with internal vibration criterion demonstrated by use of prescribed building base isolation system.

9.17. Technically, the alternative pathways are valid as they result in compliance with the sound and vibration criteria, albeit generally not in the most efficient manner. As discussed above, in the case of the Christchurch District Plan alternative pathways provided were generally not used and were found to make the plan more confusing for users and harder to administer for the Council.

[10] Acoustic Engineering Services, NZTA Ventilation specification review, 30 June 2020
[11] Beca, Ventilation systems installed for road-traffic noise mitigation, 26 June 2014

Appendix 3: Economic Assessment

INSIGHT | ECONOMICS

Final Report: 16 August 2023

Economic Assessment of Options to Manage Adverse Rail Noise Effects

Prepared for: **KiwiRail Holdings Limited**

Authorship

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Contents

1. Executive Summary

Introduction

The rail network is an integral part of New Zealand's transport infrastructure and is estimated to generate nearly $2 billion of value annually (via reduced traffic). To ensure that it is free to grow and operate as needed, and to protect the health and amenity of people, KiwiRail promotes the inclusion of District Plan provisions that require new buildings and/or alterations to existing ones, for noise sensitive activities to mitigate the effects of rail noise. To assist decision-makers, this report assesses the likely high level economic costs and benefits of three options for managing such effects.

Options Analysed

The three options analysed are:

1. Do nothing – where the adverse effects of rail noise are not managed (Option A in the s32 report);

2. KiwiRail's proposed provisions – which apply within 100 metres of the rail network (Option G in the s32 report); and

3. No noise sensitive development within 100 metres of the rail network (Option E in the s32 report).

Option Costs and Benefits

The main costs and benefits of the options relate to:

1. Adverse health and amenity effects from prolonged exposure to rail noise.

2. Costs of changing building designs and/or locations to mitigate effects.

3. Policy implementation, administration, and compliance costs.

4. The opportunity cost of potentially foregoing noise sensitive development near the network.

5. Compromised rail operation and efficiency due to potential reverse sensitivity issues (complaints, changes in operating regime).

Worked Example

The likely costs and benefits of each option are area- and context-specific because they depend on a range of factors that are fluid through both time and space. To demonstrate how the approach can be applied in each territorial authority where Kiwirail's preferred provisions are sought, we derived a model that can be applied on a case-by-case-basis. It contains nearly 20 inputs and assumptions that can be populated with figures that match the circumstances of each district at that time to provide timely and reliable insights to the likely costs and benefits of the three options evaluated herein.

Table 1 below shows the various inputs and parameters in the model, which are populated here with a set of hypothetical values purely for illustration.

Table 1: Model Parameters for Assessing Option Costs and Benefits (Hypothetical Example)

Area of Land Affected & Likely Dwelling Yield	**Values**
Control Area (Buffer) start distance in metres from edge of rail network	10
Control Area (Buffer) end distance in metres from edge of rail network	100
Share of land within proposed buffer otherwise available for development	80%
Residential development density - dwellings/ha (gross)	10
Metres per kilometre	1,000
Square metres per hectare	10,000
Land Values for Noise Sensitive and Non-Sensitive Activities	**Values**
Value of land zoned for residential & other noise sensitive activities ($/m2)	$400
Value of land zoned for non-noise sensitive activities ($/m2)	$200
Health & Amenity Benefits	**Values**
Average dwelling price	$540,000
Mitigation Impact (dB of noise reduction)	5
Mitigation benefits (as a % of property value) per 1 dB improvement	1.20%
Policy Compliance Cost Parameters	**Values**
Average dwelling build cost	$300,000
Mitigation fixed costs per dwelling	$3,000
Mitigation variable cost (as a % of construction cost)	3%
Impacts on Rail Operation	**Values**
Annual value of rail to New Zealand (from Deloitte Study)	$1,900,000,000
Impact of new noise sensitive activities on value of rail (as a %)	2%
Total length of NZ railway track (km)	3,700
Financial Parameters	**Values**
Time Period of Analysis (years)	30
Discount Rate	10%

Finally, Table 2 shows the corresponding option costs and benefits for this specific example, where KiwiRail's proposed provisions generate the lowest net cost and hence are the preferred option.

Table 2: Estimated Net Costs/Benefits per Kilometre of Track (Hypothetical Example)

Costs/Benefits per km of Track	**Option 1**	**Option 2**	**Option 3**
Amenity & health benefits	-$4,665,600	$0	$0
Impacts on rail operation	-$97,000	$0	$0
Policy compliance costs	$0	-$1,728,000	$0
Housing market impacts	$0	$0	-$28,800,000
Option Net Benefits/Costs	**-$4,762,600**	**-$1,728,000**	**-$28,800,000**

2. Introduction

2.1 Context & Purpose of Report

KiwiRail is responsible for the development and operation of New Zealand's rail network. To ensure that the rail network is free to grow and operate as needed to meet ever-evolving needs, KiwiRail promotes the inclusion of District Plan provisions that require new buildings, and/or alterations to existing ones, for noise sensitive activities to mitigate the effects of rail noise. To assist, this high-level report assesses the likely key economic costs and benefits of three options for managing such effects, including KiwiRail's proposed provisions.

2.2 Steps in Assessment & Report Structure

Below are the key steps in our assessment and the sections of this report where each is addressed.

1. Understand the strategic context (section **3**)
2. Identify options to manage rail noise effects (section **4**)
3. Identify option effects and key stakeholders (section **5**)
4. Assess the impacts of each option on stakeholders (sections **6 to 9**)
5. Identify the best/preferred option (section **10**)

The rest of this report works through each step.

3. Strategic Context

3.1 About the New Zealand Freight Task

New Zealand, like all developed nations, is highly dependent on domestic and international trade. This trade creates a massive freight task, with approximately 280 million tonnes moved around NZ annually.[1] While rail plays a key role in the freight sector, particularly for certain goods like timber, dairy, and meat[2], most of the national freight task is performed by diesel trucks. These generate harmful emissions, including CO_2, and are therefore the target of a concerted effort to decarbonise the transport fleet. For example, the New Zealand freight and supply chain strategy seeks to move 20% more freight by 2035 while generating 25% lower emissions, including via modal shifts to rail.

3.2 Rail for Passengers

Rail is not just a freight mode, either, and also plays an increasingly important role in keeping people moving in and around our largest metropolitan areas, particularly Auckland and Wellington. As those cities continue to intensify with more people living in and around centres serviced by the rail network, the share of passenger journeys taken by rail will also naturally increase too. The potential for to reconnect large metropolitan centres through inter-regional passenger rail is also an increasing focus, building on pilot programmes like the Te Huia connection between Auckland and Hamilton.

3.3 The Future Role of Rail

In parallel, the New Zealand Government has recognised the need to maximise the value of its existing investments in the rail network, including making rail a more attractive mode for freight and expanding the passenger rail network. Previously, investment in the rail network lacked a long-term view about its role in the transport system. This caused short-term thinking and investment decision-making, so a new approach was needed.[3]

The New Zealand Rail Plan[4] was developed in 2021 to articulate the Government's vision and priorities for rail to 2030, and to identify the investment needed to achieve it. In June 2021, the Rail Network Investment Programme (RNIP) was created to fund various planks of the Rail Plan that will help renew the network, restore it to a resilient and reliable state, and support freight and passenger rail growth and productivity.[5]

3.4 The Value of Rail to New Zealand

The New Zealand rail network delivers significant value to its freight and passenger customers, and also generates significant benefits for all New Zealanders. These wider benefits are far-reaching, but the most significant are lower road congestion, fewer road accidents, and lower carbon emissions that result from less road traffic.

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[1] https://www.transport.govt.nz/assets/Uploads/Freight-and-supply-chain-issues-paper-full-version.pdf

[2] https://www.kiwirail.co.nz/our-business/freight/

[3] https://www.transport.govt.nz/area-of-interest/infrastructure-and-investment/the-new-zealand-rail-plan/

[4] ibid

[5] ibid

In 2021, Ernst & Young were commissioned by the Ministry of Transport to evaluate the value of rail to New Zealand.[6] Their study built on an earlier analysis from 2016 and considered the benefits of (i) national freight rail, and (ii) passenger rail in Auckland and Wellington.[7] Two scenarios were modelled. The first assumed that all rail services were cancelled, with all rail freight and passengers shifted to the road network. The second scenario also assumed that all rail services were cancelled and shifted to the road network, but with 20% higher rail traffic to capture the impacts of projected future growth. For both scenarios, the value of rail equals the costs of road traffic avoided.

The table below summarises the study's estimates of rail's benefits for the first scenario, where rail volumes match today. In short, the value of rail is estimated to be $1.7 to $2.1 billion per annum.

Table 3: Estimated Annual Value of Rail to New Zealand

Benefit	**Low Estimate**	**High Estimate**
Time (congestion) savings	$939	$1,054
Reduced air pollution	$170	$474
- NOx emissions	$92	$394
- SOx emissions	**<$1**	<1
- Brake & tire (PM10)	$21	$22
- Exhaust (PM2.5)	$57	$58
Reduced fuel use	$211	$222
Reduced GHG emissions	$178	$182
Maintenance benefits	$104	$107
Safety	$94	$98
- Death	$63	$65
- Serious injuries	$25	$27
- Minor injuries	$5	$6
Totals	**$1,695**	**$2,137**

In the words of the Ernst & Young study, as demonstrated above, rail transportation provides the largest benefits to the road sector and society through:

- Time and congestion savings (49% - 55% of benefits)
- Reduced air pollution (10% - 22% of benefits)
- Reduced fuel use and maintenance costs (14% of benefits)
- Reduced greenhouse gas (GHG) emissions (9% to 10% of benefits).

The report also notes that the second scenario, where rail volumes are 20% higher, generates higher benefits than the scenario summarise above, but the difference is not linear with rail volumes. Specifically, the second scenario generates benefits that are about 10% higher than scenario one.

[6] Ernst & Young, the Value of Rail in New Zealand, 2021.

[7] i.e. it excluded inter-island ferries and long-distance passenger rail services, which are also operated by KiwiRail.

3.5 Need for Operational Freedom & Flexibility

To continue realising rail's substantial value to New Zealand, as per above, and to maximise its potential to limit growth in road traffic over time, the rail network must be available for operations 24/7 just like the road network. Reverse sensitivity from nearby sensitive receivers risks undermining that flexibility.

3.6 Summary and Conclusion

Rail is an important part of New Zealand's current transport mix. It provides significant value to New Zealand. It is necessary to protect that critical role to enable rail traffic to grow over time alongside population and economic growth. It is on this basis that KiwiRail seeks the inclusion of District Plan provisions which manage the risk to its operations and future growth that reverse sensitivity poses.

4. Policy Options

This section identifies three policy options to manage the adverse effects of rail noise. These were considered the most plausible/workable options from the long list shown in the appendix.

4.1 Option 1: Do Nothing (option A in the s32 report)

The first option is to "do nothing" with the adverse effects of rail noise not managed, either in the District Plan, or via other means. This forms the baseline (or counterfactual) against which the impacts of the other options are assessed.

4.2 Option 2: KiwiRail Proposed Provisions (option G in the s32 report)

The next option is KiwiRail's proposed provisions. These require new buildings for noise sensitive activities, or alterations to existing ones, within 100 metres of the railway network boundary to mitigate the effects of noise. Specifically, affected buildings must either:

(a) be designed, constructed and maintained to achieve indoor design noise levels resulting from the railway not exceeding the maximum values in the following table; or

Building Type	Occupancy or Activity	Max Railway Noise LAeq(1h)
Residential	Sleeping spaces	35 dB
	All other habitable rooms	40 dB
Visitor Accommodation	Sleeping spaces	35 dB
	All other habitable rooms	40 dB
Education Facility	Lecture rooms/theatres, music studios, assembly halls	35 dB
	Teaching & sleeping areas, conference rooms, drama studios	40 dB
	Libraries	45 dB
Health	Overnight medical care, wards	40 dB
	Clinics, consulting rooms, theatres, nurses' stations	45 dB
Cultural	Places of worship, marae	35 dB

(b) be located at least 50 metres from any railway network, and is designed so that a noise barrier completely blocks line-of-sight from all parts of doors and windows, to all points 3.8 metres above railway tracks, or

(c) it can be demonstrated by way of prediction or measurement that the noise at all exterior façades of the listed activity is no more than 15 dB above the relevant noise levels in Table 1 (above).

If windows must be closed to achieve the design noise levels in (a), mechanical ventilation must be designed, constructed, and maintained. Finally, a report must be submitted to the Council demonstrating compliance with the proposed provisions prior to the construction or alteration of any building containing a noise sensitive activity.

We note the assessment of the costs of Option 2 may also be helpful in assessing a scenario where KiwiRail adopts the funding of the various mitigation measures. This scenario is not assessed

separately below, but we note from an economics assessment, the feasibility of implementing these provisions drops rapidly should KiwiRail adopt both its internal (eg track maintenance and noise reduction costs) and the cost of implementing the provisions. Given the benefits of the provisions also attribute the benefits of the costs of implementation (via warmer, drier, and quieter homes that are also worth more) solely to the landowner, this further reduces the burden of the costs of those provisions sitting with the landowner, rather than KiwiRail.

4.3 Option 3: No Noise Sensitive Development within 100 Metres (option E in the s32 report)

The final option is to prevent new buildings for noise sensitive activities, or alterations to existing ones, occurring within 100 metres of the railway network to avoid adverse noise effects. For clarity, this option does not preclude activities that are not noise-sensitive (eg commercial, industrial or rural activities) from establishing there.

5. Option Impacts & Key Stakeholders

This section identifies likely option impacts and key stakeholders affected.

5.1 Option Costs

The main costs of the options are likely to be:

1. Adverse **health and amenity effects** from prolonged exposure to rail noise. These impacts will vary with several factors, including distance from the network, the design and orientation of buildings, the extent of outdoor activity, plus the health and resilience of affected people.

2. Costs of **changing building designs and/or locations** to mitigate effects. These costs result directly from the need to mitigate effects within the 100-metre buffer area (where deemed necessary by a suitably-qualified noise/acoustic expert).

3. Policy **implementation (ie construction), administration, and compliance** costs. While KiwiRail is seeking the inclusion of provisions only during District Plan review processes, rather than via its own plan change processes (which helps minimise implementation costs), the proposal will still have ongoing administration and compliance costs. These include costs borne by Councils as the administrators of District Plans, plus costs incurred by affected landowners, such as the engaging a noise/acoustic expert to assess the extent of mitigation required, if any.

4. Potential **impacts on housing supply**. If affected properties cannot mitigate the adverse effects of rail noise in a financially feasible manner, there may be a reduction in the quantity of new housing built. This, in turn, could affect the wider housing market and may affect the ability of some Councils to meet their obligations under the National Policy Statement on Urban Development 2020 (NPSUD).

5. **Compromised rail operation and efficiency** due to potential reverse sensitivity. Finally, for options that do not properly manage the adverse effects of rail noise on nearby noise sensitive activities, there may be potential risks to the ongoing operation and efficiency of the rail network.

5.2 Option Benefits

The main benefits of the options are likely to be:

- Improved **health and amenity effects** from properly managing exposure to rail noise. In many cases, these measures will also result in **warmer, drier, healthier homes** that are cheaper to run.

- For options that properly manage the adverse effects of noise, there will be **benefits from the ongoing, unconstrained operation of the rail network**. To the extent that rail can attract a larger share of the national freight task, as sought by several policy initiatives, all new Zealanders will benefit from **lower congestion, accidents, and harmful emissions**.

- Compared to options that effectively sterilise development (for noise sensitive activities) near the rail network, those that enable it will **allow affected land to be put to higher and better uses** than they likely would to otherwise.

- Finally, to the extent that options avoid investments that would otherwise be needed, there will be benefits in the form of **avoided costs saved**.

5.3 Key Stakeholder Groups

Our analysis considers the extent to which option costs and benefits affect the following key stakeholder groups:

- **Affected property owners** – this group will be directly affected in several ways. First, if they develop their land to accommodate noise sensitive activities near the railway line and no mitigation measures are adopted, future occupants may experience adverse effects from prolonged exposure to rail noise. Conversely, affected property owners may face provisions that either (i) limit their ability to develop their land for certain activities, and/or (ii) which impose additional costs to enable noise sensitive activities to establish there.

- **Rail network customers** – this group could be adversely affected if growth in noise sensitive activities near the rail network causes reverse sensitivity, which in turn reduces the frequency, reach, and/or availability of the rail services upon which they rely.

- **KiwiRail and the NZ Government** – As the rail network operator and funder, respectively, KiwiRail and the New Zealand Government will also be affected by the presence or absence of provisions to manage the adverse effects of rail noise. For example, if such effects are left unmanaged, these groups may be negatively impacted by potential constraints arising from reverse sensitivity, which would undermine the operation of – and investment in – the rail network.

- **Territorial authorities** – to the extent that provisions are included in District Plans, territorial authorities will bear the costs and responsibility of incorporating and administering them. While these costs are unlikely to be significant over and above those already associated with their day-to-day functions, they are still an important consideration.

- **NZ's people and its economy** – finally, we note that provisions to manage adverse rail noise, or the absence thereof, may have far reaching effects. For example, if such effects are not properly managed leading to reverse sensitivity that curtail rail operation or availability, any consequent increases in road freight traffic will have negative effects on all of New Zealand. In addition, New Zealanders will bear some of the costs of treating adverse health effects via the tax-funded public health system.

6. Health and Amenity Impacts

This section considers the health and amenity impacts of each option.

6.1 Option 1: Do Nothing[8]

Under this option, the District Plan does not contain provisions that manage the adverse health and amenity impacts of rail noise. Accordingly, it exposes proximate noise sensitive activities to potential adverse health and amenity effects from the rail network.

6.2 Option 2: KiwiRail Proposed Provisions[9]

By design, KiwiRail's proposed provisions directly manage the adverse effects of proximity to the rail network and therefore create ongoing benefits for affected landowners and their tenants (if any). In addition, this option will have wider benefits on the increased warmth, energy efficiency and dryness of homes due to the kinds of mitigation measures imposed (see further discussion re these benefits in the report of Dr Chiles).

However, the true impacts of this option on health and amenity depend fundamentally on the extent to which any proposed mitigation measures would be required anyway, for example to meet the New Zealand Building Code. As the code (likely) continues to strengthen over time, or as developers voluntarily include such measures anyway to keep pace with consumer preferences, the marginal benefits of complying with these provisions will decline. So too, however will the costs, which we return in section 8 below.

To the extent that KiwiRail's proposal does cause some buildings to install design features or elements that they would not have otherwise, there will be health and amenity benefits. First, and most foremost, the adverse effects of rail noise will be properly managed. While it is difficult to accurately quantify such benefits, a recent report for Christchurch City Council (CCC) estimated the health and amenity benefits of noise attenuation to be approximately 1.2% of property value per decibel of road noise reduction.[10]

We consider it unlikely that health and amenity effects accrue linearly with property value, as suggested by the CCC estimate. This would imply, for example, that a $1 million house receives double the benefits of a $500,000 one. Instead, there are likely to also be lump-sum (per-property) elements. That said, these estimates are the best currently available, so below we use them to show the potential benefits for different combinations of property values and noise level reductions.

Table 4: Health & Amenity Benefits by Property Value and Size of Noise Reduction in dB ($000s)

Property Value (000s)	**Noise Reduction dB**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
$250	$3	$6	$9	$12	$15	$18	$21	$24	$27	$30
$500	$6	$12	$18	$24	$30	$36	$42	$48	$54	$60
$750	$9	$18	$27	$36	$45	$54	$63	$72	$81	$90

[8] Option A in the s32 report

[9] Option G in the s32 report

[10] Formative, Christchurch Plan Change 5E Noise Sensitive Activities Near Road and Rail Corridors, 30 September 2022.

$1,000	$12	$24	$36	$48	$60	$72	$84	$96	$108	$120
$1,250	$15	$30	$45	$60	$75	$90	$105	$120	$135	$150
$1,500	$18	$36	$54	$72	$90	$108	$126	$144	$162	$180
$1,750	$21	$42	$63	$84	$105	$126	$147	$168	$189	$210
$2,000	$24	$48	$72	$96	$120	$144	$168	$192	$216	$240

Table 4 shows that heath and amenity benefits could be substantial, especially if they accrue linearly with property value as assumed/modelled. For example, a 5dB reduction could translate to a $30,000 benefit for a $500,000 home, or $60,000 for a $1 million home.

In addition, measures adopted to comply with KiwiRail's proposed provisions, such as double glazing and/or mechanical ventilation, are likely to make homes warmer, healthier, and drier. For example, a 2022 interim report by EECA[11] found that 62% of families who were provided heat pumps reported being in very good or excellent health, compared to only 46% before installation. Further, EECA's final report from December 2022[12] noted that electricity use (through winter) falls in a house fitted with a heat pump by an estimated 16% relative to a house without a heat pump installed.

Thus, not only do heat pumps make homes warmer, drier, and healthier, but they also save on energy costs. Over time, these savings will add up and help offset the initial costs of purchase and installation.

6.3 Option 3: No Noise Sensitive Development within 100 Metres[13]

This option also (largely) avoids the adverse effects of rail noise but does not deliver the additional benefits resulting from building improvements associated with the KiwiRail proposal.

[11] Motu report for EECA, Warmer Kiwis Study: Interim Report: An impact evaluation of the Warmer Kiwi Homes programme

[12] Motu report for EECA, Warmer Kiwis Study: Final Report: An impact evaluation of the Warmer Kiwi Homes programme

[13] Option E in the s32 report

7. Impacts on Rail Uptake & Operation

This section considers impacts of each option on rail network uptake and operation.

7.1 Option 1: Do Nothing[14]

Because this option does not manage adverse rail noise effects, it can cause reverse sensitivity that gradually undermines the future uptake and operation of the rail network. This, in turn, would erode the value created by rail (as summarised above) and limit rail's ability to attract market share from the road freight sector. In addition, it can affect the ability of passenger rail services to shift people out of single occupancy vehicles during rush hour, which are a major contributor to congestion and delay on the road network as well as emissions.

Unfortunately, it is impossible to accurately assess the extent to which reverse sensitivity resulting from this option would disrupt the rail network and the consequential impacts on the economy. However, for the sake of illustration, we note that every 1% reduction in rail traffic caused by reverse sensitivity from new noise sensitive activities establishing nearby would cost the broader economy approximately $17 to $21 million per annum (based on the annual values shown in section 3.3 above).

7.2 Option 2: KiwiRail Proposed Provisions[15]

By design, KiwiRail's proposed provisions would directly manage the adverse effects of new noise sensitive activities establishing in proximity to the rail network which would help it become an increasingly credible alternative to road transport for freight and passenger movements. However, that said, we acknowledge that reverse sensitivity may still arise from existing proximate activities.

7.3 Option 3: No Noise Sensitive Development within 100 Metres[16]

This option also (largely) avoids the adverse effects of rail noise and therefore should result in the same outcomes for the rail network as KiwiRail's proposed provisions.

[14] Option A in the s32 report

[15] Option G in the s32 report

[16] Option E in the s32 report

8. Policy Administration/Compliance Costs

8.1 Option 1: Status Quo[17]

The status quo does not incur any administrative or compliance costs because it is (assumed to be) devoid of such provisions.

8.2 Option 2: KiwiRail Proposed Provisions[18]

KiwiRail's proposed provisions will have one-off costs to the Council of including them in the District Plan. However, because KiwiRail is proposing their introduction only during District Plan review or Plan Change processes, where changes to plans are occurring anyway, the marginal costs to Councils of including the proposed provisions is likely to be negligible. Further, while there will be ongoing costs from administering the provisions once operative, these are not expected to be material in the context of functions ordinarily carried out by Councils.

The greatest administrative and compliance costs associated with this option are those that fall on affected landowners. First, affected properties must commission a noise/acoustic expert to identify the need for, and optimal types of, mitigation to manage rail noise. We understand that these are likely to cost about a few thousand dollars.

Where buildings cannot be situated on a site or designed to locate sensitive activities away from the rail corridor, installing insulation, double glazing, mechanical ventilation, and other mitigation features will be the major cost felt by affected landowners. Again, unfortunately, it is difficult to provide reliable generalised estimates of these features because they are context-specific, and depend on the particular design choices of each landowner and their preferred use of their site. In addition, as noted earlier, the true cost of complying with these provisions will depend on the extent to which such measures would have been included in the building design anyway (either due to Building Code requirements and/or because the developer chose to adopt them).

Another complication is that the nature and cost of mitigation works will differ with several variables, including building height and distance from the rail network. For example, the following table from a recent report by Chiles Limited indicates the general relationship between distance from the rail network and the level of noise experienced.[19]

[17] Option A in the s32 report

[18] Option G in the s32 report

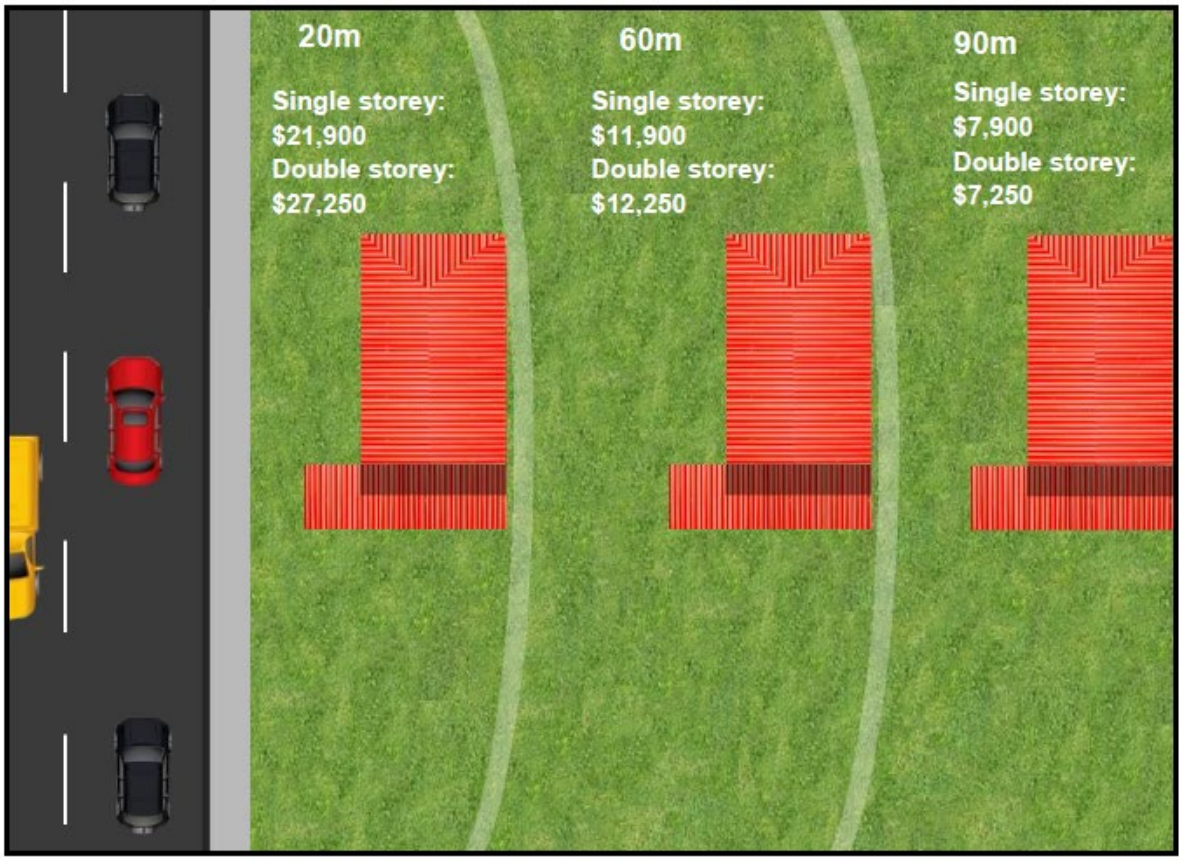
[19] Chiles Limited, Land use controls for railway sound and vibration, March 2023.

Table 5: Relationship Between Distance and Sound Levels

Distance from Track	Sound Level $L_{Aeq(1h)}$
10 metres	71 dB
20 metres	68 dB
30 metres	66 dB
40 metres	64 dB
50 metres	62 dB
60 metres	60 dB
70 metres	59 dB
80 metres	58 dB
90 metres	56 dB
100 metres	56 dB

To advance the analysis, and for the sake of illustration, we draw on work completed by Beca for Waka Kotahi in 2013[20], which estimated the cost of mitigating road noise for dwellings located at different distances from the state highway network. The excerpt below summarises their key findings.

Figure 1: Beca Estimate of Mitigation Costs by Distance from Road Network (2013 $)



A more recent estimate of likely costs was provided by AES for Christchurch City Council, which suggested that they may be about 1 to 2% of construction costs. Thus, the expense for a dwelling that costs $300,000 to build may be $3,000 to $4,000, while the cost for a $500,000 dwelling would be around $5,000 to $10,000. Again, however, we emphasise that the true cost of complying with the

[20] New Zealand Transport Agency Building Acoustic Mitigation Case Study, prepared for NZTA, 2013

provisions depends fundamentally on the extent to which any of the design features or building elements required would have been provided anyway.

It is also important to acknowledge that these costs will be offset by potential energy savings over time, as noted in the previous section. Plus, as set out in the table at 6.2 above, more importantly, they will likely be capitalised in the value of the property. Even setting aside that direct research, houses with double glazing and/or heat pumps are generally worth more than those without. Thus, while this option imposes upfront costs on homeowners, these will not be lost and instead could be better described as investments in the quality and future marketability of properties.

8.3 Option 3: No Noise Sensitive Development within 100 Metres[21]

This option is unlikely to impose any notable administrative or compliance costs.

[21] Option E in the s32 report

9. Housing Market Impacts

9.1 Option 1: Status Quo[22]

The status quo will not affect the quantity of housing supplied in each district.

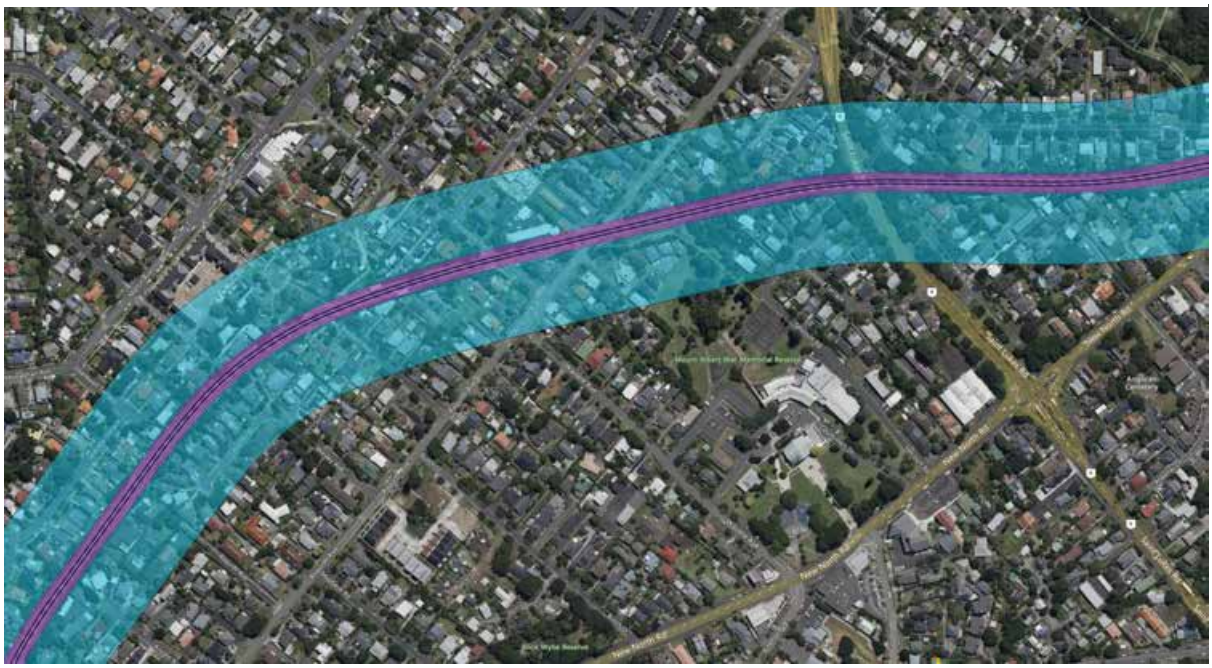
9.2 Option 2: KiwiRail Proposed Provisions[23]

KiwiRail's proposed provisions may have small impacts on housing supply at the margin if the costs of mitigation are considered prohibitively expensive. However, this seems unlikely given the quantum of costs estimated by AES for Christchurch City Council, as per the previous section.

9.3 Option 3: No Noise Sensitive Development within 100 Metres[24]

This option will have the greatest impacts on housing supply because it sterilises the use of land for noise sensitive activities within 100 metres of the rail network. To broadly quantify this impact, we used GIS to inspect the proximity of existing noise sensitive activities to the rail network in built-up areas, particularly Auckland. To that end, the figure below draws 10 and 100 metre buffers around the rail network in pink, and blue, respectively, to investigate how close existing homes are to the tracks.

Figure 2: Proximity of Noise Sensitive Activities to the Rail Network in Mt Albert, Auckland



This map shows there is very little development within 10 metres of the network, although the edges of some buildings are close. Conversely, there are large swathes of development within the 100-metre

[22] Option A in the s32 report

[23] Option G in the s32 report

[24] Option E in the s32 report

buffer. Accordingly, per kilometre of track, this option may prohibit noise sensitive development that would have otherwise likely occurred on approximately 180,000m^2 (or 18 hectares) of land.[25]

The cost of this prohibition will depend on several factors, including the zoning of affected land, the extent to which it is already developed or not, the presence or absence of other binding constraints on development, the underlying value of land, and the scope for accommodating non-noise sensitive activities instead.

Below, we estimate the value of land foregone for noise sensitive development per kilometre of track based on (i) the proportion of land that is developable for any purpose, and (ii) the incremental value of developing land for noise sensitive activities vs other activities. Table 5 presents the results.

Table 6: Value of Land Foregone for Noise Sensitive Activities by 100-Metre Setback per Kilometre of Track ($ millions)

Developable Land %	Incremental Value of Using Land for Noise Sensitive Activities per m^2							
	$50	**$100**	**$150**	**$200**	**$250**	**$300**	**$350**	**$400**
0%	$0	$0	$0	$0	$0	$0	$0	$0
10%	$1	$2	$3	$4	$5	$5	$6	$7
20%	$2	$4	$5	$7	$9	$11	$13	$14
30%	$3	$5	$8	$11	$14	$16	$19	$22
40%	$4	$7	$11	$14	$18	$22	$25	$29
50%	$5	$9	$14	$18	$23	$27	$32	$36
60%	$5	$11	$16	$22	$27	$32	$38	$43
70%	$6	$13	$19	$25	$32	$38	$44	$50
80%	$7	$14	$22	$29	$36	$43	$50	$58
90%	$8	$16	$24	$32	$41	$49	$57	$65
100%	$9	$18	$27	$36	$45	$54	$63	$72

To summarise: the opportunity cost of precluding noise sensitive development within the 100-metre buffer depends critically on the proportion of such land that is developable in the first place, and the difference in land value between noise sensitive activities and all others.

For example, suppose that the current value of residential land is $200 per square metre but (say) $100 for industrial, and that 50% of land within the buffer is available for some form of development. According to the table above, the cost per kilometre of track is $9 million.[26]

In more extreme cases, say where residential land values are $300 higher than industrial and the full buffer area is available for development, the opportunity cost per kilometre is $54 million.

[25] This equals one kilometre of track (1,000 metres) multiplied by 90 metres of developable land between the 10- and 100-meter buffers, which is then multiplied by two because the buffer extends in both directions on both sides of the tracks.

[26] This can be found by subtracting the value of land for industrial from the value for residential (which is $100 per m^2) and scanning down that column to the row labelled as 50% developable.

10. Calculating Option Net Benefits

10.1 Introduction

The likely costs and benefits of each option are area- and context-specific because they depend on a range of factors that are fluid through both time and space. To demonstrate how the approach can be applied in each territorial authority where Kiwirail's preferred provisions are sought, we derived a model that can be applied on a case-by-case-basis. It contains nearly 20 inputs and assumptions that can be populated with figures that match the circumstances of each district at that time to provide timely and reliable insights to the likely costs and benefits of the three options evaluated herein.

10.2 Worked (Hypothetical) Example

Table 7below shows the various inputs and parameters in the model, which are populated here with a set of hypothetical values purely for illustration.

Table 7: Model Parameters for Assessing Option Costs and Benefits (Hypothetical Example)

Area of Land Affected & Likely Dwelling Yield	**Values**
Control Area (Buffer) start distance in metres from edge of rail network	10
Control Area (Buffer) end distance in metres from edge of rail network	100
Share of land within proposed buffer otherwise available for development	80%
Residential development density - dwellings/ha (gross)	10
Metres per kilometre	1,000
Square metres per hectare	10,000
Land Values for Noise Sensitive and Non-Sensitive Activities	**Values**
Value of land zoned for residential & other noise sensitive activities ($/m2)	$400
Value of land zoned for non-noise sensitive activities ($/m2)	$200
Health & Amenity Benefits	**Values**
Average dwelling price	$540,000
Mitigation Impact (dB of noise reduction)	5
Mitigation benefits (as a % of property value) per 1 dB improvement	1.20%
Policy Compliance Cost Parameters	**Values**
Average dwelling build cost	$300,000
Mitigation fixed costs per dwelling	$3,000
Mitigation variable cost (as a % of construction cost)	3%
Impacts on Rail Operation	**Values**
Annual value of rail to New Zealand (from Deloitte Study)	$1,900,000,000
Impact of new noise sensitive activities on value of rail (as a %)	2%
Total length of NZ railway track (km)	3,700
Financial Parameters	**Values**
Time Period of Analysis (years)	30
Discount Rate	10%

Finally, Table 2 Table 8shows the corresponding option costs and benefits for this specific example, where KiwiRail's proposed provisions generate the lowest net cost and hence are the preferred option.

Table 8: Estimated Net Costs/Benefits per Kilometre of Track (Hypothetical Example)

Costs/Benefits per km of Track	**Option 1**	**Option 2**	**Option 3**
Amenity & health benefits	-$4,665,600	$0	$0
Impacts on rail operation	-$97,000	$0	$0
Policy compliance costs	$0	-$1,728,000	$0
Housing market impacts	$0	$0	-$28,800,000
Option Net Benefits/Costs	**-$4,762,600**	**-$1,728,000**	**-$28,800,000**

11. Appendix: Long List of Options

Below is the long list of options from which the three analysed in this report were drawn.

Option A - Do nothing:
No or limited railway noise and vibration provisions in the District Plan. This may include no specific noise and vibration rules, standards or mapping overlays, but may include consideration of reverse sensitivity effects when assessing the adverse effects of any resource consent application, depending on the existing objectives, policies and rules in the District Plan. This includes subdivision, use or development within the vicinity of the railway corridor if the District Plan provides sufficient direction to do so.

Option B – Rail operator reduces noise and vibration emissions:
The rail operator ensure that noise and vibration emissions are reduced to the extent that Activities Sensitive to Noise within 100m of the rail corridor achieve the recommended noise and vibration levels without needing to undertake any specific insulation, ventilation or construction design standards.

Option C - Noise barriers:
Acoustic walls or bunds installed by the applicant or the rail operator with no other noise or vibration management methods.

Option D - Construction design standards:
A table which specifies minimum construction materials and standards necessary to achieve internal acoustic levels within buildings, with no other noise or vibration management methods.

Option E - Setbacks:
Requiring Activities Sensitive to Noise to be set back 100m from the railway corridor with no other noise or vibration management methods.

Option F - Internal acoustic standards:
Require internal acoustic and ventilation rules and standards for noise-sensitive activities, but provide no other options to achieve compliance.

Option G – Combination of rules and standards (Proposed provisions):
Within 100m of the railway corridor, provide several options to achieve compliance with internal acoustic levels – within 50m of the rail corridor buildings are designed to meet specified Internal noise levels, or must meet a 50m setback, or where the noise at exterior façades is measured or predicted to be no more than 15 dB above the relevant noise level. Buildings must also meet mechanical ventilation standards and reporting standards. Includes an advice note to alert plan users that Activities Sensitive to Noise within the Rail Noise Control and Vibration Alert Area may be subject to vibration effects.

Option H – Proposed provisions funded by rail operator:
Within 100m of the railway corridor, via a mapped Rail Noise Control and Vibration Alert Area,

the same options to achieve compliance would be available - buildings are designed to meet specified Internal noise levels, or must meet a 50m setback, or noise at exterior façades is no more than 15 dB higher. Buildings must also meet mechanical ventilation standards and reporting standards, and there is an advice note regarding vibration effects. However, the difference is that KiwiRail would fund the achievement of these standards.

Option I - Landscaping:
Landscape planting to provide acoustic mitigation, with no other noise or vibration management methods.

Option J - National regulation:
This may include changes to the Building Act or Building Code or introduction of a National Planning Standard or National Environmental Standard. The Building Act and Code currently provides specifications to manage inter-tenancy noise (eg noise between residential apartments within the same building with shared tenancy walls). However, it does not require the management of internal noise where noise is generated from outside a building (e.g. rail noise from an adjacent rail corridor).

Option K Reverse sensitivity covenant:
A plan provision which requires a covenant whereby property owners agree not to complain about noise and vibration effects on sensitive land uses. This is often referred to as a 'no complaints' covenant.