Te Ahu a Turanga; Manawatū Tararua Highway
Notices of Requirement for Designations
Volume Three: Technical assessments

NZ TRANSPORT AGENCY
WAKA KOTAHI

New Zealand Government

2. NOISE & VIBRATION

IN THE MATTER OF	The Resource Management Act 1991
AND	
IN THE MATTER OF	Notices of requirement for designations under section 168 of the Act, in relation to Te Ahu a Turanga; Manawatū Tararua Highway Project
BY	**NZ TRANSPORT AGENCY** Requiring Authority

TE AHU A TURANGA; MANAWATŪ TARARUA HIGHWAY PROJECT
TECHNICAL ASSESSMENT #2
NOISE AND VIBRATION

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INTRODUCTION

1. My full name is **Dr Stephen Gordon Chiles**.

2. I am self-employed as an acoustician through my company Chiles Ltd. I have been employed in acoustics since 1996, as a research officer at the University of Bath, a principal environmental specialist for the NZ Transport Agency, and as a consultant for the international firms Arup, WSP, and URS, and for the specialist firms Marshall Day Acoustics and Fleming & Barron.

3. I am responsible for the assessment of operational and construction noise and vibration effects for the Te Ahu a Turanga; Manawatū Tararua Highway Project ("**the Project**").

4. I have been assisted in my assessment by John Bull and Michael Smith of Altissimo Consulting, who have conducted acoustics computer modelling and measurements under my supervision.

Qualifications and experience

5. I have the following qualifications and experience relevant to this assessment:

    (a) I have degrees of Doctor of Philosophy in Acoustics from the University of Bath, and Bachelor of Engineering in Electroacoustics from the University of Salford. I am a Chartered Professional Engineer in acoustics and a Fellow of the UK Institute of Acoustics.

    (b) Over the last decade I have worked extensively on matters relating to road operational and construction noise and vibration. I am an independent professional advisor to the NZ Transport Agency, and in that capacity I have:

        (i) reviewed acoustics assessments and advised on most major NZ Transport Agency projects;

        (ii) investigated numerous noise and vibration issues and liaised with stakeholders;

        (iii) developed a noise mitigation specification, guidance (noise assessment, construction noise and vibration, noise barriers, surface noise, building treatment and land-use planning), case studies, technical memoranda, templates, and web tools;

(iv) procured and managed engine braking and road surface noise measurement systems; and

(v) advised and given evidence on land-use planning controls near State highways.

(c) In addition to work at a national level I have been the acoustics lead in project teams for State highway projects, including for stages of: Warkworth to Wellsford, Transmission Gully, Peka Peka to Ōtaki, Tauranga Eastern Link, Christchurch Southern Motorway 2, Waikato Expressway Cambridge/Tamahere Sections, Arras Tunnel and Mt Victoria Tunnel.

(d) In addition to road projects I consult to a range of other clients including: KiwiRail, Transpower, central and local government, developers and residents. I am contracted to provide the Environmental Noise Analysis and Advice Service to the Ministry of Health and regional public health services.

(e) I am convenor of the New Zealand industry reference group for the committee responsible for approximately 200 published "ISO" acoustics standards. I was Chair of the 2012 New Zealand acoustics standards review, Chair for the development of the 2010 wind farm noise standard,[1] and a member for the 2008 general environmental noise standards.[2]

Code of conduct

6. I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2014. This assessment has been prepared in compliance with that Code, as if it were evidence being given in Environment Court proceedings. In particular, unless I state otherwise, this assessment is within my area of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

[1] NZS 6808:2010 Acoustics – Wind farm noise.
[2] NZS 6801:2008 Acoustics – Measurement of Environmental Sound, and NZS 6802:2008 Acoustics – Environmental noise.

Purpose and scope of assessment

7. I have been engaged to assess effects of operational and construction noise and vibration that would be caused by the Project, and to recommend any measures necessary to avoid, remedy or mitigate those effects.

8. Adverse effects from noise and vibration can include:

   (a) reduced amenity;

   (b) annoyance;

   (c) sleep disturbance;

   (d) health impacts; and

   (e) building cosmetic damage.

9. The scope of my assessment has involved:

   (a) investigating the existing noise environment;

   (b) calculating future road-traffic sound levels associated with the Project;

   (c) determining areas that may be adversely affected by road-traffic noise;

   (d) identifying and recommending mitigation to reduce these effects;

   (e) considering road-traffic vibration effects;

   (f) identifying houses where construction noise and vibration may be at risk of exceeding criteria; and

   (g) examining those areas to determine required construction mitigation measures and strategies.

10. In the course of this work I have visited the area around the Project on several occasions in 2017 and 2018 and inspected locations of nearby houses, including in Ashhurst and Woodville.

11. I was previously engaged in 2017 to assess potential noise and vibration effects of long-list and short-list route options and sub-options for the Project. This current assessment relates solely to the designation now proposed for the selected route.

12. I have also been separately engaged by the NZ Transport Agency in 2018 to advise on mitigation to ameliorate adverse noise effects from diverted State

Highway 3 ("**SH3**") road-traffic currently passing through Ashhurst to access Saddle Road. That work is not part of this current assessment, other than forming part of the existing environment within which the Project is assessed.

13. I have set out acoustics terms and abbreviations that I use in my assessment in **Appendix 2.A**.

Assumptions and exclusions in this assessment

14. In my assessment I have liaised with other members of the Project team. In particular, I have relied on:

    (a) indicative road and earthwork locations and design constraints from Andrew Whaley;

    (b) current and future traffic volumes, compositions and speeds from David Dunlop;

    (c) an indicative construction methodology from Grant Higgins;

    (d) an Environmental and Cultural Design Framework ("**ECDF**") from Chris Bentley; and

    (e) identification of visual issues by Boyden Evans.

15. My assessment relates to noise and vibration effects on people and buildings. I do not address potential effects on fauna.

16. My assessment of the existing environment assumes that proposed road upgrades in Ashhurst are complete because these are currently being implemented and should be fully in place by the end of 2019. This includes reduced speeds, low-noise road surfacing in some areas and reconfiguration of intersections. I have assumed that traffic will access Ashhurst from SH3 using Cambridge Avenue rather than York Street. For simplicity, in the acoustics model for the pre-existing (2016) scenario I have maintained the same road network.

EXECUTIVE SUMMARY

Project description

17. The Project is described in Part C, Volume 2 'Supporting Material', as the construction of a new road, which will form part of SH3. As a result of the construction of this new section of SH3 there will be changes in traffic

volumes on other existing roads. I have assessed noise effects both for the new section of road and over a wider area including in Ashhurst and Woodville, beyond the proposed designation.

Existing environment

18. I have assessed the existing environment based on site observations, acoustics modelling of existing road-traffic and measurements. The existing environment includes State highway traffic passing through the wider area, mainly on Saddle Road. Currently there are relatively high road-traffic noise levels in parts of Ashhurst and Woodville near roads that connect to the route over Saddle Road.

19. The proposed designation is near a few houses at the western roundabout, where there are currently moderate road-traffic noise levels from existing roads in the vicinity. There are no houses near the designation on the main western or eastern slopes, or through the wind farm area. On the lower eastern slope there are two houses near the designation where existing sound levels are relatively low, reflecting the rural environment. In the vicinity of the proposed eastern roundabout there are numerous houses which are currently exposed to road-traffic noise from existing roads.

Methodology

20. I have assessed effects of operational road-traffic noise both with reference to criteria from the relevant New Zealand Standard (NZS 6806), and also through broader consideration of changes in sound levels and potential sound characteristics. I have considered effects at 20 houses near the proposed designation, and at a further 518 locations by the wider road network.

21. For operational road-traffic vibration I have made a screening assessment to check whether any houses could be close enough to a new section of road to be at risk of exceeding guideline criteria.

22. I have used criteria from New Zealand Standard NZS 6803 to assess the effects of construction noise, and for construction vibration I have used criteria published by the NZ Transport Agency based on international standards. For both noise and vibration, I have identified locations where there is risk of exceeding criteria and then investigated the practicality of management measures for construction activity.

Model forecast

23. I have predicted road-traffic sound levels at all receivers for five scenarios, addressing the pre-existing (2016) and existing (2018) situations, as well as future scenarios in a design year of 2041 without the Project, with the Project without any mitigation, and with the Project including mitigation.

24. I have used data from previous projects to determine distances at which there may be risk of exceeding operational vibration and construction noise and vibration criteria.

Project shaping

25. I provided advice on potential noise and vibration issues during the route selection process in 2017 and during the shaping of the designation for the selected route in 2018. During the route selection I identified that one of the short-list options, Option 4, would have substantial adverse noise effects from traffic using local roads outside the Project area. I did not identify any significant issues with the selected option, Option 3. For the selected route, I did not identify any areas where noise and vibration were critical in terms of the Project shaping, and they have not been a major factor in the process.

Assessment of effects

26. In my opinion the Project will have a significant positive effect, reducing road-traffic noise levels through Ashhurst and around the outskirts of Woodville.

27. Without mitigation, the Project could have significant adverse noise effects due to increased traffic on Napier Road in Ashhurst and Vogel Street in Woodville. There could also be significant adverse effects due to sound characteristics of individual vehicles braking and accelerating at the two roundabouts and on the lower eastern slope.

28. Operational road-traffic should have minor vibration effects due to the separation of the new road from houses.

29. With normal good practice management, construction noise and vibration effects should be minor due to the separation of works from most houses. Noise from construction traffic should generally have a minor adverse effect but could potentially be significant if bulk imported fill/aggregate passes through Ashhurst, particularly at night.

Measures to avoid, remedy or mitigate actual or potential adverse noise and vibration effects

30. I have recommended use of asphaltic road surfaces on Napier Road in Ashhurst, Vogel Street in Woodville and on the lower eastern slope, to mitigate operational road-traffic noise effects in those locations.

31. To moderate vehicle sounds at roundabouts I recommend bold landscape treatments in those locations, and separation from houses of at least 100 metres for roundabouts and 200 metres for the alignment on the lower eastern slope.

32. I consider that construction noise and vibration effects should be managed in accordance with standard practice. I recommend that construction traffic passing through Ashhurst is minimised, particularly at night.

Conditions

33. To give effect to my recommendations and to maintain the assumptions of my assessment I have recommended prescriptive designation conditions that require specific control measures. In the case of landscape and traffic controls I recommend that these matters should be addressed through the ECDF and Construction Traffic Management Plan ("**CTMP**") respectively.

Conclusions

34. With the mitigation and conditions I have recommended, the residual adverse noise and vibration effects of the Project are all likely to be minor. There will be significant positive noise effects associated with reductions in traffic volumes through Ashhurst and around the outskirts of Woodville. The construction and operational activity will be clearly audible over a wide area, but at reasonable levels that should be compatible with the environment. In my opinion the noise and vibration effects of the Project are likely to be acceptable.

PROJECT DESCRIPTION

35. Part C of Volume 2 of the Assessment of Environmental Effects ("**AEE**"), 'Supporting Material', includes a Project Description. This includes the Project being described in six sectors (shown in Volume 4, drawing C2). My assessment assesses the existing environment and effects of the Project with reference these six sectors:

(a) bridge to bridge;

(b) new Manawatū River/Gorge bridge;

(c) western slope;

(d) Te Āpiti Wind Farm and ridge;

(e) eastern slope; and

(f) Woodville gateway.

36. Since SH3 through the Manawatū Gorge was closed, traffic on the State highway network has been redistributed to alternative routes. The locations at which the Project ties into the existing designated State highway network do not correlate exactly to the locations at which traffic is currently diverted to alternative routes:

(a) At the west, the Project ties into the State highway network at the intersection of SH3 and State Highway 57 ("**SH57**"), with the proposed designation extending to the existing Manawatū River bridge. Currently, a significant proportion of SH3 traffic leaves or joins the State highway network at the intersection of SH3 with Cambridge Avenue in Ashhurst, to connect to Saddle Road. The Project will result in that traffic moving back to SH3 such that there will be a significant increase in current road-traffic volumes on the existing SH3 between Cambridge Avenue and the Manawatū River bridge, outside the proposed designation.

(b) At the east, the Project ties into the State highway network at the intersection of SH3 and Woodlands Road. Currently, a significant proportion of light vehicles passing over Saddle Road by-pass Woodville to leave or join the State highway network at the intersection of State Highway 2 ("**SH2**") and Pinfold Road to the east of Woodville. The Project will result in most of that light traffic re-routing to pass through Woodville on Vogel Street (SH3/SH2) from Woodlands Road to Pinfold Road, outside the proposed designation.

37. Due to the changes in traffic that are caused by the Project, for my operational road-traffic noise assessment I have considered effects along the future route beyond the proposed designation, through Ashhurst and extending from the intersection of SH3 with Cambridge Avenue in Ashhurst

to the intersection of SH2 with Pinfold Road in Woodville. My assessment of these areas is headed Ashhurst, Ashhurst (Napier Road), and Woodville.

EXISTING ENVIRONMENT

Measurements and predictions

38. I have assessed the existing environment on the basis of my site observations, acoustics modelling, and sound level measurements at two key locations. In this instance I consider that reliance primarily on modelling to be a robust approach given that the existing noise environment at most sensitive locations is controlled by road-traffic, which is accurately represented by the modelling. Use of modelling also allows me to account for road improvements about to occur in Ashhurst that are specifically designed to reduce road-traffic noise in the existing environment.

39. The details of the acoustics modelling undertaken to predict existing road-traffic sound levels are set out in **Appendix 2.B** and details of the sound level measurements and results are set out in **Appendix 2.C**.

Ashhurst

40. When SH3 through the Manawatū Gorge closed, significant volumes of traffic were rerouted through Ashhurst to access Saddle Road. This situation, with SH3 traffic through Ashhurst, forms the existing environment. Residents in Ashhurst have reported significant disturbance from noise and vibration caused by this traffic, particularly from heavy vehicles.

41. While traffic uses several routes through Ashhurst to reach Saddle Road, for the purposes of this assessment, I have looked at the main route along Cambridge Avenue, Mulgrave Street and Salisbury Street. On this route modelling shows that in the order of 100 houses are currently exposed to over 57 dB $L_{Aeq(24h)}$.

42. This is not an unusual statistic for traffic passing through an urban area, but adverse effects are likely to have been accentuated in Ashhurst by the sudden onset of the traffic, use of minor roads not designed for such traffic flows, and houses that have not been designed or adapted for the noise environment.

43. In addition to noise effects from traffic within Ashhurst, sound from traffic on Saddle Road can be audible over a wide area. In particular, poorly silenced

engine brakes on heavy vehicles descending Saddle Road can be clearly audible in Ashhurst.

Ashhurst (Napier Road)

44. The section of SH3 Napier Road between Cambridge Avenue and the Manawatū River, has had reduced traffic volumes since the closure of the Manawatū Gorge. In the existing environment there are modest traffic flows on this section of SH3 and predicted sound levels range from 49 to 62 dB $L_{Aeq(24h)}$ at nearby houses. Road-traffic noise remains part of the character of the existing environment.

Bridge to bridge

45. There are modest traffic flows on SH57 and SH3 in this area. There is one house at the intersection of SH3 and SH57 that is currently predicted to be exposed to around 56 dB $L_{Aeq(24h)}$, accounting for screening by an existing earth bund around the house. This prediction is consistent with a level of 54 dB $L_{Aeq(24h)}$ measured at this house in September 2018. Most traffic has to brake and accelerate by the house to negotiate a sharp 90 degree turn linking SH57 and SH3, resulting in some vehicle sound characteristics likely to cause disturbance.

46. From the intersection of SH57 and SH3 to the Manawatū Gorge car parking area there is one house near the road that will be removed as a result of the Project, and another set-back on a hill above the road. At that location existing road-traffic noise will still be audible, but at a relatively low level.

New Manawatū River/Gorge bridge

47. Around the Manawatū Gorge car park and visitor area, road-traffic from the wider area is still audible in the distance, along with natural sounds from the river and vegetation. There are sporadic local sounds from visitors and their vehicles. It is likely this area is generally perceived as being relatively quiet. In the pre-existing environment (when the section of SH3 through the Manawatū Gorge was open) there was regular road-traffic adjacent to this area and associated noise.

Western slope

48. The Western slope passes through vegetated areas and farmland. There will be occasional vehicles and activity on the farm and occasional train

movements audible. Sound from road traffic in the wider area may also be audible in places. Much of this area is physically exposed and sounds caused by the wind will often be dominant. The wind farm will be audible in many places when it is operating.

Te Āpiti wind farm and ridge

49. As for the western slope, this area comprises vegetated areas and farmland. The sound from the wind farm will often be audible, along with other wind generated sound in the environment. However, when there are calm wind conditions the area is likely to be relatively quiet due to the separation from other anthropogenic sources. While Saddle Road is in the area, existing road-traffic is generally screened by the terrain.

Eastern slope

50. The top of the eastern slope will have a similar existing noise environment to the wind farm area and western slope. The lower slope passes through farm land, with isolated houses to each side of the proposed designation. This area is subject to noise from road-traffic on Saddle Road joining to Oxford Road and Woodlands Road. As such, the background environment includes this general road-traffic noise in the area. However, in some sheltered areas it is likely that natural sounds will dominate. At 75 Hope Road an ambient sound level of 50 dB $L_{Aeq(24h)}$ was measured in September 2018, with sound from wind and vegetation controlling the aural environment at that time.

Woodville gateway

51. The Woodville gateway is in the vicinity of Woodlands Road and the existing SH3, which both have moderate traffic flows from vehicles using Saddle Road. There is currently a sharp 90 degree turn at the intersection of these roads, resulting in some vehicle sound characteristics likely to cause disturbance. It is understood that this turn is to be realigned, which may reduce some of these characteristics.

52. In this area existing predicted road-traffic sound levels range from 52 to 66 dB $L_{Aeq(24h)}$ at nearby houses.

Woodville

53. There are moderate traffic volumes passing through the centre of Woodville on SH3/2 Vogel Street, including regular heavy vehicles, that control the

existing environment. Many of the buildings in this area are commercial, but there are also:

(a) in the order of 45 houses that are currently exposed to over 57 dB $L_{Aeq(24h)}$; and

(b) in the order of 7 houses exposed to over 64 dB $L_{Aeq(24h)}$.

54. The existing route on Vogel Street through Woodville has various road surface and pavement irregularities and vibration from heavy vehicles is perceptible adjacent to the road in places.

55. There are houses on the outskirts of Woodville on Woodlands Road, Oxford Road and Pinfold Road that are currently exposed to noise from traffic accessing Saddle Road. Of these there are:

(a) in the order of 15 houses that are currently exposed to over 57 dB $L_{Aeq(24h)}$; and

(b) in the order of 7 houses exposed to over 64 dB $L_{Aeq(24h)}$.

METHODOLOGY

Introduction

56. My assessment covers three distinct issues, which each require different approaches:

(a) operational road-traffic noise;

(b) operational road-traffic vibration; and

(c) construction noise and vibration.

57. For a State highway project, operational road-traffic noise usually has widespread effects that often require mitigation. I have therefore made a detailed study of potential operational road-traffic noise effects, including computer modelling to allow consideration of noise levels from the existing and pre-existing scenarios, as well as the future scenarios with and without the Project. I have compared predicted noise levels to criteria from the relevant New Zealand Standard and made a broad consideration of potential noise effects including the likely character of traffic sounds and changes to the aural environment. I have then made recommendations for mitigation,

and used the computer model to confirm the effectiveness of those measures.

58. Operational road-traffic vibration can cause disturbance for people living adjacent to existing roads with pavement or surface irregularities or defects. However, for new State highways with pavements and surfaces constructed in accordance with specifications, operational road-traffic vibration should not cause disturbance, even at houses close to the road. For this Project, I have considered operational vibration through a screening assessment based on the proximity of houses to the new road corridor and likely locations of surface irregularities such as bridge movement joints.

59. Large infrastructure works, such as this Project, involve a range of construction equipment that can generate significant temporary noise and vibration. I have considered typical set-back distances needed to comply with construction noise and vibration criteria and identified "hot spot" locations where there may be risk of exceedance. There are standard site practices routinely applied to minimise construction noise and vibration levels and to manage adverse effects arising from any exceedances of criteria. I have considered the identified hot spots to determine whether adverse effects can be controlled with these standard measures or whether enhanced mitigation is required.

Operational noise

60. There is no National Environmental Standard for operational road-traffic noise, and most district plans including the Palmerston North City and Manawatū District Plans explicitly exclude sound of vehicles on roads from general noise limits.[3] The Tararua District Plan[4] also adopts the same position through a reference to NZS 6802,[5] which excludes road-traffic sound. There is an unusual provision in the Manawatu District Plan that omits airbrakes from the exclusion of vehicles from noise limits.[3]

61. In the absence of other standardised criteria, most major roading projects since 2010 have been subject to noise assessment in accordance with NZS

[3] Palmerston North City District Plan, Rule R6.2.6.2.1.b; Manawatu District Plan, Plan Change 55 (operative in part), Rule 3C.4.2.d.ii.
[4] Tararua District Plan, Rule 5.4.1.2.a.
[5] Standards New Zealand (2008) NZS 6802:2008 *Acoustics - Environmental noise*.

6806[6], which was written for this specific application. The NZ Transport Agency requires use of NZS 6806 for State highway projects.[7]

62. NZS 6806 sets absolute rather than relative criteria to protect people living near roads from sleep disturbance and to provide a reasonable level of residential amenity. The method in NZS 6806 provides performance targets and requires assessment of a number of different options for noise mitigation (often including barriers and low-noise road surfaces). The criteria from NZS 6806 are set out in the following table for new and altered roads:

Table 2.1: NZS 6806 road-traffic noise criteria

Category	*New road criteria*	*Altered road criteria*
A (Primary)	57 dB $L_{Aeq(24h)}$	64 dB $L_{Aeq(24h)}$
B (Secondary)	64 dB $L_{Aeq(24h)}$	67 dB $L_{Aeq(24h)}$
C (Internal)	40 dB $L_{Aeq(24h)}$	40 dB $L_{Aeq(24h)}$

63. The majority of the Project is defined as a new road under NZS 6806, other than at the two roundabouts where it is defined as an altered road. Road-traffic noise from other existing parts of the network outside the proposed designation are not within the scope of NZS 6806. However, due to the consequential changes in traffic volumes caused by the Project, I have considered SH3 from Cambridge Avenue to the Manawatū River and SH3/SH2 Vogel Street through Woodville to Pinfold Road as altered roads under NZS 6806.

64. Under NZS 6806, noise mitigation options are to be assessed and, if practicable, the Category A (primary) criterion should be achieved. If this is not practicable, then mitigation should be assessed against Category B. However, if it is still not practicable to comply with categories A or B, then mitigation should be implemented to ensure the internal criterion in Category C is achieved. Depending on the specific building, mitigation in Category C could include ventilation and/or sound insulation improvements ranging from

[6] Standards New Zealand (2010) NZS 6806:2010 *Acoustics - Road-traffic noise - New and altered roads*.
[7] NZ Transport Agency (2016) *Guide to assessing road-traffic noise using NZS 6806 for State highway asset improvement projects*; and NZ Transport Agency (2013) *Technical memorandum NV3 State highway noise and vibration management*.

upgraded glazing through to new wall and ceiling linings. In Category C there is no protection of outdoor amenity.

65. Since NZS 6806 was first published in 2010, a number of Boards of Inquiry[8] have considered assessments where it has been used for State highway projects. The Boards determined that broader assessment of noise effects is required additional to application of NZS 6806, and in some instances additional mitigation is necessary beyond that determined by NZS 6806. In undertaking my assessment, I have applied the methodology in NZS 6806 and I have also made a broader assessment, seeking to address the issues raised by the Board of Inquiry decisions.

66. In my assessment I have considered effects at noise sensitive locations near the Project. In accordance with NZS 6806 these are known as Protected Premises and Facilities ("**PPFs**") and include existing houses, schools, visitor accommodation and various other locations defined in the Standard. NZS 6806 requires consideration of road-traffic sound at all PPFs within 100 metres of a road in an urban area defined by Statistics New Zealand, or within 200 metres of a road in a rural area. For the Project, the area is defined by Statistics New Zealand as rural, other than in Woodville and Ashhurst.

67. I have identified the 20 PPFs listed in **Table 2.4** below, as receiver locations for my assessment. In some cases I have included houses beyond the distances specified by NZS 6806 to ensure all relevant potential noise effects are captured by my assessment. In accordance with NZS 6806, I have not considered noise effects on future (unbuilt) PPFs, unless they have building consent. I understand that all three district councils have confirmed to the NZ Transport Agency that as of 10 September 2018 there were no unimplemented building consents for new houses within 200 metres of the proposed designation. I have not had further regard to possible future houses.

68. I have not included houses in Ashhurst, Ashhurst (Napier Road) and Woodville in **Table 2.4** as PPFs, but there are an additional 518 receivers included in the acoustics modelling and shown on the drawings that I have considered in my assessment.

[8] Waterview Connection, Transmission Gully, MacKays to Peka Peka, Christchurch Southern Motorway, Peka Peka to North Ōtaki, Basin Bridge, Northern Corridor Improvements, East West Link.

69. Road-traffic sound levels have been predicted for five scenarios:

    (a) Pre-existing (2016) – this is not a standard scenario required to be considered under NZS 6806, but I have included this to show the situation before the permanent closure of SH3 through the Manawatū Gorge.

    (b) Existing (2018) - the current road layout and traffic volume, including re-routed traffic passing through Ashhurst to use Saddle Road.

    (c) Future without the Project (2041) – the current road layout but with increased traffic volumes to represent a future year.

    (d) Future with the Project (2041) – the new road layout with the Project built without any specific noise mitigation and with increased traffic volumes corresponding to a future year.

    (e) Project with mitigation (2041) – the new road layout with the Project and future traffic volumes, with my recommended noise mitigation measures (low noise surfaces) added.

70. For the last three scenarios with future traffic volumes, NZS 6806 requires use of traffic forecasts for a year 10 to 20 years after opening of the road. I understand the road is intended to open in 2025 and I have therefore used traffic data for 2041, which is a standard year for traffic modelling within this 10 to 20 year period after opening. Use of 2041 provides some flexibility in case the opening year is delayed.

71. Mr Dunlop has provided three traffic forecasts for 2041 based on different growth assumptions. I understand from Mr Dunlop that he considers the lowest growth assumption to be the most realistic. However, for the purposes of my noise assessment I have used the highest growth assumption, resulting in higher traffic volumes and correspondingly higher road-traffic sound level predictions. This makes my assessment and recommendations for mitigation conservative, as potentially there will be lesser noise effects than I have considered.

72. To consider noise effects I have compared predicted sound levels under the first four modelled scenarios listed above with each other and with reference to NZS 6806 criteria. I have also qualitatively considered specific areas where the new road may give rise to distinct vehicle sound characteristics. NZS 6806 sets out a process for a formal evaluation of potential noise

mitigation options. As set out later in my assessment, in this case there are only limited areas where mitigation is required and only limited mitigation options. I have therefore been able to recommend specific noise mitigation measures without further evaluation. These recommended mitigation measures are included in the fifth scenario modelled. Prior to finalising my recommendations for noise mitigation, I discussed potential measures at two mitigation workshops for the Project (on 27 July 2018 and 14 August 2018), to establish whether there were any conflicts or synergies with other disciplines.

73. To provide a realistic assessment of operational noise effects, the acoustics modelling is based on the indicative alignment described by Mr Whaley and shown on the drawings. The final horizontal and vertical alignment to be constructed will inevitably move within the proposed designation as the design is refined, including in the development of the detailed design. I have therefore conducted sensitivity analysis to determine whether movement of the alignment would alter my findings.

Operational vibration

74. For operational road-traffic vibration there is again no relevant National Environmental Standard and no relevant district plan rules. The Tararua District Plan does include a rule for general vibration,[9] but the standard referenced in that rule is out-of-date and has been withdrawn by Standards New Zealand. There are no relevant New Zealand Standards. For previous assessments of road (and rail) vibration in New Zealand a Norwegian Standard, NS 8176[10], has often been applied as it has criteria and methods designed specifically for this application. NS 8176 recommends a criterion of 0.3 mm/s $v_{w,95}$ for operational road-traffic vibration from new roads, and this is the guideline recommended by the NZ Transport Agency.[7]

75. Previous measurements of vibration at numerous different sites have demonstrated that the 0.3 mm/s $v_{w,95}$ criterion is readily achieved near to a well-constructed State highway. To make a screening assessment, I have reviewed the location of the proposed designation and indicative alignment to confirm whether any new traffic lanes could be close enough to houses for there to be a risk of exceeding the criterion.

[9] Tararua District Plan, Rule 5.4.1.2.h.
[10] Norwegian Standard NS 8176E:2005 Vibration and shock – Measurement of vibration in buildings from land based transport and guidance to evaluation of its effects on human beings.

Construction noise and vibration

76. With respect to construction noise and vibration there are no relevant National Environmental Standards, but all three district plans[11] require use of the New Zealand Standard NZS 6803[12] for construction noise. This also forms the basis of guidance by the NZ Transport Agency.[13]

77. NZS 6803 sets out guideline criteria and management methods for construction noise. For the Project, the long-term criteria from NZS 6803 are applicable as set out in the following table:

Table 2.2: NZS 6803 construction noise criteria

Time of week	*Time period*	$L_{Aeq(15\ min)}$	L_{AFmax}
Weekdays	0630-0730	55 dB	75 dB
	0730-1800	70 dB	85 dB
	1800-2000	65 dB	80 dB
	2000-0630	45 dB	75 dB
Saturdays	0730-1800	70 dB	85 dB
	1800-0730	45 dB	75 dB
Sundays and Public Holidays	0730-1800	55 dB	85 dB
	1800-0730	45 dB	75 dB

78. For most large infrastructure projects near existing houses, it is sometimes impracticable for certain construction processes to fully comply with these criteria. Construction noise effects can usually still be managed to a reasonable degree through good practice, such as detailed in the NZ Transport Agency guide,[13] including greater emphasis on effective stakeholder engagement.

79. For general construction vibration, there are no relevant provisions in the three district plans, although the Tararua District Plan does refer to a standard specifically for noise and vibration from blasting.[14] Any blasting for the Project would be in areas of cut that are all remote from houses.

80. In the absence of any national standards, the NZ Transport Agency has developed construction vibration criteria based on standards from other

[11] Palmerston North City District Plan, Rule R6.2.6.2.1.f; Manawatu District Plan, Plan Change 55 (operative in part), Rule 3C.4.2.c; and Tararua District Plan, Rule 5.4.1.2.f.
[12] Standards New Zealand (1999) NZS 6803:1999 *Acoustics - Construction noise.*
[13] NZ Transport Agency (2013) *State highway construction and maintenance noise and vibration guide*, August 2013, Version 1.0.
[14] Tararua District Plan, Rule 5.4.1.2.e.

countries, as set out in the following table. The criteria relate both to perception of vibration resulting in disturbance for people, and also to potential cosmetic damage to buildings.

Table 2.3: NZ Transport Agency construction vibration criteria

Receiver	*Location*	*Details*	*Category A ppv*	*Category B ppv*
Occupied PPFs	Inside the building	Night 2000h to 0630h	0.3 mm/s	1 mm/s
		Day 0630h to 2000h	1 mm/s	5 mm/s
Other occupied buildings	Inside the building	Day 0630h to 2000h	2 mm/s	5 mm/s
Unoccupied buildings	Building foundation	Vibration transient	5 mm/s	BS 5228-2[15] Table B.2
		Vibration continuous		50% of BS 5228-2 Table B.2

81. These vibration criteria provide a tiered approach to allow the substantial variabilities in vibration sensitivities of people and buildings to be considered. The inclusion of higher "Category B" criteria allows a graduated response whereby more intense assessment and monitoring is required above the Category B criteria than between the Category A and B criteria.

82. I have used the same PPFs identified as receivers for operational noise effects in my assessment of construction noise and vibration.

83. Based on construction noise and vibration levels for similar infrastructure projects, I have identified PPFs within a 200 metre buffer distance from the proposed designation whereby they are likely to be affected to some extent but where compliance with noise and vibration criteria will generally be achieved using standard practices. I have then identified PPFs within a 50 metre buffer distance whereby enhanced mitigation might be required to maintain compliance with noise and vibration criteria. I have considered construction activities in each of these "hot spot" areas and potential mitigation.

[15] British Standard BS 5228-2:2009 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration.

MODEL FORECAST

84. Details of the acoustics model for operational road-traffic noise are set out in **Appendix 2.B**. Predicted road-traffic sound levels at each PPF under each of the five scenarios modelled are shown in the following table.

Table 2.4: PPFs and predicted sound levels

PPF / Address	*NZS 6806 type*	*Predicted $L_{Aeq(24h)}$ sound levels, dB*				
		Without Project			*With Project*	
		Pre-existing (2016)	*Existing (2018)*	*Future (2041)*	*Without mitigation (2041)*	*With mitigation (2041)*
1213 Fitzherbert East Road	altered	58	56	59	58	58
1158 Fitzherbert East Road*	altered	49	46	49	51	51
1171 Fitzherbert East Road*	altered	50	44	47	52	52
1630 Napier Road	altered	54	44	47	55	55
5 Adele Street	altered	70	66	69	71	66
9 Adele Street	altered	59	55	58	60	55
4 Franklin Road	altered	66	57	60	59	57
5 Franklin Road	altered	62	52	55	57	54
9 Hampson Street	altered	58	54	57	60	55
75 Hope Road	new	39	42	45	57	52
29 Hope Road	new	45	49	52	53	48
3 Mabel Street	altered	65	60	63	66	61
5 Stanley Street	altered	55	57	60	57	53
9 Stanley Street	altered	55	54	57	57	52
49899 State Highway 3	altered	69	65	68	70	65
49901 State Highway 3	altered	67	63	66	68	63
49846 State Highway 3	altered	66	57	60	58	56
49807 State Highway 3	new	48	34	37	56	51
49807A State Highway 3	altered	58	45	48	53	49
15 Troup Road	altered	57	53	56	57	52

*Only the altered section of SH57 Fitzherbert Road near SH3 is included in the model

85. An overview of the modelled noise contours over the wider area for each scenario is shown in Volume 4, drawings N1 to N5. More detailed contours for the final scenario of the Project with mitigation are shown in Volume 4, drawings N6 to N11.

86. The computer model has predicted sound levels across a grid and also at specific PPFs. The grid is interpolated to generate the noise contours giving a visual representation of noise exposure over a wide area. However, I have made my assessment on the basis of the predictions at individual PPFs which are more accurate. Predicted sound levels at PPFs in **Table 2.4** and on the drawings are colour coded according to NZS 6806 categories:

Category A – green, Category B – orange, Category C – red. As set out above, the thresholds for these categories vary between PPFs by new and altered sections or road. In most instances the altered road criteria are applicable other than at three PPFs as listed in **Table 2.4** where new road criteria apply.

87. Previous measurements of engine braking indicate that levels can be in the order of 75 dB L_{AFmax} at a distance of approximately 50 metres from a truck.

88. Road-traffic vibration should comply with the 0.3 mm/s $v_{w,95}$ criterion beyond 15 metres of a new road[16] and some previous measurements by new roads have shown compliance at much shorter distances. All PPFs are further than this distance from the new road. Some PPFs are closer to existing roads but this Project should not result in increased vibration levels at those locations.

89. Construction of the Project will require a range of standard equipment. The majority of the Project involves extensive earthworks, paving and compaction, but there are also structures requiring piling, and there will be general construction activities including construction traffic. On the basis of sound levels predicted and measured for these same activities on previous projects, it is straight-forward to comply with the 70 dB $L_{Aeq(15\ min)}$ daytime construction noise limit and 1 mm/s daytime vibration limit for occupied buildings at a distance of 200 metres. Increased noise screening and management can be required to maintain compliance at shorter distances, and for construction activities closer than 50 metres to PPFs it might not be practicable to comply with the daytime noise limit or the 5 mm/s unoccupied building vibration limit at all times, or might require enhanced mitigation. From my experience with constrained urban sites it still remains feasible to manage construction noise and vibration effects in these instances, but more detailed investigation can be required.

PROJECT SHAPING

Route options

90. In 2017 I advised the NZ Transport Agency on potential noise and vibration effects from long-list and short-list options and sub-options for a new route for SH3 to replace the Manawatū Gorge. At the long-list stage there were options with cuts, viaducts and tunnels that would limit the gradient of the

[16] NZ Transport Agency (2015) Guide to the management of effects on noise sensitive land use near to the State highway network, September 2015, Version 1.0.

new road and would be preferable in terms of operational noise as it would reduce vehicle engine and braking sounds. However, for other reasons, all options that progressed to the short-list were for routes passing over the hills with similar adverse noise effects associated with road gradients. I advised that gradients were not a fatal flaw with these options.

91. Of the short-list options and sub-options, I identified increased effects where the routes connected into different parts of the existing State highway network to the pre-existing Manawatū Gorge route or passed near houses previously unaffected by State highway road-traffic noise. One of the options in particular (Option 4) connected to SH3 closer to Palmerston North at Stoney Creek Road. That option would have resulted in significantly increased traffic using Stoney Creek Road and other minor roads outside the Project area, causing substantial adverse noise effects. In this respect the selected route is preferable to other short-list options and sub-options as it does not affect many additional houses to the pre-existing scenario.

92. In terms of construction noise and vibration, some of the long-list options such as the large cut option would have caused substantially greater adverse effects due to activity associated with disposal of extreme quantities of cut material off-site. However, for the short-list options I identified that all routes would have similar construction noise and vibration effects to a degree that should be manageable with conventional methods.

93. The proposed designation for the selected route is near to a small number of PPFs. The larger number of receivers by the modelled roads shown on Volume 4, drawings N1 to N5, is due to my extension of the noise assessment area beyond the designation, but those are not affected by the Project shaping for the selected route which relates only to the designation. The PPFs near the designation are only in the bridge to bridge area and on the lower eastern slope and Woodville gateway.

94. Noise and vibration considerations have not needed to influence the Project shaping with respect to the central part of the Project in the wind farm area and upper slopes where it is remote from PPFs.

95. At both east and west ends of the Project, roundabouts are proposed in the vicinity of PPFs. Roundabouts cause all traffic to brake and accelerate to some extent, resulting in disturbing sound characteristics from some vehicles. During the Project shaping the Project team considered whether

alternative intersection forms could be used to allow the main traffic flow to move freely to avoid or reduce braking and acceleration sounds.

96. Roundabouts have been maintained in the indicative design for road safety and intersection efficiency reasons. With forecast traffic movements I understand from Mr Dunlop that the intersection of SH3 and SH57 will give a substandard level of service without a roundabout (or signalisation/grade separation). From a safety perspective, I understand the roundabouts at both ends are required to signal a change in road environment as vehicles come to the end of the long descents on separated carriageways. The potential noise effects of maintaining roundabouts are set out later in my assessment.

97. Through the Project shaping the designation has been extended so the locations of the two roundabouts can been moved away from PPFs as far as practicable.

98. The road gradients of the indicative alignment will give rise to engine braking noise effects. In the Project shaping there were no practical options that would avoid the need for relatively steep gradients at both ends of the Project. This is an inherent feature of the Project and minor changes to the gradients would not materially alter engine braking issues.

ASSESSMENT OF EFFECTS

Positive effects

Ashhurst

99. The Project results in a substantial reduction in traffic volumes through Ashhurst. Compared to the scenario without the Project in 2041, with the Project, road-traffic noise is reduced by approximately 7 dB at in the order of 250 houses in Ashhurst. With the Project, the majority of these houses have a noise exposure of less than 57 dB $L_{Aeq(24h)}$, which is the most stringent new road criteria in NZS 6806. This represents a significant positive effect of the Project, although for residents this might be perceived simply as a return to the pre-existing (2016) situation.

100. Road-traffic vibration has not been quantified in Ashhurst, but there are numerous PPFs close to the road and there has been reported vibration disturbance. The frequency of heavy vehicles causing vibration disturbance in Ashhurst will significantly reduce with the Project. As the vibration levels

have not been quantified the extent of this positive effect is not certain, but it will be at least a minor positive effect of the Project.

Woodville

101. The Project results in a substantial reduction in traffic volumes on Woodlands, Oxford and Pinfold Roads around Woodville. Compared to the scenario without the Project in 2041, with the Project, road-traffic noise is reduced by 10 dB or more at in the order of 25 houses on the outskirts of Woodville. Again, while this represents a significant positive effect of the Project, for residents this might be perceived simply as a return to the pre-existing (2016) situation.

Adverse effects

Operational

Ashhurst (Napier Road)

102. Numerous PPFs will be exposed to increased road-traffic noise as a result of the Project, which is an adverse effect.

103. The following two figures show future (2041) predicted road-traffic sound levels on SH3 Napier Road in Ashhurst between Cambridge Avenue (left) and the Manawatū River (right), with and without the Project. The figures show overall noise contours in 1 dB increments, coloured in 5 dB bands, and also label the predicted sound level at each PPF. PPFs are colour coded according to NZS 6806 categories. The cut batters by the road to the right of the figures have not been accurately modelled due to limited digital terrain data, but the overall trends shown are realistic.

Figure 2.1: Ashhurst (Napier Road) noise contours without the Project

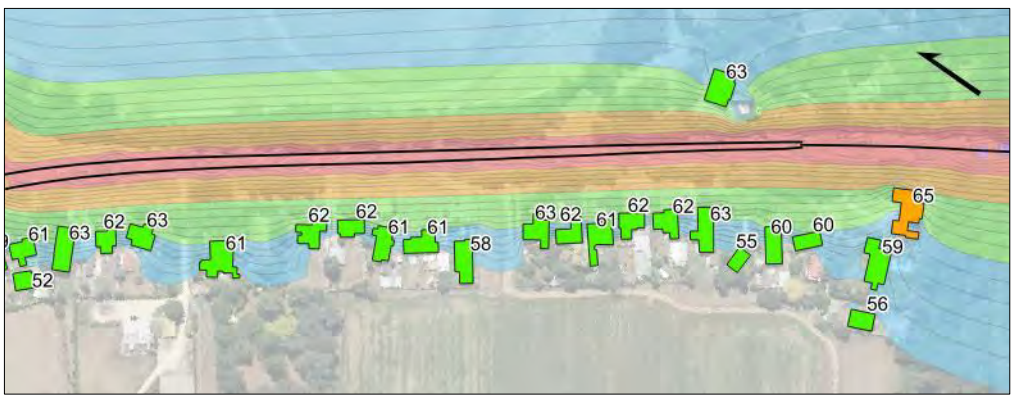
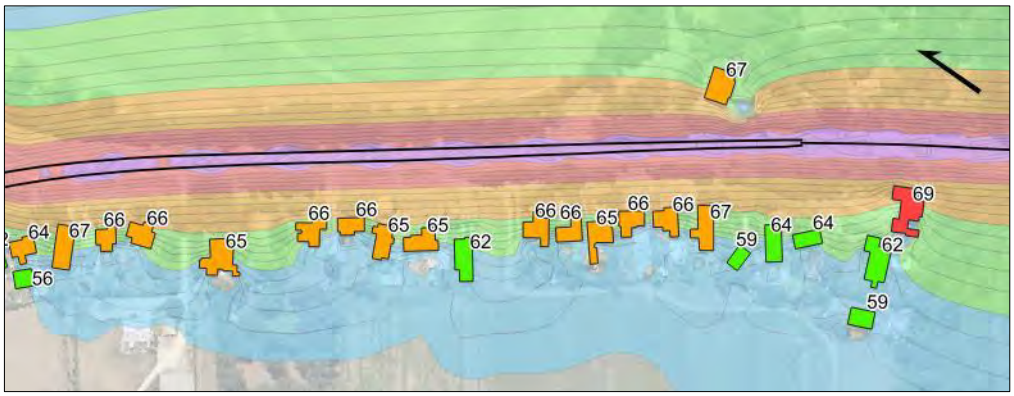


Figure 2.2: Ashhurst (Napier Road) noise contours with the Project

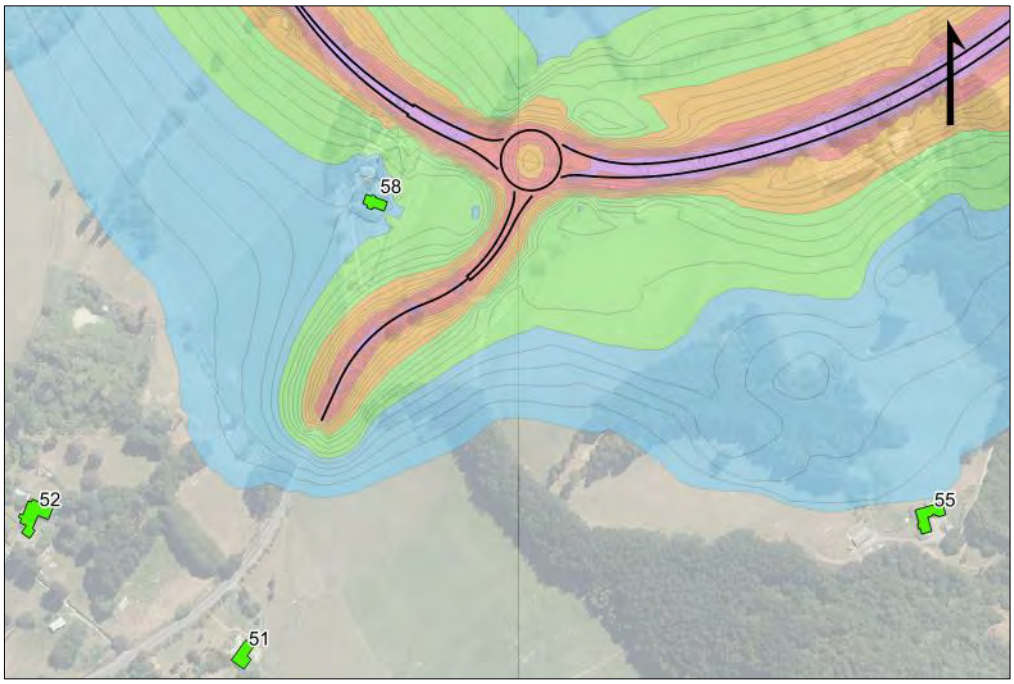


104. There are in the order of 24 PPFs in this area that without the Project will be exposed to future road-traffic noise levels mainly below NZS 6806 Category A, 64 dB $L_{Aeq(24h)}$. With the Project, 16 of these PPFs move into Category B and 1 is exposed to more than 67 dB $L_{Aeq(24h)}$ so moves into Category C. The noise levels increase by approximately 4 dB which is a modest amount, but the resulting noise exposures are high, as can be seen from the NZS 6806 categories. On this basis I consider this increased exposure to represent a significant adverse noise effect.

Bridge to bridge

105. In the bridge to bridge area there are four PPFs that will receive road-traffic noise within NZS 6806 Category A for the future scenario with the Project, as shown in the following figure. As these PPFs already experience road-traffic noise in the environment the noise effect should generally be minor.

Figure 2.3: Bridge to bridge noise contours with the Project



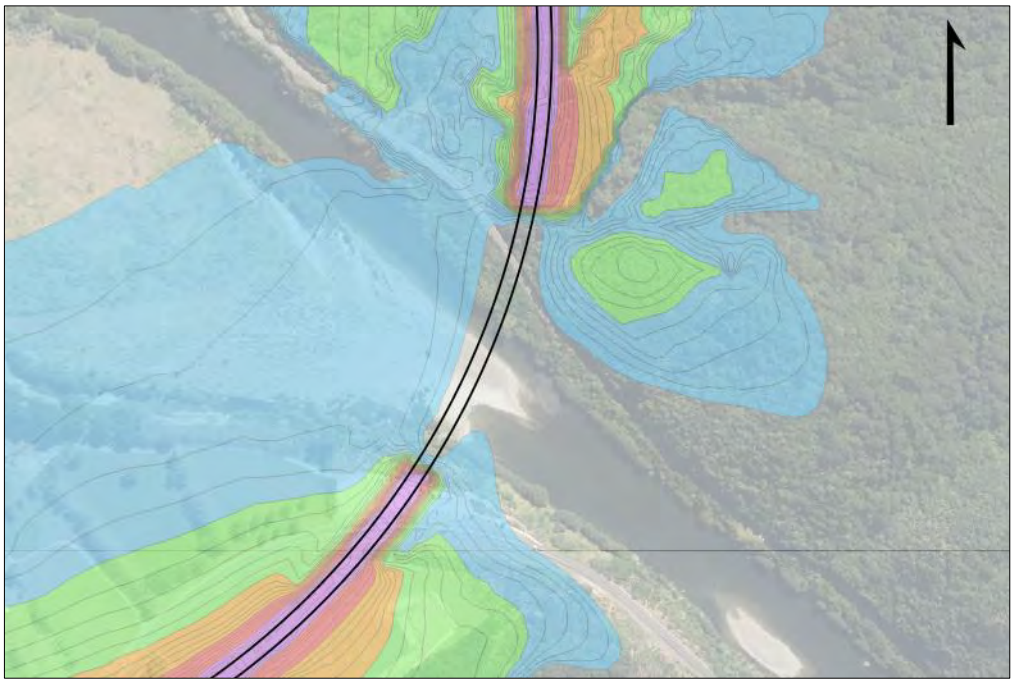
106. The acoustics modelling for the PPF adjacent to the SH3 and SH57 intersection includes noise screening by an existing earth bund beside the property. I will discuss the durability of that bund later with respect to mitigation measures.

107. Sound characteristics from vehicles traversing the roundabout could cause significant disturbance at nearby PPFs. If there were no controls to moderate driver behaviour at this roundabout this could result in a significant adverse noise effect.

New Manawatū River/Gorge bridge

108. The following figure shows future noise contours at the Manawatū Gorge car park and visitor area with the Project. The model includes a 0.8 m high concrete safety barrier on the sides of the bridge and approach embankment.

Figure 2.4: New Manawatū bridge noise contours with the Project



109. Road-traffic noise will control the aural environment at the car park and visitor area. There are no standardised criteria for this situation. In the context of an area that is dependent on vehicle access, and has historically been adjacent to a State highway, the adverse effect of road-traffic noise in this area is considered minor.

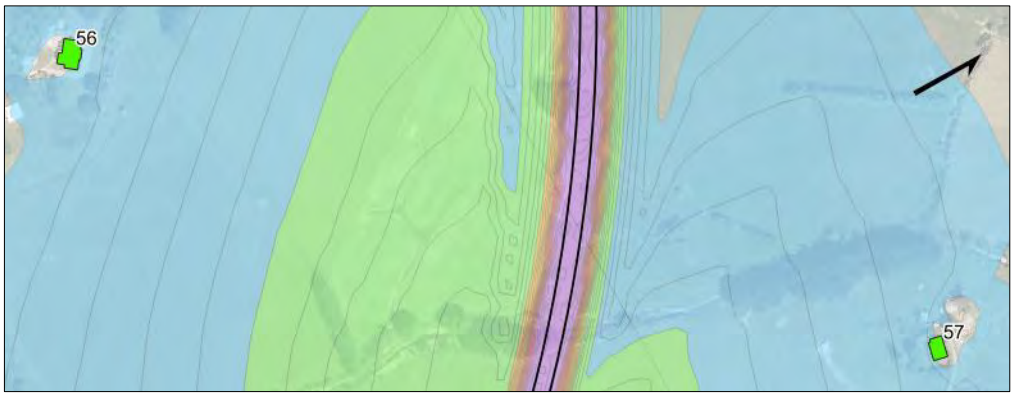
Western slope and Te Āpiti wind farm and ridge

110. There are no PPFs near the western slope or upper eastern slope. However, sound from trucks engine braking will be audible over a wide area, albeit at modest levels. This sound will be similar to trucks engine braking on the existing Saddle Road. As such, while there will be some variation in where the sound is heard, the noise effect should be minor.

Eastern slope

111. There are two PPFs near the lower eastern slope that are both predicted to receive road-traffic noise within NZS 6806 Category A, as shown in the following figure.

Figure 2.5: Lower eastern slope noise contours with the Project

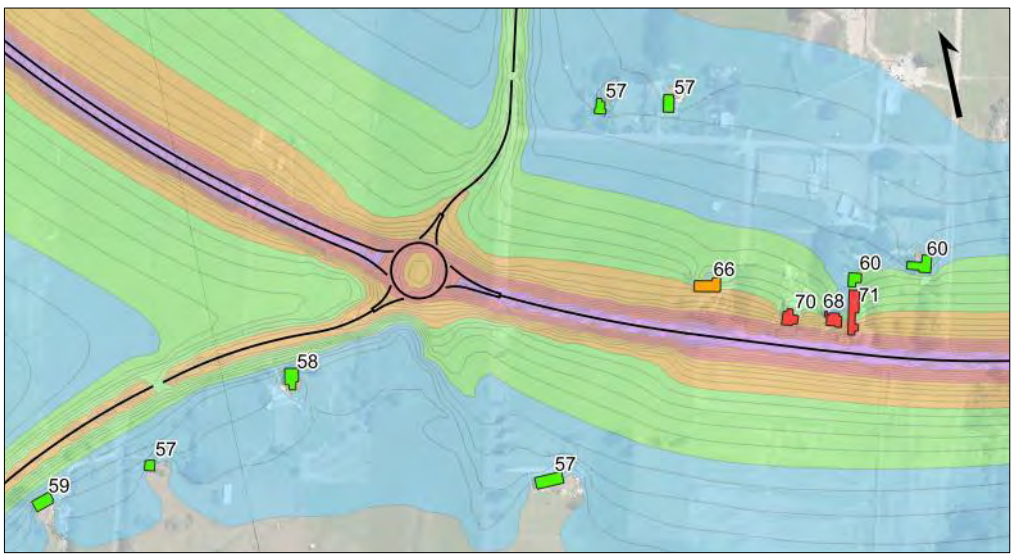


112. These PPFs currently experience relatively low levels of road-traffic noise from the wider environment and with the Project there will be a marked change. However, the resulting road-traffic sound levels are in compliance with NZS 6806 Category A, and the noise effect should generally be minor. However, adverse effects of engine braking noise at these PPFs are potentially significant.

Woodville gateway

113. At the Woodville gateway there are numerous PPFs in the vicinity of the roundabout. The noise levels at most of these PPFs are predicted to be in NZS 6806 Category A as shown on the following figure. There is one PPF by Vogel Street in Category B and three in Category C. I have addressed these four PPFs in my consideration of effects along all of Vogel Street through Woodville below.

Figure 2.6: Woodville gateway noise contours with the Project



114. All PPFs in this area are already affected by road-traffic noise and the predicted future increase should only have a minor adverse noise effect. However, as for the western roundabout, sound characteristics from vehicles traversing the eastern roundabout could cause significant disturbance at these PPFs. If there were no controls to moderate driver behaviour at this roundabout this could result in a significant adverse noise effect.

Woodville

115. The Project results in a substantial increase in future traffic volumes using SH3/2 Vogel Street through Woodville. The following two figures show future (2041) predicted road-traffic sound levels in Woodville with and without the Project.

Figure 2.7: Woodville (Vogel Street) noise contours without the Project

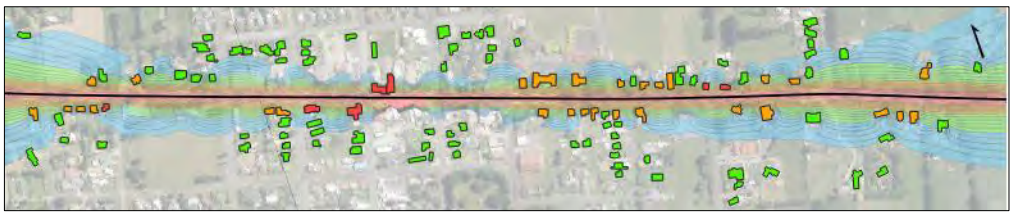
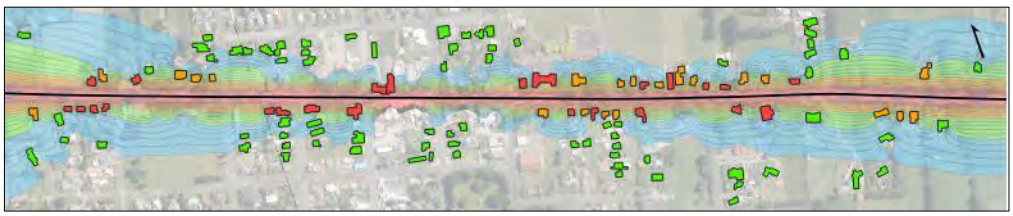


Figure 2.8: Woodville (Vogel Street) noise contours with the Project



116. Without the Project, 39 PPFs in Woodville are predicted to be in Categories B or C, and this number would increase to 50 PPFs with the Project. While the Project is only a contributing factor to existing high noise exposures, it does materially worsen an unsatisfactory situation whereby residents are subject to road-traffic noise levels above recommended criteria. In my opinion this would be a significant adverse effect.

117. I understand that in response to community feedback based on economic considerations, the Project has been constrained so State highway traffic remains travelling through the centre of Woodville. To some extent the adverse noise effect is an unavoidable consequence of that decision.

Sensitivity to road alignment changes

118. I have reviewed road-traffic noise effects with respect to the sensitivity of acoustics modelling to changes in the alignment within the designation. Generally, I have found that my assessment is not sensitive to changes to the alignment within the designation, but I have identified three areas where changes in the alignment could potentially alter my assessment:

    (a) at the SH3/SH57 intersection I have assumed the traffic lanes around the roundabout are at least 100 metres from the nearest PPF;

    (b) at the lower eastern slope I have assumed that traffic lanes are at least 200 metres from the nearest PPFs; and

    (c) at the Woodville gateway I have assumed the traffic lanes around the roundabout are at least 100 metres from the nearest PPFs.

119. If the alignment moved within these distances, the noise exposure categories of PPFs are likely to increase and the degree of noise effects would worsen. I have discussed appropriate conditions to avoid that occurring later in my assessment.

Operational vibration

120. Throughout the Project, no PPFs are closer than 15 metres to new roads, even allowing for the alignment to move within the designation. There are no PPFs near potential bridge joints. Therefore, operational vibration should comply with the criteria and while it may be felt by people the adverse vibration effects should be minor.

Construction

121. Volume 4, drawing N12 shows PPFs within a 200 metre and 50 metre buffer of the designation where construction works may occur.

122. There are two areas where works in the proposed designation may be closer than 50 metres to PPFs:

    (a) SH3 and SH57 intersection; and

    (b) Woodville gateway.

123. In these areas there are no structures to be constructed near PPFs and only standard earthworks are required. As such, there are a range of options that

are available to maintain compliance with the noise limits in these areas, including temporary screening if necessary. There is scope in these areas to avoid site access points, yards, laydown areas and fixed plant close to PPFs.

124. On the basis that normal good practice is followed,[13] works should generally comply with the construction noise and vibration criteria in all areas. The works will cause temporary daytime disturbance to residents, but most people should be able to continue normal domestic activities with only minor adjustments, particularly if there is effective advanced communication about when construction activities are due to occur. There should not be significant night works near PPFs, other than potentially short-term activity that may be required to connect to the existing road network (and other activities noted in the Project description in Part C of the AEE), without causing daytime traffic disruption. Therefore, any potential sleep disturbance effects should be limited. On this basis I consider that adverse noise and vibration effects from construction within the designation should be minor.

125. Construction traffic passing through Ashhurst may exacerbate existing operational road-traffic noise disturbance. For occasional heavy vehicles during the daytime and light vehicles, construction traffic should not be distinct from general traffic in Ashhurst and should only have a minor adverse noise effect. However, if bulk imported fill/aggregate were to pass through Ashhurst it could materially increase existing noise disturbance. Potentially there could be in the order of 100 heavy construction vehicles a day passing through Ashhurst at peak times. The extent of the effect would depend on the number of trucks, timing and duration, but could be significant.

126. Construction traffic passing through Woodville would use the existing State highways (SH2 and SH3). While a temporary increase in heavy vehicle traffic may be noticeable, the noise effects should be minor in this environment.

SUMMARY RATING OF EFFECTS

127. The Project will result in a significant positive effect from reduced road-traffic noise in Ashhurst and around the outskirts of Woodville.

128. Without mitigation the Project will result in significant adverse noise effects from increased traffic on SH3 Napier Road in Ashhurst between Cambridge Avenue and the Manawatū River, and on SH3/2 Vogel Street through Woodville.

129. Without mitigation the Project might result in significant adverse effects from sound of individual vehicles braking and accelerating at the two roundabouts, and from vehicles engine braking near PPFs on the lower eastern slope.

130. Without mitigation other operational road-traffic noise and vibration effects should be minor.

131. With standard good practice management, adverse noise and vibration effects from construction in the designation should be minor.

132. Noise from transporting bulk imported fill/aggregate is potentially a significant adverse effect if large numbers of trucks pass through Ashhurst for an extended period and/or at night.

MEASURES TO AVOID, REMEDY OR MITIGATE ACTUAL OR POTENTIAL ADVERSE NOISE AND VIBRATION EFFECTS

Proposed mitigation measures

Operational

Ashhurst (Napier Road) and Woodville

133. I have identified a significant adverse noise effect that could arise from increased traffic on SH3 Napier Road in Ashhurst between Cambridge Avenue and the Manawatū River, and on SH3/2 Vogel Street through Woodville. In both areas the scope for noise barriers is limited by gaps that would be needed for driveways from the road. In both areas there is currently a chip seal road surface, other than a short section of asphaltic surface at the SH3/SH2 intersection in Woodville.

134. Chip seal is a relatively noisy road surface type and a noticeable reduction in noise in the order of 4 dB could be achieved in both areas by using an asphaltic surface. The exact type of surface would depend on engineering requirements, but a significant noise reduction could be achieved in these locations by use of either porous asphalt or stone mastic asphalt. Based on a porous asphalt surface the predicted sound levels would be reduced as shown in the following figures:

Figure 2.9: Ashhurst (Napier Road) noise contours with the Project and an asphaltic road surface

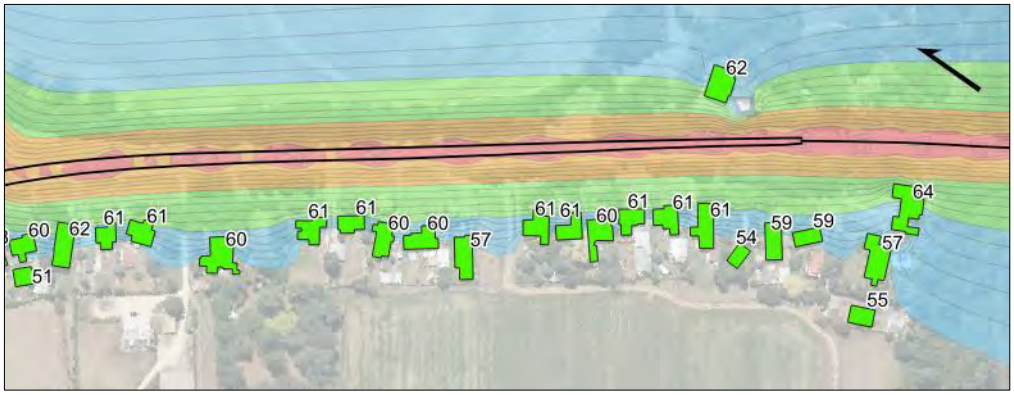


Figure 2.10: Woodville (Vogel Street) noise contours with the Project and an asphaltic road surface

135. It can be seen that with an asphaltic surface all PPFs by this section of SH3 Napier Road in Ashhurst and most PPFs by Vogel Street in Woodville are in NZS 6806 Category A. On this basis, with an asphaltic road surface, the residual adverse noise effect in these areas would be minor.

Bridge to bridge and Woodville gateway

136. I have identified a potentially significant adverse noise effect at each of the roundabouts due to individual vehicles braking and accelerating. To mitigate this effect, the road environment needs to encourage gradual speed changes. I have liaised with Mr Bentley who has confirmed it is practical to clearly signal the presence of the roundabouts and the changing environment through bold landscape treatment of the areas. He is including principles for these treatments in the ECDF, which would be further developed in due course and shown as part of the Outline Plan for these works.

137. On the basis that the road design minimises disturbance from individual vehicles at roundabouts, and roundabout traffic lanes are at least 100 metres from PPFs, I consider that the residual adverse noise effect should be minor.

138. The acoustics modelling relies on the presence of an existing earth bund around the PPF at the intersection of SH3 and SH57. The bund has steep sides that might not be durable to provide a long-term barrier. There is space within the designation to either enhance or replace this existing bund. I recommend that, subject to landowner approval, the upgrading of this bund to maintain the current noise reduction be addressed through the ECDF, with details included in the Outline Plan.

Eastern slope

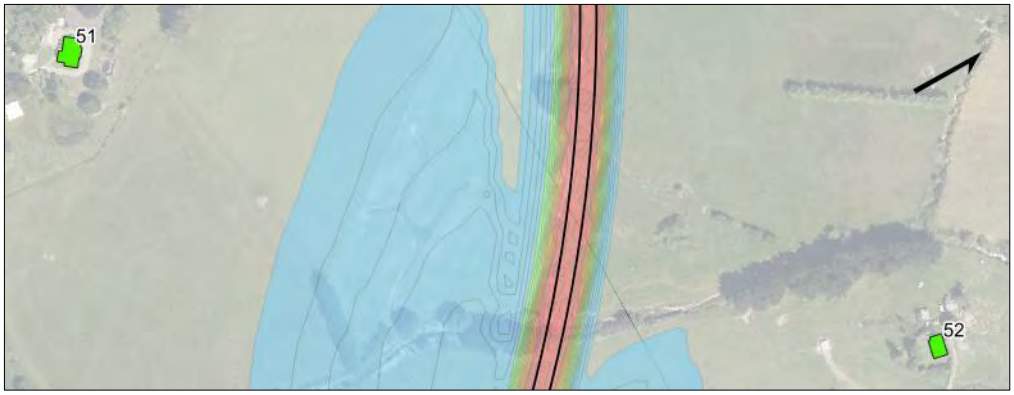
139. For the two PPFs nearest the lower eastern slope I have identified engine braking as a potentially significant adverse effect. I am not aware of a method to address this effect other than fitting individual trucks with effective exhaust silencers, which is beyond the powers of the road controlling authority. In other areas engine braking can be prohibited or other methods applied to identify trucks and minimise engine braking use. However, in this location at the end of a long steep downhill gradient it would conflict with safety to restrict or discourage use of engine brakes.

140. Engine braking noise will reduce with distance from the road, so maintaining separation from PPFs will assist in minimising the effect. However, it will still be clearly audible and potentially disturbing at several hundred metres.

141. At the lower eastern slope I previously set out that I consider general road-traffic noise levels to have a minor adverse noise effect, although it does alter the existing environment. Considering the effects of road-traffic noise holistically in this location, while engine braking noise cannot be mitigated directly, it is possible to reduce general traffic noise through barriers or a low noise road surface.

142. On the elevated section of the lower eastern slope a road-side concrete safety barrier could form a noise barrier. However, Mr Bentley has advised that any solid road-side barriers in this location are not preferred from a visual and landscape perspective, although could be used if necessary for noise mitigation. A low noise asphaltic road surface extending for 1.5 km from the roundabout up the eastern slope would reduce road-traffic noise by approximately 4 dB resulting in the predicted sound levels shown in the following figure:

Figure 2.11: Lower eastern slope noise contours with the Project and an asphaltic road surface



143. With this general reduction in road-traffic noise from an asphalt surface, or alternative reduction by a solid barrier, and if traffic lanes are kept at least 200 metres from PPFs, while engine braking noise will still be clearly audible, I consider that the overall noise effects in this area should be minor.

Construction

144. As described previously, if construction activities are managed in accordance with normal good practice then noise and vibration effects should be minor. A standard approach adopted for most major State highway projects is to use a Construction Noise and Vibration Management Plan ("**CNVMP**") to provide a structure through which issues can be identified and actioned. I consider that such a control is appropriate to give effect to my assumption of normal good practice being applied.

145. I have highlighted a potential significant effect if high volumes of heavy construction vehicles pass through Ashhurst, particularly at night. I recommend this issue should be addressed through a CTMP, noting that the draft conditions relating to the CTMP state that, as a minimum, the CTMP must describe methods to limit the movement of heavy vehicles through Ashhurst at night. Heavy construction vehicles should not travel through Ashhurst at night other than oversized loads and essential movements such as if concrete trucks are needed for continuous pours. With controls in a CTMP minimising bulk imported fill/aggregate movements in particular, the residual noise effects should be minor.

Conditions

146. Designation conditions for road-traffic noise are often performance based at least in part, allowing flexibility for alternative mitigation solutions as the road design is developed. However, in this instance the available options are limited, and greater certainty is provided by requiring specific treatments. These specified treatments exceed the requirements of NZS 6806, although confirmation of compliance with NZS 6806 should be provided in the Outline Plan for the works.

147. To give effect to my recommendations for noise mitigation set out above, I recommend that conditions should be imposed on the designation requiring the following:

    (a) Prior to opening of the new road an asphaltic surface must be laid on SH3 Napier Road in Ashhurst between Cambridge Avenue and the Manawatū River and for the extent of SH3/2 Vogel Street in Woodville.

    (b) Within 12 months of the new road opening to traffic either an asphaltic surface must be laid on the main alignment, or concrete safety edge barriers must be used, from the eastern roundabout extending at least 1.5 km to the west of the roundabout.

    (c) The ECDF must include road environment design principles to encourage vehicles to make gradual speed changes approaching and departing from the two roundabouts.

    (d) The ECDF must address upgrading of the existing bund, subject to landowner approval, at the SH3/SH57 intersection to provide enduring noise mitigation.

    (e) Traffic lanes of roundabouts must not be closer than 100 metres to PPFs.

    (f) Traffic lanes must not be closer than 200 metres to the houses at 49807 State Highway 3 and 75 Hope Road, Woodville.

    (g) Construction noise and vibration must be controlled through a CNVMP.

    (h) The CTMP must include methods to minimise heavy construction traffic passing through Ashhurst, including avoidance of heavy construction traffic passing through Ashhurst at night other than oversized loads and essential deliveries.

CONCLUSION AND RECOMMENDATIONS

148. I have assessed operational and construction noise and vibration from the Project. I have found that due to the small number of PPFs near the designation, potential noise and vibration effects are generally minor. However, there are potentially significant adverse effects arising from individual vehicles negotiating roundabouts at each end of the Project and from heavy vehicles using engine brakes on long steep descents.

149. I have recommended design of the road environment to moderate vehicles at roundabouts and minimum separation distances between roundabouts and houses. With these measures the adverse effect should be minor.

150. While the effects of engine braking noise cannot practically be fully mitigated, I have recommended an asphaltic road surface on the lower eastern slope and minimum separation distances to minimise the overall road-traffic noise effect. With these measures I consider there will be a minor adverse noise effect in this area.

151. In the wider area I have found the Project will have significant positive effects through a reduction in road-traffic noise in Ashhurst, but without mitigation there could be significant adverse effects through increased road-traffic noise on SH3/2 Vogel Street in Woodville and on SH3 Napier Road in Ashhurst. I have recommended an asphaltic road surface in these areas that would reduce noise levels and result in a minor adverse effect.

152. Construction will use standard processes, and I have found that noise and vibration effects should be minor if normal good practice controls are applied. Bulk construction traffic passing through Ashhurst could have potentially significant adverse noise effects, but this could be controlled through a CTMP.

153. In summary, while there are various potential noise and vibration effects, with the mitigation and conditions I have recommended the residual noise and vibration effects are all likely to be minor. The construction and operational activity will be clearly audible over a wide area, but at reasonable levels that should be compatible with the environment. In my opinion the noise and vibration effects of the Project are likely to be acceptable.

Dr Stephen Chiles

2.A GLOSSARY OF ABBREVIATIONS & TERMS

APPENDIX 2.A: Glossary of abbreviations and terms

Table 2.A.1: Glossary of abbreviations

Abbreviation	*Description*
AADT	Annual average daily traffic
BS	British Standard
CNVMP	Construction noise and vibration management plan
CTMP	Construction traffic management plan
dB	Decibels
DIN	German Standard (Deutsches Institut für Normung)
ECDF	Environmental and cultural design framework
HV	Heavy vehicle
km	Kilometre
km/h	Kilometres per hour
$L_{Aeq(24h)}$	Time-average sound level over a twenty-four hour period, measured in dB
$L_{Aeq(15min)}$	Time-average sound level over a 15 minute hour period, measured in dB
L_{AFmax}	Maximum sound level, measured in dB
mm/s	Millimetres per second
NS	Norwegian Standard
NZS	New Zealand Standard
PPF	Protected premises and facilities
ppv	Peak particle velocity
SH2	State Highway 2
SH3	State Highway 3
SH57	State Highway 57
$v_{w,95}$	Statistical maximum weighted velocity with 95% probability
vpd	Vehicles per day

Table 2.A.2: Glossary of terms

Term	*Definition*
Annual average daily traffic	The total volume of traffic passing a roadside observation point over the period of a calendar year, divided by the number of days in that year (365 or 366 days). Measured in vehicles per day.
Free-field (Noise)	Description of a location which is at least 3.5 metres from any significant sound reflecting surface other than the ground.
Vehicles per day	The number of vehicles observed passing a point on a road in both directions for 24 hours.
Traffic volume	The number of vehicles flowing in both directions past a particular point in a given time (e.g. vehicles per hour, vehicles per day).

2.B
ACOUSTICS MODELLING DETAILS

APPENDIX 2.B: Acoustics modelling details

Road-traffic sound levels have been predicted using an acoustics computer model with the following parameters.

Table 2.B.1: Acoustics modelling details

Parameter	*Setting/source*
Operator	John Bull (detail checking – Stephen Chiles)
Software	CadnaA 2018 (build 161.4801)
Algorithm	CRTN (Calculation of Road Traffic Noise. UK Department of Transport and the Welsh Office. ISBN 0115508473. 1988) Low traffic flow cut-offs and adjustments have not been applied.
Parameter	$L_{Aeq(24h)}$ (taken as $L_{10(18h)}$ - 3dB)
Receivers	Free-field, 1.5 m high at ground floor, all buildings approximated as single-storey (height relative to the ground at one corner of the building estimated to be representative)
Sound contour grid	Free-field, 1.5 m high
Ground absorption	0.5
Road surface	Corrections in accordance with NZTA Guide to State highway road surface noise, v1, January 2014, p37.
Terrain	Base terrain: Palmerston North DEM, LINZ Data Service (15 metre resolution). This data is relatively coarse and has resulted in modelling artefacts occurring in some areas. While these issues affect the shape of noise contours in places such as at existing bridges and where there are steep gradients, they do not affect the modelling of the new alignment and are not material to the conclusions of the assessment. Within 200m of earthworks: Study_Area_LiDAR_Merged.las, GHD (resampled to 5 metre resolution) Existing bund at 1213 Fitzherbert East Road: manually added with an assumed height of 2 metres relative to the surrounding terrain.
New roads	51_38113_XC_NOR_BASE_OPTION_V3_WGS84_20180827.shp (received from GHD 28/08/18)
Building footprints	NZ Building Outlines, LINZ Data Service (retrieved 13/08/18)
PPF addresses	NZ street addresses, LINZ Data Service (retrieved 09/08/18)

Five scenarios have been modelled with the road and traffic characteristics set out in the following table.

Table 2.B.2: Road and traffic characteristics

Scenario	*Road*	*From*	*To*	*AADT*	*%HV*	*Speed*	*Surface*
2016 – Pre-existing	SH3	Cambridge	80km/h sign	7360	11	80	Chipseal
		80km/h sign	SH57			100	
2018 – Existing	SH3	Cambridge	80km/h sign	2903	14	80	Chipseal
		80km/h sign	SH57			100	
2041 – Without Project	SH3	Cambridge	80km/h sign	5805	14	80	Chipseal
		80km/h sign	SH57			100	
2041 – With Project	SH3	Cambridge	SH57	14720	11	80	Chipseal
2041 – Project with mitigation	SH3	Cambridge	Manawatu River	14720	11	80	PA10
		Manawatu River	SH57				Chipseal
2016 – Pre-existing	SH3 (Gorge)	SH57	Gorge	7620	12	100	Chipseal
2041 – With Project	SH3 (New)	SH57	100m east of SH57	15240	12	80	Chipseal
		100m east of SH57	100m west of Woodlands			100	
		100m west of Woodlands	Woodlands			80	
2041 – Project with mitigation	SH3 (New)	SH57	100m east of SH57	15240	12	80	Chipseal
		100m east of SH57	1.5km west of Woodlands			100	
		1.5km west of Woodlands	100m west of Woodlands			100	PA10
		100m west of Woodlands	Woodlands			80	
2016 – Pre-existing	SH3	Gorge	Woodlands	8058	12	100	Chipseal
2018 – Existing	SH3	Gorge	Woodlands	831	14	100	Chipseal
2041 – Without Project	SH3	Gorge	Woodlands	1662	14	100	Chipseal
2041 – With Project	SH3 (Old)	Gorge	Woodlands	900	10	100	Chipseal
2041 – Project with mitigation	SH3 (Old)	Gorge	Woodlands	900	10	100	Chipseal

Scenario	*Road*	*From*	*To*	*AADT*	*%HV*	*Speed*	*Surface*
2016 – Pre-existing	SH3	Woodlands	50km/h sign	7620	12	100	Chipseal
		50km/h sign	SH2			50	
2018 – Existing	SH3	Woodlands	50km/h sign	4480	10	80	Chipseal
		50km/h sign	SH2			50	
2041 – Without Project	SH3	Woodlands	50km/h sign	8960	10	80	Chipseal
		50km/h sign	SH2			50	
2041 – With Project	SH3	Woodlands	50km/h sign	15240	12	80	Chipseal
		50km/h sign	SH2			50	
2041 – Project with mitigation	SH3	Woodlands	50km/h sign	15240	12	80	PA10
		50km/h sign	SH2			50	
2016 – Pre-existing	SH2	SH3	50km/h sign	5880	13	50	Chipseal
		50km/h sign	Pinfold			70	
2018 – Existing	SH2	SH3	50km/h sign	4039	12	50	Chipseal
		50km/h sign	Pinfold			70	
2041 – Without Project	SH2	SH3	50km/h sign	8078	12	50	Chipseal
		50km/h sign	Pinfold			70	
2041 – With Project	SH2	SH3	50km/h sign	11760	13	50	Chipseal
		50km/h sign	Pinfold			70	
2041 – Project with mitigation	SH2	SH3	50km/h sign	11760	13	50	PA10
		50km/h sign	Pinfold			70	
2016 – Pre-existing	Cambridge	SH3	Mulgrave	8290	11	50	Chipseal
2018 – Existing	Cambridge	SH3	Mulgrave	9072	10	50	PA10
2041 – Without Project	Cambridge	SH3	Mulgrave	18144	10	50	PA10
2041 – With Project	Cambridge	SH3	Mulgrave	16580	11	50	PA10
2041 – Project with mitigation	Cambridge	SH3	Mulgrave	16580	11	50	PA10
2016 – Pre-existing	Salisbury	Mulgrave	Wyndham	1200	10	50	Chipseal
2018 – Existing	Salisbury	Mulgrave	Wyndham	6339	10	50	PA10
2041 – Without Project	Salisbury	Mulgrave	Wyndham	12678	10	50	PA10
2041 – With Project	Salisbury	Mulgrave	Wyndham	2400	10	50	PA10
2041 – Project with mitigation	Salisbury	Mulgrave	Wyndham	2400	10	50	PA10

Scenario	*Road*	*From*	*To*	*AADT*	*%HV*	*Speed*	*Surface*
2016 – Pre-existing	Saddle	Salisbury	Woodlands	150	10	100	Chipseal
2018 – Existing	Saddle	Salisbury	Woodlands	6078	11	80	Chipseal
2041 – Without Project	Saddle	Salisbury	Woodlands	12156	11	80	Chipseal
2041 – With Project	Saddle	Salisbury	Woodlands	300	10	80	Chipseal
2041 – Project with mitigation	Saddle	Salisbury	Woodlands	300	10	80	Chipseal
2016 – Pre-existing	Woodlands	Saddle	SH3	200	10	100	Chipseal
2018 – Existing	Woodlands	Saddle	SH3	4287	10	80	Chipseal
2041 – Without Project	Woodlands	Saddle	SH3	8574	10	80	Chipseal
2041 – With Project	Woodlands	Saddle	SH3	400	10	80	Chipseal
2041 – Project with mitigation	Woodlands	Saddle	SH3	400	10	80	Chipseal
2016 – Pre-existing	Oxford	Saddle	SH2	240	15	100	Chipseal
2018 – Existing	Oxford	Saddle	SH2	2081	15	80	Chipseal
2041 – Without Project	Oxford	Saddle	SH2	4162	15	80	Chipseal
2041 – With Project	Oxford	Saddle	SH2	480	15	80	Chipseal
2041 – Project with mitigation	Oxford	Saddle	SH2	480	15	80	Chipseal
2016 – Pre-existing	SH57	Aokautere	SH3	2360	14	100	Chipseal
2018 – Existing	SH57	Aokautere	SH3	1728	12	100	Chipseal
2041 – Without Project	SH57	Aokautere	SH3	3455	12	100	Chipseal
2041 – With Project	SH57	Aokautere	SH3	4720	14	100	Chipseal
2041 – Project with mitigation	SH57	Aokautere	SH3	4720	14	100	Chipseal

After the acoustics modelling Mr Dunlop updated his traffic forecast. The updates relate to Cambridge Avenue and SH3 from Cambridge Avenue to SH57 in the scenarios without the Project. The acoustics modelling has not been updated with those latest traffic forecasts but the changes would slightly lessen the noise effects assessed due to the Project.

2.C
SOUND LEVEL SURVEY

APPENDIX 2.C: Sound level survey

1213 Fitzherbert East Road

Table 2.C.1: 1213 Fitzherbert East Road - survey details

Parameter	*Setting/source*
Operator	Michael Smith
Address	1213 Fitzherbert East Road (corner SH3/SH57)
	NZTM 1834637E 5534202S
Equipment	ARL Ngara Type 1 SLM Serial 878106 calibrated 31/7/18
	Pulsar 105 Type 1 calibrator, calibrated 31/7/18
Parameter	$L_{Aeq(24h)}$
Observations	Traffic sound on SH57 audible behind bund. Significant vegetation sound from large trees to the north-west of the property
Average level	54 dB $L_{Aeq(24h)}$
6/9/18	50 dB $L_{Aeq(24h)}$
7/9/18	53 dB $L_{Aeq(24h)}$
8/9/18	58 dB $L_{Aeq(24h)}$
9/9/18	49 dB $L_{Aeq(24h)}$
10/9/18	51 dB $L_{Aeq(24h)}$

Figure 2.C.1: 1213 Fitzherbert East Road – graphs of measured sound levels and meteorological conditions

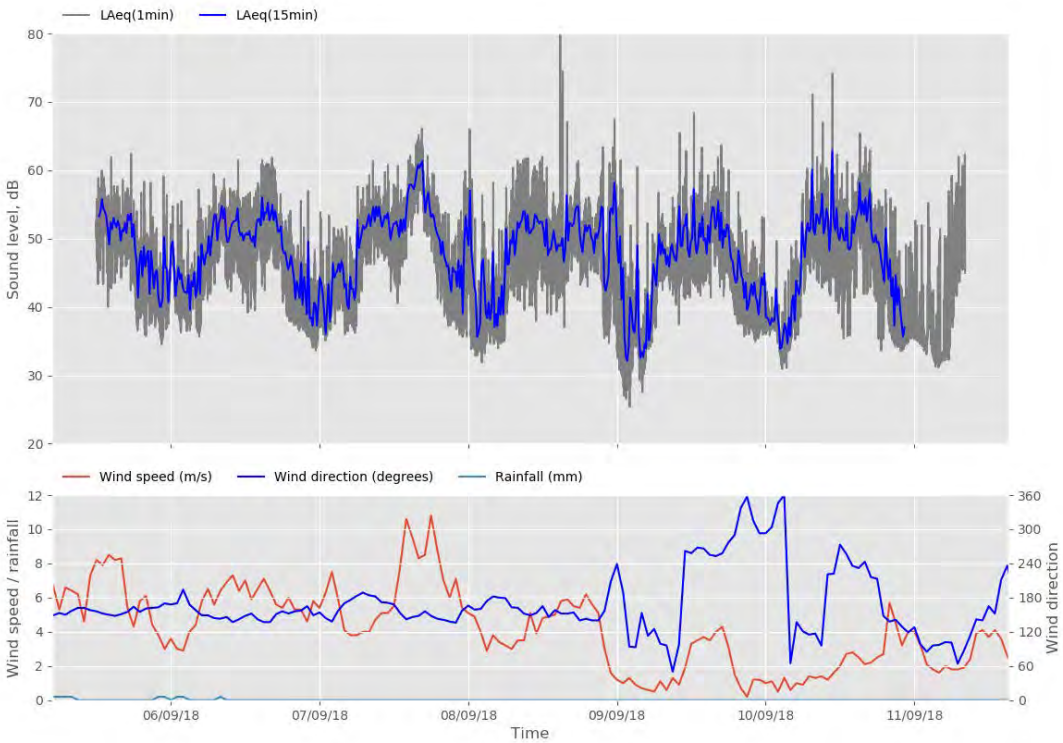


Figure 2.C.2: 1213 Fitzherbert East Road - aerial photograph showing monitoring location

Figure 2.C.3: 1213 Fitzherbert East Road - photographs of sound level monitoring position

North view

East view

South view

West view

75 Hope Road

Table 2.C.2: 75 Hope Road - survey details

Parameter	*Setting/source*
Operator	Michael Smith / Tim Dreadon
Address	75 Hope Road
Equipment	ARL Ngara Type 1 SLM Serial 878106 calibrated 31/7/18
	Pulsar 105 Type 1 calibrator, calibrated 31/7/18
Parameter	$L_{Aeq(24h)}$
Observations	Distant traffic noise was audible, but acoustic environment
	dominated by natural sounds, particularly wind in trees
Average level	50 dB $L_{Aeq(24h)}$
15/9/18	49 dB $L_{Aeq(24h)}$
16/9/18	50 dB $L_{Aeq(24h)}$
17/9/18	49 dB $L_{Aeq(24h)}$
18/9/18	50 dB $L_{Aeq(24h)}$

Figure 2.C.4: 75 Hope Road – graphs of measured sound levels and meteorological conditions

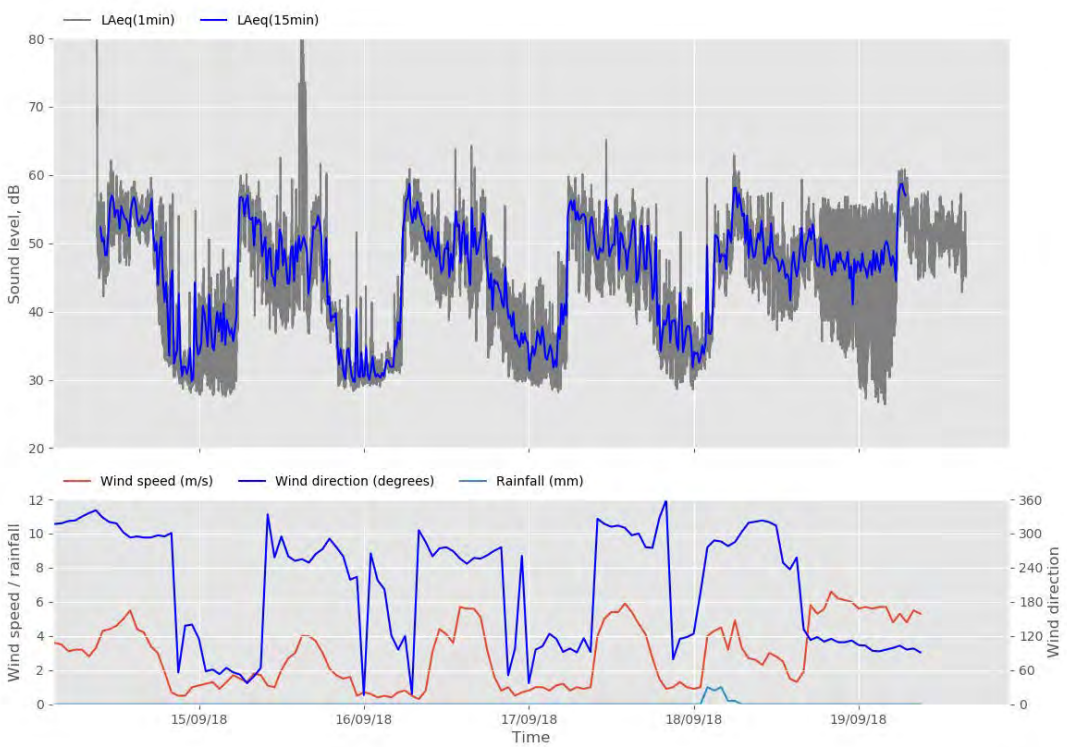


Figure 2.C.5: 75 Hope Road - aerial photograph showing monitoring location

Figure 2.C.6: 75 Hope Road - photographs of sound level monitoring position

North view

East view

South view

West view