

16. Noise and vibration

Overview

The rural and sparsely populated nature of the majority of the Project area means that specific noise and vibration mitigation is not required for most of the Project.

Construction noise will generally be within the limits of *NZS 6803:1999* and where construction works are proposed in close proximity to sensitive receivers, the Construction Noise and Vibration Management Plan (CNVMP) outlines protocols for engaging with affected parties and minimising noise and disruption. With this process in place, any potential adverse noise effects arising from construction will be able to be adequately managed.

In some areas, noise attenuation benefits will be delivered by OGPA pavement surfaces and proposed solid safety barriers. Based on an acoustics assessment, a small number of areas potentially requiring specific noise mitigation were identified and assessed using the process set out in *NZS 6806:2010*. Proposed mitigation consists of noise walls and bunds of varying heights and the modification of three buildings. With this mitigation in place, the effects of noise will be acceptable.

All potential vibration effects, both from construction and operation of the Project, will be such that no specific mitigation is considered necessary beyond management in accordance with the CNVMP.

16.1 Introduction

This chapter presents the assessment of the noise and vibration effects of both the construction and operation of the Project. The assessment of operational traffic noise should also be read in conjunction with the plan sets **NA, NB and NC**. The information contained in this chapter is based on the Assessment of Acoustics Effects (**Technical Report 12**).

16.2 Existing noise levels

The Project area is currently characterised by a number of different land uses, which provide differing noise and vibration levels. The majority of the area is rural, with areas of suburban development towards the southern end of the Project around eastern Porirua and Wellington City (Linden). In rural areas the noise environment is typical of an isolated area with larger holdings and forest plantations, where natural noises (such as cicadas, birds and wind in trees) are dominant. In these rural locations ambient noise levels were measured as being between 38 and 54 dB $L_{Aeq(24h)}$. Where rural areas are close to existing roads, such as SH1 at MacKays Crossing and SH58 to the east of Pauatahanui, ambient noise levels are higher. At these locations, the proximity to a State highway means that traffic noise from the significant daily traffic flows is dominant and is up to 60 dB $L_{Aeq(24h)}$.

The suburban areas in the vicinity of the Project, such as Cannons Creek and Waitangirua, also have a natural noise environment (such as birds, cicadas and wind in trees), but these environments also commonly feature people-oriented noise, such as music, machinery and household noises, including pets. In these suburban areas, ambient noise levels were measured as between 42 and 53 $L_{Aeq(24h)}$. Where vehicles are present, traffic noise tends to dominate. Some of the suburban areas in the Project area are within existing State highway noise environments, including Linden and Ranui Heights, which are close to SH1 and in the vicinity of SH58. The upper levels of State highway noise around SH1 were recorded as being 59 $L_{Aeq(24h)}$.

Another potential source of noise in a State highway environment is from engine braking by heavy vehicles. Measurements of this were taken at two locations in the region where engine brakes might be expected to be used (Ngauranga Gorge and Haywards Hill). This was undertaken to provide an indication of engine brake use and noise levels, and provide a guide indicating noise effects associated with the hill sections of the Project. Over a two hour period in Ngauranga Gorge, engine brakes were observed on only three occasions with an average maximum noise level of 93 dB L_{AFmax} at 5 metres.

16.3 Assessment of noise effects

Noise effects have been assessed for both the construction and operation phases of the Project.

16.3.1 Construction noise

Management of noise from construction activities is guided by *NZS 6803:1999 'Acoustics - Construction Noise* (NZS 6803:1999) which provides noise limits for construction works. It takes into account factors such as the sensitivity of the receiver, the duration of the works and the time of the day and week. In accordance with *NZS 6803:1999*, the Project's construction works will generally only be conducted between 0630h and 2000h from Monday to Saturday inclusive, with particularly noisy activities being further restricted to between 0730h and 1800h. Construction may occur outside these times in some instances but will be subject to the CNVMP.

The rural nature and sparse population through most of the Project area means that noise from construction is not likely to be an issue in most areas. The areas where works will occur in close proximity to residential areas, and therefore have the potential to result in adverse construction noise effects, are:

- at the southern tie-in around Linden, Tawa, Kenepuru and Ranui Heights;
- in the vicinity of the eastern Porirua suburbs of Cannons Creek, Waitangirua and Whitby, from the construction of the Link Roads;
- in the vicinity of SH58 and Flightys Road;
- in the vicinity of Paekakariki Hill Road; and
- in the vicinity of MacKays Crossing.

Even at these locations construction noise is predicted to comply with the limits contained in *NZS 6803:1999*, most of the time. In some locations (particularly in the vicinity of the southern tie-in at Linden) some of the proposed noise walls to mitigate operational road traffic noise (described in

Table 16.4) will be erected during the construction phase to also provide noise attenuation during the construction period. In rare instances (such as where night time works might be needed for a short duration) the CNVMP sets out a process for informing and minimising the disruption to nearby residents.

The relatively low number of dwellings close to the Project construction area and the implementation of the CNVMP mean that any adverse noise effects arising from construction will be able to be managed in accordance with *NZS 6803:1999*.

16.3.2 Operational noise

The assessment of operational noise effects was undertaken in accordance with *NZS 6806:2010 Acoustics - Road-traffic noise - New and altered roads* (NZS 6806:2010). The assessment is described in full in **Technical Report 12** but broadly it involved:

- identifying protected premises and facilities (PPFs) within the vicinity of the proposed roads;
- modelling predicted noise levels without any specific form of mitigation at each PPF; and
- evaluating potential noise mitigation options, where appropriate

16.3.2.1 Protected premises and facilities

PPFs are defined fully in NZS 6806:2010 but include facilities such as:

- buildings used primarily for residential activities;
- marae;
- spaces within buildings used for overnight medical care; and
- teaching areas and sleeping rooms in buildings used as education facilities.

For rural areas defined by Statistics New Zealand (i.e. the Project area north of Battle Hill) PPFs up to 200m from the road are included. In urban areas PPFs up to 100m from the road are included. As such, the following areas were identified as containing one or more PPFs:

- MacKays Crossing;
- Paekakariki Hill Road;
- Flightys Road;
- SH58 east of Pauatahanui;
- proposed Silverwood subdivision area;
- in the vicinity of James Cook Drive (where the Whitby Link Road will connect to the local road network);
- in the vicinity of Warspite Avenue (where the Waitangirua Link Road will connect to the local road network);

- Takapu Road;
- Bluff Road / Kenepuru Drive;
- Ranui Heights;
- Linden;
- Rangatira Road;
- Greenacres; and
- Tawa.

Battle Hill Farm Forest Park (BHFFP) was also considered although there are no locations meeting the definition of a PPF.

16.3.2.2 Modelling

The noise model took into account factors such as predicted traffic volumes, pavement surfaces, topography, proposed safety barriers, and proposed bridges. Noise levels for the NZS 6806 assessment are presented in terms of three categories of predicted noise levels at a PPF, as shown in Table 16.1.

Table 16.1: NZS 6806 categories

Category	Criterion	Altered roads	New roads ⁸⁹
A	Primary	64 dB LAeq(24h)	57 dB LAeq(24h)
B	Secondary	67 dB LAeq(24h)	64 dB LAeq(24h)
C	Internal	40 dB LAeq(24h)	40 dB LAeq(24h)

For the assessment, the levels for altered roads have been included as they are relevant in locations where the Project will connect to the existing road network (either the State highway or local road network). Category A and B noise level criteria are measured outside a PPF, and when these are exceeded Category C criteria apply inside the building.

These categories have been developed for assessment, rather than consenting, purposes. However, in general terms:

- **Category A** indicates that no more than minor adverse noise effects are predicted.
- **Category B** indicates a slightly increased level of noise compared to category A but the adverse noise effects would still be considered to be no more than minor in most cases.
- **Category C** indicates that there may be more than minor noise effects outside, and mitigation may be required to achieve an acceptable level of noise inside.

89. With predicted traffic volumes of 2,500 to 75,000 AADT at the design year.

The basic assessment process was to initially model two scenarios for each area:

- **Do nothing** – 2031 without the Project constructed
- **Do minimum** – 2031 with the Project constructed, but with no specific noise mitigation

The purpose of this initial modelling was to determine in which areas noise mitigation should be considered and then to provide a baseline for the evaluation of noise mitigation options.

Generally, the consideration of mitigation options was undertaken where the initial modelling indicated that for the Do Minimum scenario there would be PPFs in categories B or C.

Modelling was undertaken for all of the areas containing one or more PPF and a summary of the results for each of these areas is shown in Table 16.2 and the plans **NB01- 21**.

Table 16.2: Predicted noise levels for the Do Minimum scenario

Area	Key modelling results	Do mitigation options need to be considered?
A: MacKays Crossing	The Project will shift SH1 away from the most affected PPFs, reducing the road-traffic noise levels for these currently affected buildings. It will however increase noise levels at other PPFs. All of the affected PPFs are category A or B, except for one category C. The category C PPF is owned by the Crown and is to be demolished.	Yes
B: Battle Hill Farm Forest Park	Noise levels will increase through BHFFP and this will change the amenity of the area for park users. There are no PPFs in this area that will be affected. The increased noise level in the park will be reduced to a degree by the topography, such as Gas Line Ridge which will provide some acoustics screening. The greatest increase in noise will be experienced by pedestrians crossing under the Main Alignment (via underpass Bridge No. 7) to access the Akatarawa Forest.	No ⁹⁰
C: Paekakariki Hill Road	There will be an increase in noise levels at a number of PPFs in these two areas but all are either category A or B.	Yes
D: Flightys Road		
E: SH58 Interchange	The Project will result in a reduction in noise levels for some PPFs and an increase for others. The PPFs which will experience increased noise levels are predicted to be either category A or B.	Yes
F: Silverwood	The area includes a large consented subdivision to the west of the Main Alignment and a small number of existing properties along Bradey Road to the east of the Main Alignment. The developers of the	Yes ⁹¹

90. Although not required under NZS 6806 (as there are no PPFs), noise mitigation options through BHFFP were considered in recognition of potential noise effects for recreational users of the Park.

91. While noise mitigation options were assessed for this area, noise mitigation for the proposed Silverwood subdivision is to be provided by Silverwood in accordance with an agreement between Silverwood Joint Venture and the NZTA.

Area	Key modelling results	Do mitigation options need to be considered?
	subdivision have entered into an agreement with the NZTA regarding noise effects. This requires acoustic treatment to be provided at the new dwellings (at the cost of the developer).	
G: James Cook Drive	Traffic volumes along James Cook Drive will increase as a result of traffic using the Whitby Link Road. All PPFs are predicted to be within category A.	No
H: Warspite Avenue	Traffic volumes along Warspite Avenue will increase as a result of traffic using the Waitangirua Link Road. All PPFs are predicted to be within category A, with the exception of one of the residential buildings at the back of the marae which will be category B.	Yes
I: Takapu Road	There will be an increase in road-traffic noise audible from Takapu Road but at all PPFs it will be within category A.	No
J: Bluff Road	There will be an increase in road-traffic noise audible from Bluff Road as a result of traffic using the Kenepuru Link Road but at all PPFs it will be within category A.	No
K: Ranui Heights	Parts of Ranui Heights currently experience noise from existing SH1 and noise levels would be expected to increase by about 5 dB through general traffic growth. The (unmitigated) Project would cause several PPFs to be in categories B and C.	Yes
L: Linden	Parts of Linden currently experience noise from existing SH1 and noise levels would be expected to increase by about 5 dB through general traffic growth. The (unmitigated) Project would cause some PPFs to experience decreased noise levels and some increased noise levels. Some of those PPFs with increased levels are predicted to be categories B and C.	Yes
M: Rangatira Road	There are two PPFs on Rangatira Road but both are predicted to be in category A.	No
N: Greenacres	Parts of Greenacres currently experience noise from existing SH1 and noise levels would be expected to increase by about 5 dB through general traffic growth. However, the (unmitigated) Project will, cause several PPFs to be in categories B and C.	Yes
O: Tawa	Parts of Tawa currently experience noise from existing SH1 and noise levels would be expected to increase by about 5 dB through general traffic growth. However, the Project will cause several PPFs (including Linden School and He Huarahi Tamariki Complex) to be in categories B and C.	Yes

As a result of the initial assessment summarised in Table 16.2, noise mitigation options were assessed for a majority of the areas. NZS 6806:2010 sets out a process for the evaluation of mitigation options. The process is not purely based on reaching a specific noise level reduction but aims to achieve the best practicable option (BPO) by taking into account aspects such as the visual and urban design implications, constructability and value-for-money of various mitigation options. This is intended to produce a more integrated solution than if noise mitigation was considered in isolation.

Details about the mitigation options evaluated for each area are contained in **Technical Report 12**. For five areas where mitigation was considered, the BPO was not to provide any noise mitigation. The reasons for this are summarised in Table 16.3.

Table 16.3: Areas where noise mitigation was not recommended

Area	Reason mitigation was not recommended
A: MacKays Crossing	All PPFs are in Categories A or B except one PPF in category C which is owned by the Crown and will be removed. Options tested include use of a low noise road surface and roadside barriers. All options were found to have relatively poor benefit-cost ratios due to the large extent of works required to benefit a small number of PPFs. Furthermore, barriers tested do not provide significant benefit due to the topography, and create adverse visual effects.
B: Battle Hill Farm Forest Park	Using a low noise road surface would not fundamentally alter the change in acoustic amenity in the park and the main visitor area will be screened by the topography of Gas-Line Ridge.
C: Paekakariki Hill Road	All PPFs are in categories A or B. A low road noise surface and / or a bund would have limited effectiveness and a bund would create adverse visual effects.
E: SH58 Interchange	All PPFs are in categories A or B. A low-noise road surface has a poor BCR due to the limited number of PPFs that would benefit from the mitigation.
F Silverwood	The Silverwood subdivision is subject to an agreement between the developers and the NZTA. The agreement required buildings in the subdivision to be constructed to mitigate future road-traffic noise and no noise mitigation as part of the Project is therefore required.

For all the other areas where mitigation was considered, specific noise mitigation is recommended and a summary of currently proposed mitigation is set out in Table 16.4.

Table 16.4: Currently proposed noise mitigation

Area	Currently proposed noise mitigation
D: Flightys Road	2m high noise bund along the western (northbound) carriageway of the Main Alignment adjacent to the properties at Flightys Road (total length of approximately 378m).
H: Warspite Avenue (Marae)	2m high noise barrier along the southern side of the Waitangirua Link Road at the proposed new intersection with Warspite Avenue adjacent to the marae (total length of approximately 150m).
K: Ranui Heights	2 - 3m high noise barrier along the eastern (southbound) carriageway of the Main Alignment adjacent to the properties at 37 Apple Terrace - 56A Huanui Street (total length of approximately 151m).
L: Linden	2m high noise bund along the western (northbound) carriageway of the Main Alignment adjacent to the properties at 86 - 92 Tremewan Street (total length of approximately 100m).
N: Greenacres	2 - 2.5m high noise barrier along the eastern (southbound) carriageway of the Main Alignment at the Linden tie-in (total length of approximately 532m, not continuous). Building modification (acoustic treatment) of 2 Little Collins Street, 2 Raroa Terrace and one bedroom of 8 Allen Terrace.
O: Tawa	2-3m high noise barrier along the western designation boundary of the Main Alignment at the Linden tie-in (total length of 572m).

The proposed noise mitigation measures described in Table 16.4 reflect the BPO to mitigate the potential adverse noise effects from the operation of the Project. Consultation has been undertaken

with all landowners where noise walls are proposed and in some cases landowners have requested changes to the heights of the noise wall based on their preference for noise reduction or views. Where possible these requests have been accommodated. The specific design the proposed noise mitigation has not yet been determined could be altered as part of the detailed design of the Project. The NZTA has made a commitment to all landowners that they will be consulted with again as part of the noise mitigation detailed design process.

Although the purpose of noise walls is to provide on-going mitigation of traffic noise from the operation of the Project, the noise walls at Ranui Heights, Greenacres and Tawa will be erected at the start of the construction phase to provide noise reduction benefits during construction as well. The other barriers are dependent on new earthworks, but will still be constructed as early as practicable.

In summary, construction noise can be adequately managed as construction will largely occur in sparsely populated rural areas. Mitigation options for operational noise have been assessed in accordance with NZS 6806:2010 and noise mitigation is proposed in a number of areas, mainly where the Project is in proximity to urban areas. As such, operational road noise will be able to be mitigated to an acceptable level in accordance with NZS 6806:2010.

16.4 Assessment of vibration effects

16.4.1 Vibration effects during construction

The only residential area of the Project where adverse vibration effects from construction could potentially be an issue is around Linden / Tawa where works will occur in close proximity to existing dwellings. In addition, there are two heritage features that could potentially be adversely affected by construction vibration:

- St. Joseph's Church; and
- the brick splinter proof blast containment structure (brick fuel tank) at the bottom of the Te Puka valley.

Vibration will predominantly result from ground compaction work and excavation in bedrock. This has the potential to cause two types of adverse effect:

- nuisance and annoyance from the perception of vibration; and
- cosmetic damage to existing buildings.

Potential nuisance and annoyance can be reduced by not undertaking this type of work at night and by clearly communicating to nearby residents when and for how long compaction will occur. As long as this information is communicated accurately and with adequate forewarning, the public is generally reasonably accepting of these kinds of short-term events. Procedures for this communication are set out in the CNVMP.

Damage to existing structures from construction vibration is considered unlikely but structures that could potentially be affected (including the two aforementioned heritage structures) will be assessed before works commence. The same structures will be monitored during construction and re-assessed

once works have been completed and any damage caused as a result of vibration from construction of the Project will be repaired. This process is explained in the CNVMP.

Implementation of the communication procedures will ensure that any potential adverse vibration effects in terms of nuisance will be adequately managed. Any adverse effects on existing buildings will be remedied. As such, the adverse effects from vibration as a result of construction of the Project will be able to be adequately managed and remedied if necessary.

16.4.2 Operational vibration effects

Adverse vibration effects can occur where a building or other structure is located close to a road. For the Project, the only area where this could occur is at the southern tie-in at Linden / Tawa.

Measurements of vibration were undertaken at two dwellings and in a reserve adjacent to SH1 at Linden. Vibration levels reduced rapidly as the distance from the formed carriageway increased. Within 7m of the carriageway, vibration levels were measured at v_{w95} 0.28mm/s, which is below the v_{w95} 0.3mm/s threshold contained in the Norwegian Standard NS 8176E:2005. This indicates good pavement condition and levels complied with the limits contained in NS 8176E:2005.

It is assumed that the new pavements surfaces (i.e. of the Main Alignment and the re-aligned SH1) will be maintained to the same standard as currently occur. Once the Project is complete, the nearest building to any part of the new or re-aligned State highway will be approximately 10m. As this is greater than 7m it is considered that any adverse vibration effects arising from the operation of the Project will be negligible.