Construction noise and vibration assessment

Peka Peka to North Ōtaki Expressway

12 FEBRUARY 2013

Prepared for

NZ Transport Agency

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42176987

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H	12 February 2013	Minor editorial changes

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Abbreviations

Abbreviation	Description
AEE	Assessment of environmental effects
BS	British Standard
CEMP	Construction Environmental Management Plan
CNVMP	Construction noise and vibration management plan
CNVMS	Construction noise and vibration management schedule
dB	Decibels
DIN	German Standard (Deutsches Institut für Normung)
HV	Heavy vehicle
Hz	Hertz
km	Kilometre
$L_{Aeq(15min)}$	Time-average sound level over a 15 minute hour period, measured in dB.
L_{AFmax}	Maximum sound level, measured in dB.
NIMT	North Island Main Trunk
NoR	Notice of requirement
NZS	New Zealand Standard
NZTA	NZ Transport Agency
OP	Outline plan
PPF	Protected premises and facilities
ppv	Peak particle velocity
RoNS	Road of national significance
RMA	Resource Management Act 1991
SAR	Scheme assessment report
SARA	Scheme assessment report addendum
SH1	State highway 1

Executive Summary

Term	Definition
Alignment	The horizontal or vertical geometric form of the centre line of the carriageway.
Continuous vibration	Vibration that is maintained for an indefinite period of time.
Draft Construction Guide	NZTA publication *State highway guide to construction and maintenance noise and vibration*, v0.6 September 2012
Designation	Defined in section 166 of the RMA as: "a provision made in a district plan to give effect to a requirement made by a requiring authority under section 168 or section 168A or clause 4 of schedule 1."
Expressway	A road mainly for through traffic, usually dual carriageway, with full or partial control of access. Intersections are generally grade separated.
Local road	A road (other than a State highway) in the district, and under the control, of a territorial authority, as defined in Section 5 of the Land Transport Management Act 2003.
Notice of requirement	A notice given to a territorial authority (under section 168 of the RMA) or by a territorial authority (under section 168A of the RMA) of a requirement for land, water, subsoil or airspace to be designated.
Outline plan	A plan of the public work, project, or work to be constructed on designated land provided to a territorial authority, pursuant to section 176A of the RMA, prior to the work being undertaken.
Road reserve	A legally described area within which facilities such as roads, footpaths and associated features may be constructed and maintained for public travel.
Transient vibration	Transient vibration is temporarily sustained vibration but which may be frequently repeated. For example, the vibration resulting from impact piling.

Executive Summary

This technical report documents the assessment of construction noise and vibration for the Peka Peka to North Ōtaki Expressway Project ('Expressway' and 'Project'). A separate report has been prepared for operational noise and vibration.

This report discusses the relevant standards and guidelines for construction noise and vibration management. The New Zealand Standard NZS 6803 and the British Standard BS 5228-2 provide the primary criteria for acceptable levels of construction noise and vibration respectively, as well as potential mitigation measures. The two tiers of vibration criteria proposed by the NZTA for State highway projects are discussed. Residential and commercial receivers potentially affected along the route are identified.

Indicative noise and vibration levels are predicted for each stage of the construction process. These levels are based on typical equipment, and will be reviewed when a contractor is appointed and the construction methodology developed. Based on the indicative calculations at this stage, construction noise and vibration is likely to cause some disturbance to daytime activities at the adjacent receivers which will require management.

The NZTA has established processes to manage construction noise and vibration, which are consistent with the referenced standards. A critical part of these processes is the use of a construction noise and vibration management plan (CNVMP) for the Project as a whole, and schedules (CNVMS) for individual activities and locations. The proposed designation conditions require a draft CNVMP to be submitted to Kāpiti Coast District Council as part of the outline plan process.

The existing environment includes significant road-traffic noise from the State highway and occasional rail noise from the North Island Main Trunk (NIMT). A noise survey and modelling of existing noise levels was performed as part of the operational noise assessment. In some locations, construction noise will not be greater than existing road-traffic noise.

Effects from construction noise and vibration for the Project will be temporary, and construction noise will generally remain within reasonable limits determined by NZS6803. No significant night works are anticipated. There will be some disturbance, but with appropriate management measures as set out in this report, the adverse noise and vibration effects are considered reasonable.

1

Introduction

1.1 Project overview

The NZ Transport Agency (the NZTA) is lodging a Notice of Requirement (NoR) and applications for resource consents for the construction, operation and maintenance of the Peka Peka to North Ōtaki section of the Kāpiti Expressway project. The Project would require the re-alignment of approximately 1.2 kilometres of the North Island Main Trunk (NIMT) through Ōtaki, and KiwiRail is lodging an NoR for that purpose. In this application, 'the Project' refers to:

- construction of the main road alignment;
- realignment of part of the NIMT; and
- associated local road connections.

1.2 Project description

1.2.1 Main alignment

The Wellington Northern Corridor Road of National Significance (RoNS) runs from Wellington Airport to Levin. The Project is one of eight sections of the Wellington Northern Corridor RoNS. The location of the Project in the overall scheme of this corridor is illustrated in Figure 1-1.

The NZTA proposes in this application to designate land and obtain the resource consents necessary to construct, operate and maintain the Expressway. The Project extends from Te Kowhai Road in the south to Taylors Road just north of Ōtaki, an approximate distance of 13 kilometres.

The Expressway will provide two lanes of traffic in each direction. Connections to existing local roads, new local roads and access points over the Expressway to maintain safe connectivity between the western and eastern sides of the Expressway are also proposed as part of the project. There is a new crossing of the Ōtaki River proposed as part of the Project, along with crossings of other watercourses.

On completion, it is proposed that the Expressway become State Highway 1 (SH1) and that the existing SH1 between Peka Peka and North Ōtaki will become a local arterial road, allowing for the separation of local and through traffic. The power to declare roads to be State highways or revoke status resides with the Chief Executive of the Ministry of Transport, not with the NZTA.

1.2.2 North Island Main Trunk

KiwiRail proposes to designate land in the Kāpiti Coast District Plan for the construction, operation and maintenance of a re-aligned section of the NIMT through Ōtaki. The realignment of the NIMT is to facilitate the Expressway, however at the same time the realignment yields other benefits including the removal of a level crossing.

1 Introduction

Figure 1-1 Project location

1.3 Operational noise assessment

A detailed assessment of operational road and rail traffic noise and vibration for the Project was performed by URS between July 2011 and October 2012. This was initially performed as a scheme assessment report addendum, which was finalised in 2011, and has been expanded in 2012 to consider mitigation options in more detail. That work is documented in the Operational noise and vibration assessment report[1], and is not part of this report.

1.4 Construction noise and vibration assessment

A construction noise and vibration assessment for the Project was conducted by URS between February 2012 and August 2012. Unlike the operational noise and vibration report, as the construction methodology has not been confirmed and the construction equipment used will depend on the appointed contractor, only indicative predictions have been made of the noise and vibration

[1] URS Report 42176986/002/H dated 12 February 2013

1 Introduction

levels from construction activities. The role of this report is to provide the key construction noise and vibration parameters that will be applied within the CNVMP, and to determine that construction noise and vibration can be appropriately managed and the effects acceptable.

The overall assessment and management of construction noise and vibration is performed over several phases, as shown in Figure 1-2, with the current phase highlighted. The purpose of the assessment in this current phase is to identify any significant adverse effects that cannot be adequately avoided or mitigated. It is considered that with appropriate mitigation, the residual effects of noise and vibration associated with the Project's construction will be acceptable. Designation conditions will require the detailed assessment and management of these potential issues in the future stages.

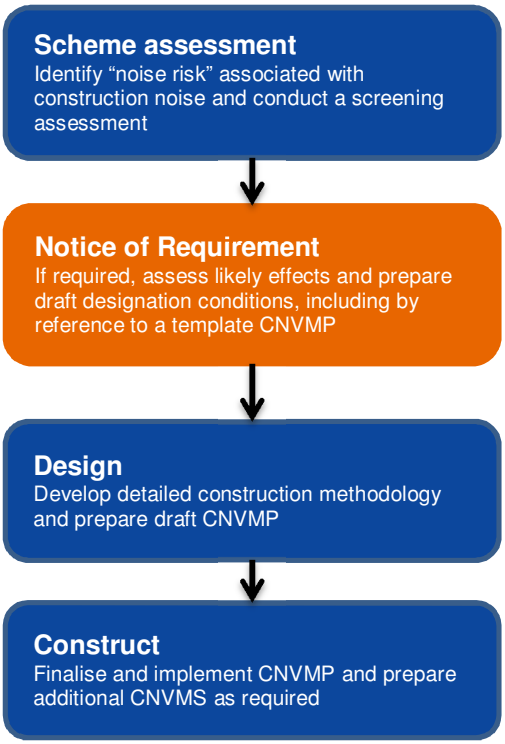

Figure 1-2 Project phases

The NZTA has prepared a draft State highway construction and maintenance noise and vibration guide[2] ('draft Construction Guide') that documents its approach to construction noise and vibration management at each of these different phases. The guide also describes good practice for the management of construction noise.

For some projects where construction will be occurring in close proximity to receivers, construction noise and vibration may require detailed assessment during the scheme assessment. This was not the case for the Project as construction can be performed using conventional techniques with typical buffer distances between activities and receivers. Minimal night works will be required, which are discussed in more detail in Section 3.2.

[2] State highway construction and maintenance noise and vibration guide, Draft v0.6, dated September 2012

1 Introduction

During the detailed design phase, a draft construction noise and vibration management plan (CNVMP) will be finalised and included in the outline plan. The NZTA has prepared a CNVMP template, which will be used for the Project. A copy of this template has been included in the application. The NZTA's Transport Noise website[3] contains a construction noise calculator and other online management tools which will assist the contractor and project team. During the construction phase, the contractor will be responsible for implementing the CNVMP and developing the construction noise and vibration management schedules (CNVMS) as necessary.

The relationship between the key management documents is shown in Figure 1-3. The requirements for the Construction Environmental Management Plan (CEMP) are specified in NZTA Minimum Standard Z/4[4].

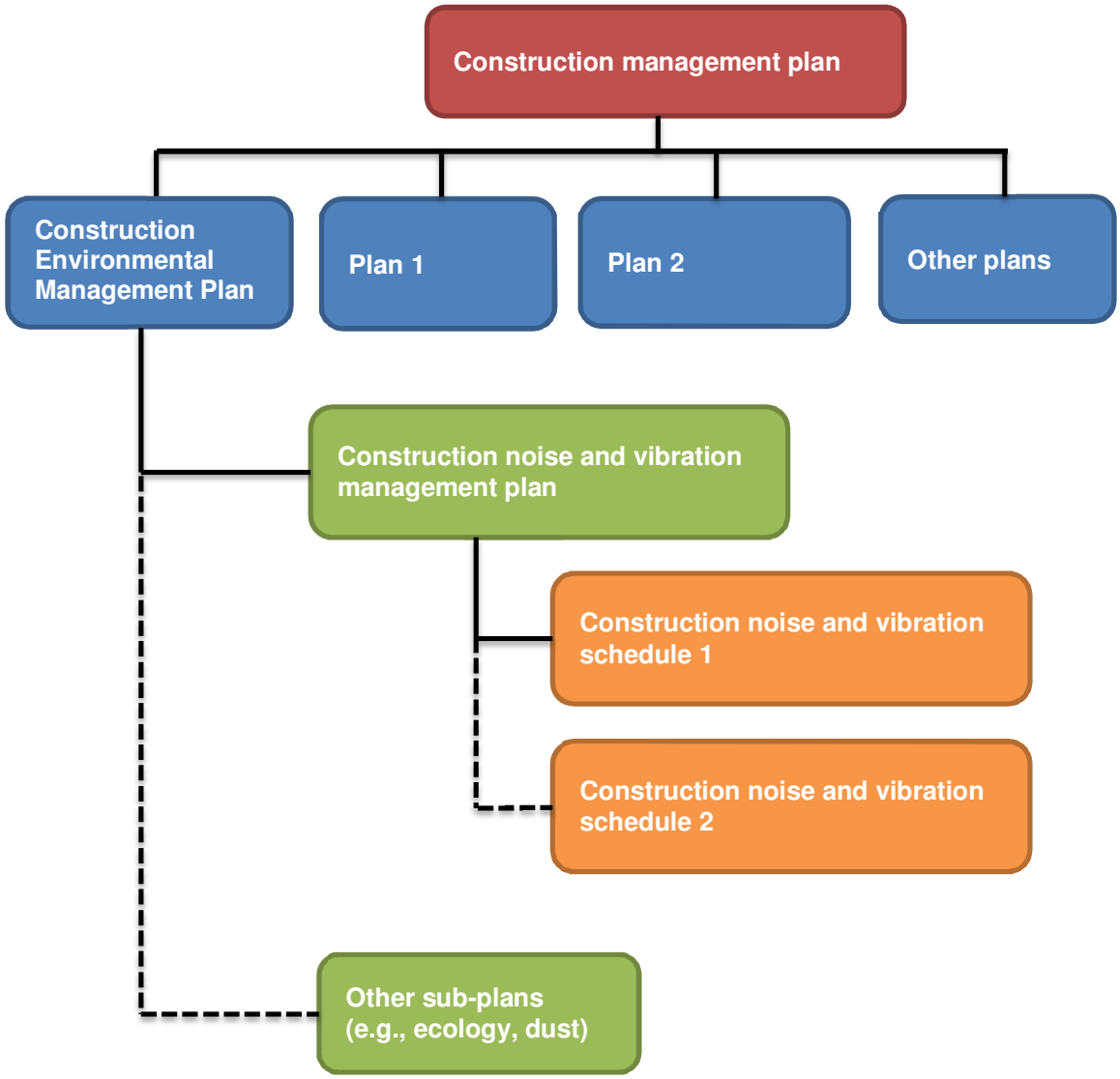

Figure 1-3 Key documents in the management of construction noise and vibration

[3] www.acoustics.nzta.govt.nz
[4] Minimum Standard Z/4 – Contractor's social and environmental management plan

2

Criteria

2.1 District Plan

The operative Kāpiti Coast District Plan has a rule for controlled activities in both rural and residential zones that noise for construction associated with new roads shall comply with the limits prescribed in the provisional New Zealand Standard NZS 6803P:1984[5]. The Project is not a controlled activity but this rule serves as a reference. This standard is referenced for other construction activities throughout the district.

The 1984 provisional standard was upgraded to a full standard as NZS 6803:1999[6]. The key difference is that the 1999 version is expanded to outline processes such as the use of management plans. The 1999 version also acknowledges that the guideline noise criteria in the standard might not be achievable in all instances; provides additional guidance to the management of construction noise; but maintains the previous numeric criteria. The primary assessment parameter changed to $L_{Aeq(t)}$, which is consistent with current practice.

NZS 6803:1999 has been adopted as the appropriate standard for construction noise management in this assessment.

2.2 New Zealand Standard NZS 6803

NZS 6803 provides a framework for managing construction noise. Part of this framework is guideline noise limits, which are shown in Table 2-1. For large infrastructure projects in many instances it is not practicable to meet these limits. In particular night works are often required when working on or near an existing State highway due to high traffic volumes and potential delays from daytime road works. It is unlikely that the NZS 6803 guideline night-time noise limits could be achieved at residential receivers near road works. Also, where works are very close to receivers there may be times when it is not practicable to comply with the daytime limits. In such cases construction noise should still be managed to reasonable levels through good practice, such as detailed in the draft NZTA guide, but also in those circumstances greater emphasis is needed on effective stakeholder engagement.

NZS 6803 provides different guideline noise limits for different activity durations. For roading projects, long-term criteria (more than 20 weeks) are often appropriate, as receivers are exposed to noise from multiple activities over the duration of the project, despite each activity being of short duration. For example, where the new alignment will be used as an access / haul road, receivers will be exposed to construction noise for a longer period. Due to the proximity of the Project to the existing State highway, ambient noise levels are already elevated and this intermittent exposure to daytime noise is not expected to have a significant effect. Therefore the short-term criteria (less than 20 weeks) are appropriate for most activities.

[5] NZS 6803P:1984, The Measurement and Assessment of Noise from Construction, Maintenance and Demolition Work
[6] NZS 6803:1999, Acoustics – Construction noise

2 Criteria

Table 2-1 NZS 6806:1999 guideline construction noise limits

Time of week	Time period	Duration of construction work at any one location					
		less than 2 weeks		less than 20 weeks		more than 20 weeks	
		$L_{Aeq(1h)}$	L_{AFmax}	$L_{Aeq(1h)}$	L_{AFmax}	$L_{Aeq(1h)}$	L_{AFmax}
Residential							
Weekdays	0630-0730	65 dB	75 dB	60 dB	75 dB	55 dB	75 dB
	0730-1800	80 dB	95 dB	75 dB	90 dB	70 dB	85 dB
	1800-2000	75 dB	90 dB	70 dB	85 dB	65 dB	80 dB
	2000-0630	45 dB	75 dB	45 dB	75 dB	45 dB	75 dB
Saturdays	0630-0730	45 dB	75 dB	45 dB	75 dB	45 dB	75 dB
	0730-1800	80 dB	95 dB	75 dB	90 dB	70 dB	85 dB
	1800-2000	45 dB	75 dB	45 dB	75 dB	45 dB	75 dB
	2000-0630	45 dB	75 dB	45 dB	75 dB	45 dB	75 dB
Sundays and public holidays	0630-0730	45 dB	75 dB	45 dB	75 dB	45 dB	75 dB
	0730-1800	55 dB	85 dB	55 dB	85 dB	55 dB	85 dB
	1800-2000	45 dB	75 dB	45 dB	75 dB	45 dB	75 dB
	2000-0630	45 dB	75 dB	45 dB	75 dB	45 dB	75 dB
Industrial and commercial							
All days	0730-1800	80 dB	-	75 dB	-	70 dB	-
	1800-0730	85 dB	-	80 dB	-	75 dB	-

2.3 British Standard BS 5228-2

There are no standardised criteria in New Zealand for construction vibration. For this assessment the criteria in British Standard BS 5228-2:2009[7] are primarily used as they cover building damage, damage to other objects and human perception. The main issue for daytime construction vibration is building damage, as residential dwellings are often unoccupied, or occupied with uses less sensitive to annoyance during the day. Table 2-2, Table 2-3 and Table 2-4 give a summary of the BS 5228-2 criteria. Vibration levels are given as the peak particle velocity. BS 5228-2 also provides guidance for vibration affecting sensitive electronic instruments. However, there are no receivers near the Project where this is known to be relevant.

Table 2-2 Human response to construction vibration

Vibration level	Response
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10.0 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

[7] BS 5228-2:2009, Code of practice for noise and vibration control on construction and open sites - Part 2: Vibration

2 Criteria

Table 2-3 Transient vibration guide values for cosmetic building damage

Building type	Peak component particle velocity in frequency range of predominant pulse, at base of building
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above
Unreinforced or light framed structures Residential or light commercial buildings	(maximum displacement of 0.6 mm below 4 Hz) 15 mm/s at 4 Hz, 20 mm/s at 15 Hz, 50 mm/s at 40 Hz and above

*Guide values would be reduced for continuous rather than transient vibration

Table 2-4 Vibration guide levels for other structures

Structure	Peak particle velocity
Retaining walls - slender and potentially sensitive masonry walls	10 mm/s at toe 40 mm/s at crest (reduced for continuous vibration)
Underground services	30 mm/s transient vibration 15 mm/s continuous vibration

2.4 NZTA two-tier criteria

The draft Construction Guide proposes two tiers of vibration criteria, as shown in Table 2-5, which have been developed in consultation with experts within the New Zealand acoustics community. These are structured as part of a process whereby construction should be managed to comply with the Category A criteria. If measured or predicted vibration levels exceed the Category A criteria, then vibration should be managed to comply with the Category A criteria as far as practicable. If the construction vibration exceeds the Category B criteria then construction activity shall only proceed if there is continuous monitoring of vibration levels, and effects on those buildings at risk of exceeding the Category B criteria are considered acceptable.

The criteria are largely based on BS 5228-2, with a reference to the German Standard DIN 4150-3[8] for the Category A building damage criteria. These criteria were adopted in the conditions for the Transmission Gully Project, and have been adopted for the Project.

Table 2-5 NZTA recommended vibration criteria

Receiver	Location	Details	Category A	Category B
Occupied dwellings	Inside the building	Night time (2000-0630h)	0.3 mm/s ppv	1 mm/s ppv
		Day time (2000-0630h)	1 mm/s ppv	5 mm/s ppv
Other occupied buildings	Inside the building	Day time (2000-0630h)	2 mm/s ppv	5 mm/s ppv
All other buildings	Building foundation	Transient	5 mm/s ppv	Table 2-3
		Continuous		50% of Table 2-3

[8] DIN 4150-3:1999 Structural vibration - Effects of vibration on structures

Additional criteria should be used in the case of historic, vibration-sensitive or multi-storey buildings, however this is not the case for the Project, as the buildings of historic interest near the Project are of relatively standard construction types[9].

2.5 Receivers

Construction noise has been assessed for all residential and commercial receivers within 100 metres of the earthworks boundary, which represents the extent to which heavy machinery should be operating. In addition to the Protected Premises and Facilities (PPFs) identified in the operation noise and vibration assessment report, commercial premises are assessed as receivers for construction noise and vibration. A review of the noise and vibration sensitivity of commercial premises in the vicinity of the works will occur when the CNVMP is prepared, however as most of these premises access the existing State highway, some tolerance of noise is expected.

Construction vibration has only been assessed for receivers within 100 metres of the earthworks boundary, as vibration at greater distances will not cause any building damage and is unlikely to cause annoyance (see Section 3.4).

The receivers are grouped and discussed in Section 5.2.

[9] Ian Bowman (2012), Assessment of Build Heritage Effects, Revision F 26 September 2012

3

Construction works

A construction methodology report[10] has been prepared for the Project, which outlines the philosophy for the construction. A detailed methodology however will not be available until after the statutory approvals and the Project is prepared for construction. This assessment has been based on that report, and our experience on other similar projects.

Noise and vibration levels have been predicted for a range of typical construction activities. An overview of the scale of the indicative construction works is provided in Table 3-1.

Table 3-1 Indicative construction overview

Item	Section 1	Section 2	Section 3	Section 4
Section description	Ōtaki North through to Ōtaki River Bridge	Ōtaki River Bridge to Old Hautere Road	Old Hautere Road to Te Horo	Te Horo to Peka Peka Interchange
Chainages	0000 - 3500	3500 -5250	5250 - 8600	8600 - 12250
Earthworks: - Cut - Undercut - Fill	 270,000 m^3 54,000 m^3 210,000 m^3	 290,000 m^3 3,000 m^3 35,000 m^3	 80,000 m^3 27,000 m^3 137,000 m^3	 190,000 m^3 130,000 m^3 470,000 m^3
Production duration	68 weeks	73 weeks	20 weeks	48 weeks
Truck movements: - In section - Between sections (SH1 and haul roads)	 10,500 3,000	 1,800 12,800	 6,800 3,200	 23,500 14,200
Drainages	8 culverts 5.5 km of swales	3 culverts 3 km of swales	7 culverts 5.5 km of swales	12 culverts 6.5 km of swales
Pavement area - Expressway - Local roads	 90,000 m^2 9,500 m^2	 49,000 m^2 11,000 m^2	 84,000 m^2 14,000 m^2	 91,000 m^2 19,000 m^2
Pavement production duration	50 weeks	30 weeks	49 weeks	55 weeks
Truck movements - imported pavement materials	3,000	1,800	3,000	3,500

[10] Opus (2012), Construction Methodology Report, Revision B, 8/9/12

3 Construction works

3.1 Activities

3.1.1 Road

The most significant activity in terms of timeframe and extent are the actual road works. This involves bulk earthworks, transporting fill, grading and levelling, and compaction.

Preparing the basecourse and surface will involve the spreading of fill, distributing the chips / asphalt, and compaction.

In addition to the road, kerbing, safety barriers and roadside furniture will be installed, and line marking conducted.

3.1.2 Bridges

There are nine bridges along the route, which are listed in Table 3-2 along with a brief comment on their proximity to properties. Bored piles will be used in preference to vibratory or driven piles. The existing State highway bridge in Ōtaki will be demolished after Bridges 2 and 3 are constructed.

Table 3-2 Bridge locations

No.	Location	Comment
1	Waitohu Stream Bridge	No nearby PPFs
2 & 3	Ōtaki State highway link	Eastern end of bridge approximately 50 metres from nearest PPF
4	Rahui Road Underpass	The nearest PPFs at the former Rahui Milk Transfer Station which is 25 metres from the earthworks boundary
5	Ōtaki River Bridge	No nearby PPFs
6 & 7	South Ōtaki interchange	No nearby PPFs
8	Te Horo Underpass	Nearest PPF 50 metres from bridge structure
9	Mary Crest Rail Bridge	The nearest PPF is over 100 metres from this structure

3.1.3 Tie-ins

The Expressway will tie-in with the existing State highway to the north of the Project, and the MacKays to Peka Peka expressway to the south. No significant nightworks are anticipated to be required at these locations, and the nearest receivers are over 100 metres from the tie-ins.

3.1.4 Rail

The railway will be diverted west of the existing alignment in Ōtaki to allow for the Expressway. The extent of the realignment is from the Ōtaki Railway Station, to north of the Main Highway overbridge, as shown in Figure 3-1. The rail works will consist of earthworks which are similar in nature to those required for the roads, and in addition laying of the ballast, sleepers and rail delivery and fixing. The closest receivers are 230 Main Highway and the Ōtaki Motel, which are 60-80 metres from the realigned railway.

3 Construction works

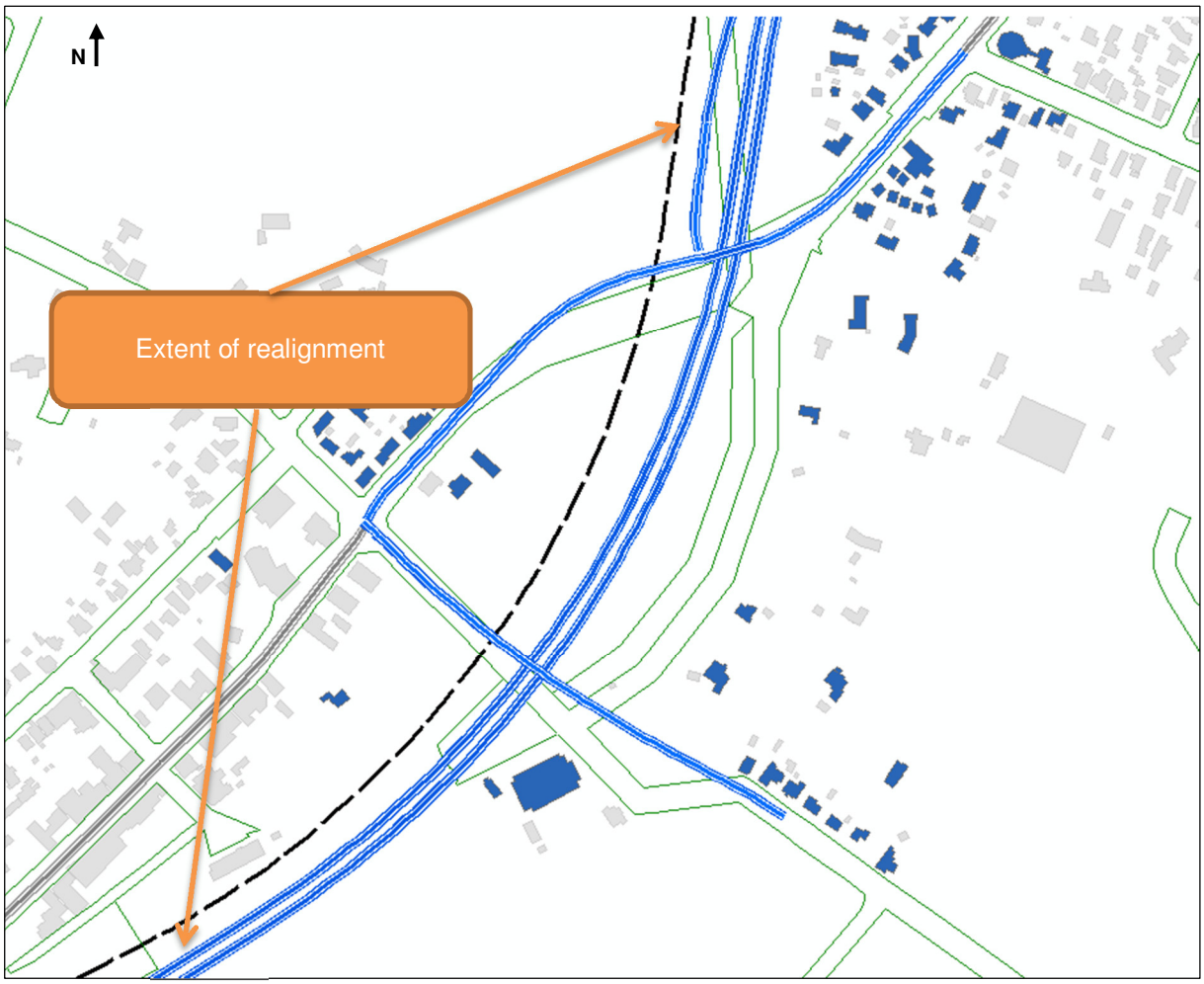

Figure 3-1 Extent of rail realignment

3.1.5 Vehicle movements

It will be necessary to transport soil between different parts of the Project to balance the cut and fill requirements. It is anticipated that approximately 800,000 m^3 of fill will be transported within the Project, with 45,000 m^3 imported from elsewhere. Vehicle movements will occur either on the alignment, or via the State highway network. It is expected that vehicle movements on local roads can generally be avoided, and that additional traffic on the State highway is considered insignificant. At some locations such as on County Road vehicle movements may be required for a limited duration for a specific activity. Vehicle movements along the alignment have been considered as part of the road works assessment.

3.1.6 Summary

Construction works have been summarised into the activities listed in Table 3-3 with a description of the activities and typical equipment.

Table 3-3 Construction activities

Activity	Description
Road - Earthworks	Earthworks crews will form the surface with a dozer/grader. Short-haul earth movements will be performed with a scraper, and long-haul movements will be using excavators and trucks.
Road - Pavement	Spreading fill, chip sealing. Rolling and compaction.
Road - Finishing	Roadside furniture, line marking. Vehicle movements.
Bridges	Piling will be required, which will be bored. Localised ground improvements by undercutting / installation of gravel columns. Continuous pours of concrete may be required. Demolition of the existing bridge will involve hydraulic breakers and crushers.
Site compound	The site compound is proposed to be located between ch3200–3400, the quarry adjacent to the Ōtaki River. If necessary there may be concrete batching and a pre-cast yard at the site.
Laydown areas	In addition to the site compound, laydown areas may be used along the route where several vehicles may be operational in the area at once, along with generators etc.
Rail - Earthworks	Levelling of surface with a dozer/grader.
Rail - Ballast	Spreading ballast, and levelling of surface with a dozer/grader.
Rail - Sleepers	Transportation of rails to site, and lifting to the track.
Rail - Rail delivery and fixing	Lifting onto sleepers, welding rail joints. Compaction and tamping.

3.2 Night works

It is expected that most construction activities will be only performed during the day, but night works may be required where activities interact with live roads and rail for safety or operational reasons. Continuous pours of concrete may be required. These night works are to be of limited duration. Activities with potential night works include:

Bridges:

- Bridge 2 - crossing the existing NIMT rail line
- Bridge 4 - Rahui Road Underpass, span crossing the existing NIMT rail line
- Bridge 7 - Ōtaki Gorge Road NIMT Underpass
- Bridge 8 - Te Horo SH1 Underpass, span across NIMT
- Bridge 9 - SH1 Mary Crest Overpass, across NIMT

Local road construction works that may have night time construction work are:

- Ch 0000 to Ch 0600 SH1widening/Ōtaki northern gateway construction
- Ch 1500 and Ch 1800 - SH1 realignment tie in and County Road north tie in
- Ch 2100 - Rahui Road/SH1, Rahui Road County Road south tie in
- Ch 3900 - SH1/ Otaki Gorge Road Roundabout tie in
- Ch 4300 - Otaki Gorge Road/Old Hautere Road tie in
- Ch 5300 - Old Hautere Road tie in
- Ch 7400 - Te Horo Beach Road tie in
- Ch 7900 - School Road / Gear Road intersection
- Ch 8600 - Gear Road tie in
- Ch 9500 - New local road connection to SH1
- Ch 12250 - Peka Peka Interchange, Expressway and local connection

Where night works will exceed the guideline noise limits, these works will be scheduled to avoid periods of maximum sensitivity, for example not working past midnight unless continuous operations are required. The nature of the works and any restrictions will be documented in a construction noise and vibration management schedule prepared for the specific works and location. The relationship between the schedules and the overarching plan is shown in Figure 1-3.

3.3 Predicted noise levels

From the types of equipment and duration of works envisaged, a conservative assessment has been made for typical activities using the construction noise calculator on the Transport Noise website. From these calculations, buffer distances required from construction activities to comply with guideline noise limits in NZS 6803 have been determined.

Indicative equipment source levels are provided in Table 3-4, and predictions for each activity at different distances in Table 3-5. These calculations are conservative in that they assume several items of equipment all at the same distance from a receiver. An overview of the nature of the construction activities and locations is provided in Table 3-1.

Table 3-4 Indicative equipment noise levels

Equipment*	Type	Estimated L_{Aeq} at 10 m	Data reference
Excavator	40 tonne	80 dB	BS 5228
Scraper	30 tonne	80 dB	BS 5228
Haul truck	40 tonne	88 dB	BS 5228
Hydraulic breaker	7.4 tonne	92 dB	BS 5228
Water truck		76 dB	BS 5228
Generator		59 dB	BS 5228
Waste truck		78 dB	BS 5228
Batching plant		86 dB	URS estimate
Rail tamping machine		89 dB	URS estimate
Dynamic track stabliser		76 dB	URS estimate
Disk cutter / rail saw		87 dB	URS estimate

* Model types to be confirmed

Table 3-5 Predicted construction noise levels

Activity	Items	Noise level at 50 m	Noise level at 100 m	Noise level at 200 m
Road - Earthworks	3 × excavator 3 × scrapers 1 × long haul truck	79 dB	73 dB	67 dB
Road - Pavement	Dozer Spreading / chipping fill. Roller Paving	71 dB	65 dB	59 dB
Bridges - construction	Auger Truck mounted concrete pump Crane / winch Generator	72 dB	66 dB	60 dB
Bridges - demolition	Hydraulic breaker Crusher	81 dB	75 dB	69 dB
Batching plant at site base		75 dB	69 dB	63 dB
Laydown areas	3 × excavator 3 × scrapers 1 × long haul truck Generator Water truck filling Repairing activities (grinder etc)	75 dB	69 dB	63 dB
Vehicle movements	Haul truck passbys (25% or time)	63 dB	57 dB	51 dB
Rail track building	Crane Trucks Welding Tamping / compaction	77 dB	72 dB	66 dB

3.4 Predicted vibration levels

Vibratory compaction is the main source of construction vibration associated with the Project with the potential for adverse effects. Appendix E of BS 5228 provides a method for calculating three different probabilities of exceedance of a given vibration level during compaction works. This method uses the inputs listed in Table 3-6 which have been modelled on a Sakai SV512 vibratory roller. Predicted vibration levels are shown Table 3-7 and Table 3-8 for different distances, for both low and high settings, with commentary provided on the resultant effects on the basis of the criteria in Section 2.3.

Table 3-6 Vibratory compactor calculation inputs

Number of vibrating drums	Maximum amplitude of drum vibration	Vibrating drum width
1	Low - 0.9 mm /s High - 2.0 mm/s	2.15 m

3 Construction works

Table 3-7 Vibration levels from vibratory compactor - low setting

Distance from source	Exceedence probability 50%	33%	5%	Comment
5 metres	3 mm/s	6 mm/s	12 mm/s	Structural and cosmetic damage possible. Careful assessment required if any buildings are this close to final alignment
10 metres	2 mm/s	3 mm/s	6 mm/s	Cosmetic damage is possible. High level of annoyance expected. Assessment based on chosen equipment advisable.
20 metres	0.6 mm/s	1 mm/s	2 mm/s	Vibration to be clearly perceptible and may cause annoyance. No risk of structural or cosmetic damage
50 metres	0.2 mm/s	0.3 mm/s	0.6 m/s	Vibration to be perceptible at times, but annoyance should be minimal.

Table 3-8 Vibration levels from vibratory compactor - high setting

Distance from source	Exceedence probability 50%	33%	5%	Comment
5 metres	11 mm/s	21 mm/s	41 mm/s	Structural and cosmetic damage possible. Careful assessment required if any buildings are this close to final alignment.
10 metres	5 mm/s	10 mm/s	18 mm/s	Cosmetic damage is possible. Assessment based on chosen equipment advisable. Vibration is likely to be intolerable for any more than a brief exposure
20 metres	2 mm/s	4 mm/s	8 mm/s	Cosmetic damage is possible. High level of annoyance expected
50 metres	0.6 mm/s	1 mm/s	2 m/s	Vibration to be clearly perceptible and may cause annoyance. No risk of structural or cosmetic damage
100 metres	0.2 mm/s	0.4 mm/s	0.8 m/s	Vibration to be perceptible at times, but annoyance should be minimal.

It is recommended that this type of vibratory compaction should only be used at 'low' settings within 50 metres of receivers unless more detailed analysis is undertaken.

The other construction activity with potential for significant vibration generation is the bored piles for bridgework. No model for this activity is provided in BS 5228, however an assessment has been performed based on vibratory piling, which is expected to generate greater vibration levels than bored piles. The vibration predictions are shown in Table 3-9.

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Table 3-9 Vibration levels from vibratory piling

	Exceedence probability			
Distance from source	**50%**	**33%**	**5%**	**Comment**
10 metres	3 mm/s	6 mm/s	13 mm/s	Structural and cosmetic damage possible. Careful assessment required if any buildings are this close to final alignment
20 metres	1 mm/s	3 mm/s	5 mm/s	Cosmetic damage is possible. High level of annoyance expected. Assessment based on chosen equipment advisable.
50 metres	0.4 mm/s	0.8 mm/s	2 mm/s	Vibration to be clearly perceptible and may cause annoyance. No risk of structural or cosmetic damage
100 metres	0.2 mm/s	0.3 mm/s	0.7 m/s	Vibration to be perceptible at times, but annoyance should be minimal.

For vibratory compaction and bored piles, any annoyance from vibration is unlikely to extend beyond 100 metres from the activity.

4

Design and mitigation

4.1 Overview

Mitigation measures should be planned and implemented in a structured hierarchy depending on the extent of predicted effects. In general, the hierarchy should be:

- managing times of activities to avoid night works and other sensitive times;
- liaising with neighbours so they can work around specific activities;
- selecting equipment and methodologies to restrict noise and vibration;
- using screening/enclosure/barriers;
- offering neighbours temporary relocation; and
- for long duration works, treating neighbouring buildings.

Good practice for noise mitigation is detailed in the draft Construction Guide, and any specific mitigation required will be documented in the CNVMP and schedules. Indicative mitigation is documented below to illustrate the approximate extent and types of measures likely to be required.

4.2 Specific activities

4.2.1 Roads

Noise from bulk earthworks can be reduced by limiting the number of items of equipment operating in parallel, and/or by equipment selection.

Potential annoyance can be reduced by avoiding long periods of consecutive activity; the use of broadband reversing beepers; and performing routine maintenance such as greasing tracked equipment.

4.2.2 Bridges

As documented in Section 3.1.2, most of the bridges are remote from receivers, and bored piles are being used in preference to driven or vibratory piling. No mitigation will be required for daytime activities greater than 50 metres from the receivers.

If a continuous pour of concrete is required during the bridge formation, then night works may be required. Consideration of noise will be required when selecting equipment and procedures for any night works, and direct consultation with affected properties will be necessary.

4.2.3 Tie-ins

The tie-ins to the existing State highway to the north and MacKays to Peka Peka to the south are likely to be built during the day using standard traffic control techniques.

4.2.4 Rail

The majority of the rail work can be performed during the day, however some night works may be required when connecting to the existing rail tracks, to minimise disruption. It is anticipated that it would take a weekend to tie-in the new alignment with the current alignment, where intensive works will be required.

4.2.5 Site compound

The site compound, including any batching required, should be located remote of any receivers. A potential location for this is in the vicinity of the existing concrete plant by the Ōtaki River, between chainages 3200 and 3400.

Any site should have direct access to the State highway, and vehicles movements on local roads should be discouraged.

4.3 Management processes

4.3.1 Outline plan

At the conclusion of the detailed design of the Project, the NZTA will submit an outline plan to the KCDC for approval. This plan will contain a detailed construction methodology. At that stage, a CNVMP will be submitted.

4.3.2 Management plan

A CNVMP will be prepared by the Project team, and implemented by the appointed contractors. The NZTA has a standardised template for this purpose, which is available on the Transport Noise website. The plan includes:

- noise targets;
- summary of assessments/predictions;
- general construction practices, management and mitigation;
- noise management and mitigation measures specific to activities and/or receiving environments;
- monitoring and reporting requirements;
- procedures for handling complaints; and
- procedures for review of the CNVMP throughout the Project.

4.3.3 Management schedules

For significant activities a schedule to the CNVMP (CNVMS) should be prepared once details of construction equipment and locations have been confirmed. These schedules will set out specific conditions relating to a defined activity in a pre-determined location. Generally, schedules are developed for activities that have been identified as likely to exceed the Project noise or criteria (Sections 2.2 and 2.4). For example, any activity which will require night works is likely to require a schedule to be prepared.

The schedule will be read and signed by all site personnel involved in the work, prior to the activity commencing. Again, the NZTA has prepared a standard CNVMS template which is available on the Transport Noise website.

4.3.4 Website

The NZTA has a web-based framework for the documentation of construction noise, which is available on the Transport Noise website. This allows the management plan and schedules to be uploaded, construction noise calculations to be performed, complaints to be logged as well as monitoring

records. Unless the appointed contractor has its own system for documenting construction noise management, the NZTA tools should be used.

4.4 Conditions

For construction noise and vibration it is critical that effective management processes are followed and this should be specified by designation conditions. There should also be noise and vibration criteria to provide a framework for assessment, but flexibility is needed to allow activities that cannot comply with the standard values. This frequently occurs for roading projects where night-works cannot be avoided. The NZTA has recently developed model designation conditions for road construction noise and vibration and these have been adopted for the Project. The proposed conditions for the Project can be found in Volume 2 of the AEE.

5

Assessment of noise and vibration effects

5.1 Existing environment

The Expressway route closely follows the existing State highway, with the neighbouring environments ranging from rural to urban. A noise survey has included measurements at two locations over a week to capture temporal variations, and spot measurements at six other locations to capture spatial variations. For the existing State highway, computer modelling has been used to predict existing road-traffic noise levels to supplement measurements. The results of the noise survey and modelling are detailed in the operational noise and vibration assessment report for the Project.

The noise level measured at a property adjacent the State highway in Te Horo was 65 dB, which is representative of PPFs with the most exposure to road-traffic noise. The noise level at a property in Ōtaki 50 metres from the State highway the level was 54 dB, which is a more typical level for PPFs in the vicinity of the State highway.

5.2 Receivers

North of Ōtaki Township

The receivers on Main Highway north of the new ramp and along County Road are in close proximity to the alignment, and noise from earthworks and surfacing will be in the order of 70-80 dB, although this would vary during the day. These receivers are shown in Figure 5-1, with non-sensitive buildings (e.g., sheds) shaded grey. At these levels, some disturbance to daytime activities can be expected. With effective communication with neighbours, these works should not unduly interfere with normal domestic activities.

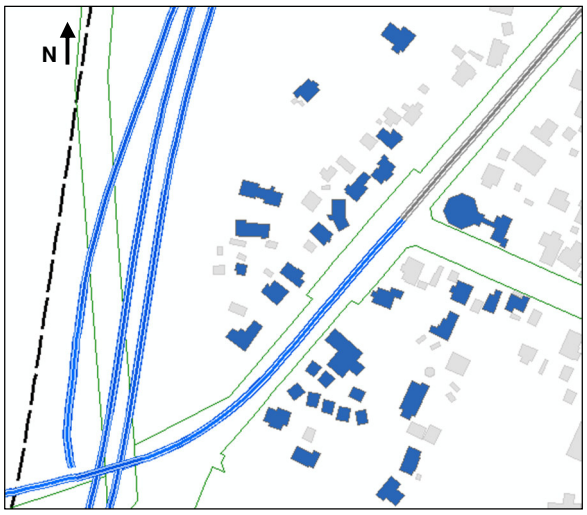

Figure 5-1 North of Ōtaki

Rahui Road

The Expressway is 20-40 metres away from the former Rahui Milk Treatment Station and Social Hall, and without mitigation, construction noise levels could be up to 85 dB at times, which would interfere with activities occurring at the time. A schedule to the CNVMP will be required for all works adjacent to this property, with activities programmed to reduce any disturbance.

5 Assessment of noise and vibration effects

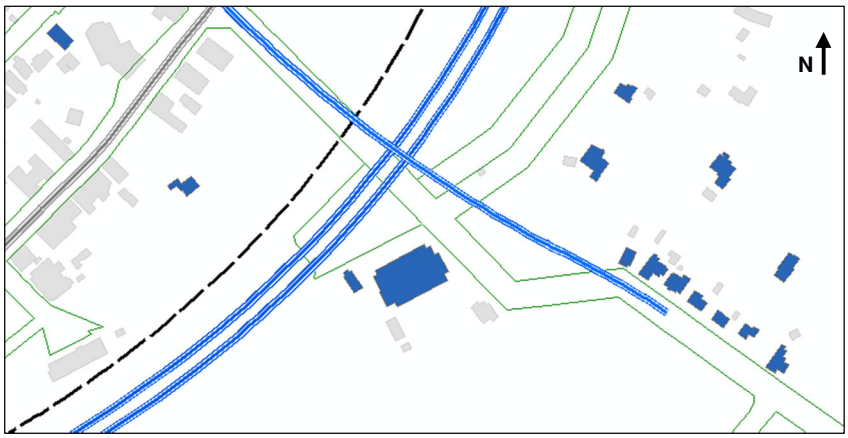

Figure 5-2 Rahui Road

As these two buildings are close to vibration sources (vibratory compaction on the alignment) there is the potential for cosmetic damage to buildings (such as cracking) and annoyance from perception of vibration. A building condition survey will be required before and after construction works to determine if any cosmetic damage has been caused, so that it can then be repaired. Annoyance will be addressed by accurately communicating the time and duration of vibration in advance, and this will generally only be during the daytime. With these controls the adverse effects of construction vibration should be acceptable. There are no adverse construction vibration effects predicted for the remainder of the Expressway route.

The realignment of Rahui Road will involve surfacing within 20 metres of receivers, however this work will be similar in scale to the periodic resurfacing of existing roads. This activity will be of relatively short-duration and effective communication should result in acceptable noise effects.

Old Hautere Road

Several receivers are within 50 metres of both the Expressway and the Old Hautere Road extension, and may experience noise levels in the order of 70-80 dB during construction. At these levels, some disturbance to daytime activities is expected. The majority of receivers are greater than 100 metres from the Expressway, resulting in noise levels in levels in the range 60-70 dB. Again, with effective communication with neighbours, these works should not unduly interfere with normal domestic activities.

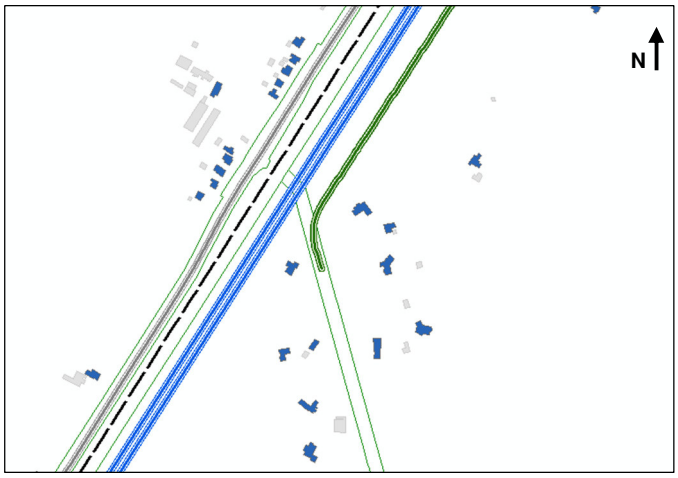

Figure 5-3 Old Hautere Road

5 Assessment of noise and vibration effects

Te Horo

The properties west of the existing State highway are approximately 100 metres from the Expressway. Construction noise is predicted to be a similar level to the existing road-traffic noise, therefore there are no significant adverse effects from construction noise at these properties.

The bridge at Te Horo is distant from most receivers and will not cause any significant vibration effects.

The brick kilns on the site north of Te Horo are in close proximity to the Expressway, however as these are to be relocated as part of the Project, a construction vibration assessment is not required.

Figure 5-4 Te Horo

South of Mary Crest

For the remainder of the Project, the Expressway and new local arterial run parallel to the existing State highway. The PPFs to the east of the Expressway are in general at least 50-100 metres from the Expressway. Construction noise is likely to be audible and there may be some annoyance. With effective communication with neighbours, these works should not unduly interfere with normal domestic activities.

5 Assessment of noise and vibration effects

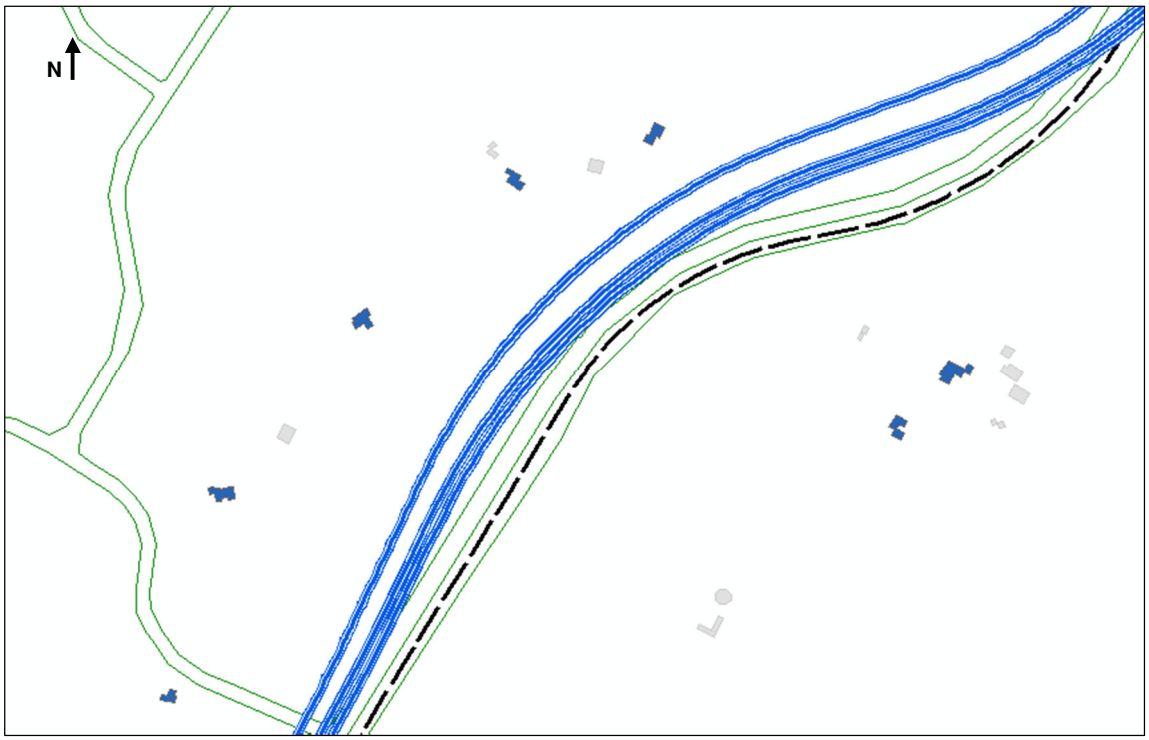

Figure 5-5 South of Mary Crest

5.3 Night works

Night works will only be required where the Project interacts with the existing State highway, railway and local roads. Their extent and duration will be limited, as discussed in Section 3.2. In these locations, the receivers are likely to already have elevated ambient noise levels due to the proximity to the State highway and NIMT. With appropriate communication with residents, and scheduling to minimise disturbances, construction noise effects from any night works will be acceptable.

5.4 Summary

The majority of the construction is separated from neighbours and while it will be audible at many places, construction noise will generally remain within reasonable limits determined by NZS 6803, using standard noise management controls. There are a small number of specific locations discussed above where neighbours are closer to the works and enhanced controls, particularly effective communication, will be required to manage noise disturbance.

Construction vibration effects are limited and will be addressed on a site-specific basis where appropriate.

The framework for construction noise and vibration management is documented in the proposed designation conditions.

6

Conclusions

NZS 6803:1999 has been adopted for the assessment of construction noise and criteria based on the British Standard BS 5228-2:2009 have been adopted for the assessment of construction vibration. Based on indicative construction techniques, for most of the Project the construction noise and vibration will be kept in compliance with the guideline limits, through the use of good practice management. This will be implemented by a construction noise and vibration management plan to be prepared in the next phase when the construction methodology is confirmed. Enhanced management will be required at a number of specific locations where works are closer to neighbours.

The framework for construction noise and vibration management documented in the proposed designation conditions will result in acceptable noise and vibration effects.

7

Limitations

URS New Zealand Limited (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of the NZ Transport Agency connection with the designation of Peka Peka to North Ōtaki Expressway and the local roads. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Acoustics Scope dated July 2010.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between February 2012 and January 2013 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

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