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Subject	Road-Traffic Noise Review	Project Name	Mackays to Peka Peka Expressway
Attention	Greg Haldane	Project No.	IZ094500
From	Sarah Alper / Stephen Chiles		
Date	22 November 2017		

1. Introduction

Since the Mackays to Peka Expressway (M2PP) opened in late February 2017 a number of nearby residents have complained about operational road-traffic noise from vehicles on the expressway.

Prior to construction of the M2PP, road-traffic noise from the M2PP was assessed in 2011 in accordance with NZS 6806 *Acoustics – road-traffic noise - new and altered roads* (NZS 6806), which recommends criteria for road-traffic noise and sets out a process for determining appropriate mitigation. NZS 6806 was prepared under the supervision of a committee which included a number of government bodies, the Acoustical Society of New Zealand and the New Zealand Institute of Environmental Health. NZS 6806 is employed by the NZ Transport Agency (Transport Agency) and other authorities such as Auckland Transport, and has been used for all recent state highway projects.

Designation conditions for the M2PP were set by a Board of Inquiry in 2012, in general accordance with NZS 6806 with minor amendments. The designation conditions are included in Appendix A.

In August 2017 the Transport Agency appointed road-traffic noise specialists Sarah Alper of Jacobs (Australia) and sole-practitioner Stephen Chiles (New Zealand) to a panel (the Panel) to undertake a review of the noise issues associated with the M2PP. The scope of this review is set out in the terms of reference (ToR) provided by the Transport Agency dated 7 August 2017¹. This report is structured around items A, B and C of the ToR, the details of which are provided in Section 2 of this document.

The ToR encompasses:

- review of operational road-traffic noise mitigation,
- review of the post-opening noise monitoring and documentation,
- review of compliance with the designation conditions,
- review of the extent to which to the operational noise effects are reasonable and the Best Practicable Option has been implemented to mitigate noise effects, and
- further options recommended by the Panel to be undertaken by the Transport Agency.

¹ <https://www.nzta.govt.nz/assets/projects/mackays-to-peka-peka/docs/noise/M2PP-Acoustic-Panel-TOR.pdf>



As required by the ToR, this review has been undertaken in general accordance with the principles of the Environment Court code of conduct for expert witness. The duty of the reviewers has been to provide impartial expert assessment irrespective of the party that has engaged them.

For this review the Panel has undertaken the following activities:

- existing documents have been reviewed,
- details of complaints have been reviewed,
- a site visit has been undertaken,
- a meeting with the project's acoustic consultant, Marshall Day Acoustics (MDA) has been undertaken, and
- additional information has been requested and reviewed.

In this document, in accordance with NZS 6806, houses are sometimes referred to as 'PPFs' (protected premises and facilities). The noise exposures of PPFs are described in terms of the categories defined in NZS 6806. Category A (Cat A) and Category B (Cat B) are based on external road-traffic noise levels where the noise levels for Cat A are lower than for Cat B. Category C (Cat C) would have higher external road-traffic noise levels than Cat A or B but is based on achieving an appropriate internal noise level. For the M2PP there are no PPFs in Cat C.

The ToR require the Panel to review noise mitigation in terms of the "Best Practicable Option" (BPO). The Panel has considered the BPO as defined in the Resource Management Act:

***best practicable option**, in relation to a discharge of a contaminant or an emission of noise, means the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to—*

(a) the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and

(b) the financial implications, and the effects on the environment, of that option when compared with other options; and

(c) the current state of technical knowledge and the likelihood that the option can be successfully applied.

2. Item A

2.1 Terms of Reference

To review, assess, and report on compliance with the operational noise designation conditions. This will include:

1. Reviewing and approving the scope for the post-opening noise monitoring programme.



2. Reviewing, analysing and reporting the results of the post-opening noise monitoring programme.
3. Comparing the predicted noise levels with measured levels to validate the acoustic model.
4. Review of documentation that noise mitigation measures have been implemented in accordance with the designation conditions.

2.2 Relevant information

The following documentation has been reviewed by the Panel.

No.	Document	Author	Version, date
1	Technical Report 15 – Assessment of Traffic Noise Effects	MDA	v2, 25/01/12
2	Statement of evidence of Siiri Wilkening	Siiri Wilkening	04/09/12
3	Noise Monitoring Plan	MDA	v3, 03/04/13
4	Noise Monitoring Result Report	MDA	28/03/13
5	Mazengarb Road Changes	MDA	24/12/13
6	M2PP Northern Interchange/Peka Peka Road Alterations	MDA	5/05/14
7	Evidence – Mazengarb Road Changes	Siiri Wilkening	4/06/14
8	Corn Hill – Traffic Noise Levels	MDA	7/10/14
9	Smithfield Road Alterations to Designation	MDA	27/05/14
10	Alignment Alteration – Effects on [REDACTED]	MDA	14/11/14
11	Smithfield Road Alteration	MDA	17/11/14
12	M2PP Expressway – Wind Rain House	MDA	20/11/14
13	Peka Peka Interchange	MDA	10/12/14
14	Wind Rain House – Amended Bund	MDA	10/12/14
15	Evidence – Smithfield Road Alteration	MDA	8/06/15
16	M2PP – Noise Barriers North of Mazengarb Road	MDA	27/07/15
17	206 Ngarara Road – Planting Request	MDA	15/06/15
18	M2PP – Noise Barriers South of Raumati Road	MDA	14/08/15
19	Site Visit 20 September 2016 – Noise Consideration	MDA	20/09/16
20	M2PP – As Built Mitigation	MDA	13/12/16
21	Review of as-built noise mitigation for the MacKays to Peka Expressway	Opus	22/02/17
22	March 2017 Ambient Noise Monitoring	MDA	13/04/17
23	March – April 2017 noise monitoring and noise levels predicted for 2026	MDA	1/05/17
24	June 2017 Ambient Noise Monitoring	MDA	10/07/17
25	Traffic Noise Monitoring Planning	MDA	16/08/17
26	Results from the M2PP as-built acoustics model	MDA	30/10/17
27	August 2017 Noise Monitoring	MDA	14/11/17
28	Computer Model Verification	MDA	16/11/17
29	Noise complaints	Various	Various



2.2.1 Meeting with Marshall Day Acoustics (MDA)

A meeting with the project team's acoustics specialist, MDA, was undertaken on Wednesday 30 August 2017 and was attended by:

- Siri Wilkening (MDA)
- Tiffany Lester (MDA)
- Stephen Chiles
- Sarah Alper (Jacobs)
- Greg Haldane (Transport Agency)

Key items of information that were raised at the meeting were:

- The project planner was the key person responsible for balancing ratings of different disciplines in the determination of the selected noise mitigation options. While many issues were considered, cost of mitigation was a key factor in option selections.
- In the evaluation of the noise mitigation options, the cost of concrete safety barriers acting as noise barriers was not reduced by the partial offset from the cost of wire rope barriers, which they would replace.
- During detailed design and construction MDA was involved on an intermittent basis only. MDA was engaged with when the project team considered a design change was potentially material in terms of road-traffic noise. MDA did not have staff in the project office and were not included in routine project correspondence. MDA highlighted the potential benefits of more regular communication and involvement with project teams.
- MDA provided the minimum requirements for noise mitigation and the project team developed the design to, at a minimum, meet these requirements. Where concrete noise barriers have been designed with angled top sections for visual reasons, MDA has assumed the project team has applied the required height to the lowest point.
- MDA did not review the noise barrier detailed design prior to construction.
- During construction, MDA updated the acoustic model in discrete areas when advised of design changes by the project team. However, MDA was not provided final as-built drawings and an as-built acoustic model was not made.
- MDA undertook two site visits during construction towards completion of the project.
- Following a site inspection MDA advised the project team to use screws rather than nails for timber noise walls, and to add battens to avoid warping. The Panel observed the screws on site but not battens.
- Conifer Court: The original design of a 2 m noise wall was changed to a noise bund. The bund was extended to the south and one part is lower than 2 m. These changes were not made in consultation with MDA.



- Raumati Road: Modelling of the noise exposure at the Cat B PPFs on Raumati Road showed that noise levels were controlled by local traffic rather than by the expressway.
- Rata Road: A noise barrier was not provided for the following reasons (i) because only two PPFs were Cat B which did not constitute a cluster and (ii) to achieve Cat A at these properties would have required a barrier 2 m high and 350 m long. This was considered to look out of place for the road user. A concrete safety barrier was not considered in this location.
- Mazengarb Road to Kapiti Road: The bund was extended following the first site inspection by MDA as it was found not to meet the requirements. Due to space constraints, the project team extended the bund with a retained earth wall. This design was not reviewed by MDA prior to construction.
- Observation Place, Quadrant Heights: The timber fence was extended all the way along the property boundary, rather than only for the limited sections required. MDA was not involved in this decision. Additionally, a specific house that had necessitated an additional 2 m high concrete noise barrier beside the expressway was purchased for the project. MDA was not informed of this purchase and the concrete barrier was built regardless.
- Mazengarb Road (south of expressway): An alteration to the designation was made to allow the local road to be realigned. Three houses were purchased. The bund by the expressway was continued further than originally modelled.
- Mazengarb Road (north of expressway): The original planned noise wall was partly changed to a bund, and built 10 m shorter than designed. MDA remodelled the barrier and the modelling showed that the PPFs remained in Cat A.
- Puriri Road: The angled section of the bund was realigned. This change was not made for acoustic reasons.
- Te Moana Road: The properties in this area are Cat B due to noise from the local road.
- Peka Peka interchange: A future full diamond interchange is being investigated.
- Te Kowhai Road: The Cat B property has been purchased and removed.
- MDA was not instructed to assess noise from bridge joints, but has subsequently noted bridge joint noise from the Waikanae River Bridge.
- MDA was not instructed to assess noise from the Audio Tactile Profile, ATP (rumble strip).
- MDA observed that the raised lane markers create noise when driven over.
- If the expressway speed limit is increased from 100 km/h to 110 km/h in the future, then noise levels are predicted to increase by 1 dB.
- The potential need to provide acoustic treatment (such as ventilation so that windows can be closed) of Cat B PPFs has been discussed on other projects.



2.3 Findings

2.3.1 Reviewing and approving the scope for the post-opening noise monitoring programme

Noise modelling

Noise modelling is not specifically referred to in Item A of the ToR, however, the Panel considers that it is appropriate to comment on it here.

In common with other major road projects in New Zealand, the primary basis for noise assessment and mitigation design for M2PP has been computer noise modelling. The Panel considers this appropriate as the noise modelling process has been demonstrated to be robust in numerous situations over many years and provides a standardised and consistent basis for assessment.

The design of a new road is developed and optimised as a project progresses. The Panel considers it important that noise models be updated at the end of a project to check whether any changes to the design have significantly altered the predicted noise levels. This activity had not occurred for M2PP. Consequently, the Panel requested that as-built road alignments and earthworks be re-entered into the MDA noise model, including actual surveyed ground heights.

Following the Panel's request, the project team arranged for a LIDAR survey to provide accurate ground heights including for noise bunds. MDA then recreated the noise model based on this as-built data and provided the Panel with a table of predicted noise levels at each PPF for the design originally presented to the Board of Inquiry in 2012 and as re-modelled in 2017 based on the as-built situation. The 2017 predictions were not provided for PPFs that were removed or are now owned by the Crown.

Noise measurements

Designation condition DC.49 requires post-opening noise monitoring as set out in the 2013 Noise Monitoring Plan (2013 NMP) that was approved by the Council. MDA provided an updated Traffic Noise Monitoring Plan in 2017 (2017 NMP). This document was based on the monitoring framework and locations from the 2013 NMP, however, in response to noise complaints, it proposed some additional measurements to be conducted during August 2017.

The Panel considers that the main purpose of noise monitoring should be to verify the noise modelling is within a reasonable tolerance, and that modelling should remain the primary compliance check. The Panel found that the August 2017 measurement locations as set out in the 2013 and 2017 NMPs were not adequately distributed along the expressway for verification of the noise model. However, MDA undertook noise measurements at additional locations in March and June 2017. With these additional monitoring locations included, the Panel considered that an adequate distribution of measurement sites along the Expressway was achieved.

The Panel reviewed the results of the March and June 2017 measurements and found that an analysis had not been conducted in accordance with the Transport Agency requirements for long-term monitoring². The data had not been corrected for traffic volumes during the survey compared to design traffic volumes, and validation criteria for weather conditions and for the duration of measurements had not been applied in accordance with the requirements.

² <http://nzta.govt.nz/assets/Highways-Information-Portal/Technical-disciplines/Noise-and-vibration/Standards/Technical-memoranda/NZTA-Noise-monitoring-requirements-V1.0.pdf>



2.3.3 Comparing the predicted noise levels with measured levels to validate the acoustic model

The MDA computer model verification report shows that generally all measurements, unaffected by other sources, are within an expected range of modelled noise levels and are lower than the predicted levels. While there are a small number of locations where the noise measurements are higher than predictions, these measurements are likely to have been affected by other sources, including other roads.

Noise measurements in the opening year of the M2PP have been made at a substantially greater number of locations than normally required for a project of this size. However, the Panel considers that many of these measurements have been compromised by poor location selection, erratic traffic volumes during some measurement periods, and inclement weather. When considering the large number of measurements, the Panel is comfortable that the computer model is validated, and it is unlikely that further measurements would give materially different results. However, for completeness, the Panel recommends that a small number of additional noise measurements be made. These measurements are to be undertaken at agreed locations, in full accordance with the Transport Agency requirements and results be presented showing daily patterns for multiple days, and analysis is to be based on these multiple days.

2.3.4 Review of documentation that noise mitigation measures have been implemented in accordance with the designation conditions

From the Panel's site inspection, the Opus review report, noise wall drawings and the as-built noise model, the Panel has found that noise walls/bunds required by the designation conditions have been adequately installed.

The Panel has found that low-noise road surfaces (e.g. porous asphalt) required by the designation conditions have been installed in the correct locations, but it is understood these have deteriorated in some areas. The areas of these surfaces (and the underlying pavement) that have deteriorated will require remedial work in order to remain in compliance with the designation conditions. Any remedial work should not create small surface patches or additional surface joints, which can result in additional noise.

The Panel has found it difficult to follow the sequence of design changes that occurred during the development of the project after the Board of Inquiry hearing, and considers that the project team did not adopt good practice design management processes and documentation with respect to noise mitigation. The Panel considers that the noise mitigation design process was not conducted strictly in accordance with the designation conditions. For example, condition DC.37C requires that *"The detailed design of any structural mitigation measures (detailed mitigation measures) shall be undertaken by a suitably qualified acoustics specialist prior to construction of the Project, in consultation with..."*. MDA as the project acoustics specialist did not lead the detailed design of mitigation measures as required by the condition. Furthermore, while the Panel has reviewed detailed drawings of noise walls, these do not appear to fully meet the requirements for a *"Noise Mitigation Plan Set"* in condition DC.38.

The Panel has found that deficiencies in the noise mitigation design process discussed above have not resulted in inadequate mitigation or less mitigation than required by the Board of Inquiry. However, opportunities for minor optimisation and improvement of noise mitigation may have been overlooked. While it is not possible to retrospectively fulfil these designation condition design requirements, the Panel recommends the project team fully document the implemented noise mitigation so that (i) the mitigation elements of the project are clear and (ii) to facilitate/inform future maintenance under designation condition DC.46.



3. Item B

3.1 Terms of Reference

To investigate and report on the extent to which operational noise effects are reasonable and the best practicable option has been implemented to mitigate noise effects. This report should specifically address the following questions:

1. Is the design and implementation of 'structural noise mitigation' within the state highway designation appropriate to achieve the BPO?
2. Whether the need for 'building modification noise mitigation' has been adequately considered and implemented?
3. Whether all relevant operational noise effects have been adequately assessed and addressed?

3.2 Relevant information

In addition to the documents listed in Section 2.2 above the Panel have reviewed the following:

No.	Document	Author	Version, date
30	M2PP Bridge Expansion Joints Noise - Remedial Options	Beca	26/09/17
31	Traffic data summary	NZTA	23/10/17
32	Bridge joint noise survey	MDA	20/11/17

3.3 Findings

3.3.1 Is the design and implementation of 'structural noise mitigation' within the state highway designation appropriate to achieve the BPO

In accordance with NZS 6806, the evaluation of noise mitigation options included input from numerous experts covering a full range of engineering and environmental considerations. In each location, a mitigation option was selected from between two and four different options that had been modelled. The Transport Agency accepted the recommendations of the project team for the selected noise mitigation options. The mitigation options and selection process were made publicly available in the Notice of Requirement. The Board of Inquiry scrutinised the information and agreed that the noise mitigation proposed was appropriate.

In general, the Panel has found that the structural noise mitigation within the road corridor (low-noise surfaces and noise walls/bunds) has been designed in accordance with NZS 6806 and is appropriate to achieve the BPO. However, with hindsight, the Panel considers that it would be appropriate to include additional measures to fulfil the BPO to address noise issues that are not explicitly covered by NZS 6806. These include:

- Significant increases in noise levels at some Cat B PPFs as a result of M2PP.
- Disturbance from vehicles travelling over ATP.
- Disturbance from vehicles travelling over bridge joints.

These issues are discussed in the following sub-sections.



It is noted that mitigation has been implemented or is planned to be implemented even though it is not required as part of the BPO. This includes:

- Additional noise walls to protect PPFs that have since been purchased by the Crown.
- Extension of noise walls and bunds beyond the minimum extents determined.
- Additional low-noise surfacing which is planned to be applied over current chipseal areas.

3.3.2 Whether the need for 'building modification noise mitigation' has been adequately considered and implemented

With the mitigation implemented, the modelling shows that there are a number of Cat B properties where the predicted external traffic noise levels are in the order of 60 dB $L_{Aeq(24h)}$. This means that with the windows ajar for ventilation/cooling the internal traffic noise level might exceed 40 dB $L_{Aeq(24h)}$. For these houses the Panel considers that building-modification mitigation³ (BMM) has not been adequately considered.

In these situations, it would be reasonable to provide BMM where the project has had a material effect, in excess of normal increases in road-traffic noise that could reasonably be expected to occur over time. The Panel considers a minimum increase of 3 dB could be adopted, whereby BMM is considered for Cat B PPFs that have experienced an increase in traffic noise level of 3 dB or more due to the project.

For M2PP there are PPFs located in a previously semi-rural/open setting which were not significantly affected by other noise such as from local roads, and where there has been an increase in noise level by 3 dB or more due to the project. The Panel recommends that the Transport Agency offer to assess such houses and install mechanical ventilation/cooling if required so that windows can be closed to achieve an internal traffic level of 40 dB $L_{Aeq(24h)}$ or lower. This approach would apply to the following PPFs: [REDACTED]

There are other Cat B PPFs in a suburban setting in the vicinity of the M2PP. For these houses the justification to investigate treatment of buildings by provision of mechanical ventilation/cooling is not obvious. Furthermore, many of these houses are only marginally within Cat B and it is likely that investigations may show that no treatment is required to achieve an internal traffic noise level of 40 dB $L_{Aeq(24h)}$. However, where there has been an increase in noise level by 3 dB or more due to the project, the Transport Agency could consider investigation of BMM. This is likely to apply to the following properties: [REDACTED]

3.3.3 Whether all relevant operational noise effects have been adequately assessed and addressed

Many of the noise complaints refer to discrete noise sources such as engine brakes and vehicles driving over ATP and bridge joints, and early morning heavy vehicle traffic. These noise sources have generally not been specifically taken into consideration in the acoustic modelling and are not referred to in NZS 6806. This is normal practice as the methodology used for the prediction of road traffic noise impacts does not allow for assessment of these types of noise sources. They should, however, still be considered and each of these noise sources is discussed below.

³ Building-modification mitigation are measures designed to reduce the internal traffic noise levels at PPFs which involve changes to buildings.



Engine brakes

Residents have reported extensive use of audible truck engine brakes on the M2PP. The Panel has observed that vehicles frequently traverse over ATP on the M2PP and this generates a similar sound to truck engine brakes, such that the two sounds could be confused. It is possible that some reported engine braking events are actually vehicles traversing over ATP.

The relatively shallow gradients of the M2PP alignment means that trucks should not need to use engine brakes. Regardless, experience elsewhere on the state highway network is that a small number of truck drivers sometimes persist in using noisy engine brakes near houses. The Transport Agency has a standard procedure for addressing engine brake noise disturbance⁴. The Panel recommends this procedure is followed. It is understood that the Transport Agency is deploying an engine braking noise camera to the M2PP, which should assist in targeted resolution of engine braking noise disturbance. Management of this issue may require ongoing effort from the Transport Agency.

ATP

During the site visit the Panel observed vehicles frequently traversing the ATP in several locations, which caused a noticeable and potentially disturbing noise. The Panel considers that noise from vehicles frequently traversing ATP could be unreasonable and requires mitigation in the vicinity of PPFs.

The Transport Agency has guidelines for ATP⁵ that recommend to: *'Evaluate noise impacts, do not install ATP roadmarkings where noise disturbance is likely. Following installation remove ATP on a case by case basis if necessary.'* The guidelines also state *'Before a decision to install ATP roadmarkings is made, an evaluation of the likely noise impacts along the route should be carried out.'*

An evaluation of noise from ATP on the M2PP does not appear to have occurred. Furthermore, the ATP has been installed on the painted edge lines rather than being offset outside the traffic lanes where it might have been less frequently traversed.

It is understood the Transport Agency is currently removing all ATP on the left-hand edge lines of the M2PP. The Panel recommends that the Transport Agency also investigate whether vehicles regularly traverse the right-hand (central) edge lines, and if so that ATP should also be removed where it is within 200 m of houses.

Bridge Expansion Joints

The M2PP has seven bridges with mechanical expansion joints and two bridges with modular type expansion joints. The modular type expansion joints are known to cause higher noise levels than some alternatives. No assessment appears to have been made of noise from the expansion joints. Standard treatment options available to reduce noise from these joints such as surface plates and cavity lining/enclosures were not installed. The joint selection was therefore contrary to a project requirement (MR A5.12c) that *"The expansion joints at Waikanae River Bridge shall be selected to minimise the road noise from the joint"*.

⁴ <http://nzta.govt.nz/assets/Highways-Information-Portal/Technical-disciplines/Noise-and-vibration/Standards/Technical-memoranda/Tech-memo-NV6-Engine-braking-noise-v1.0.pdf>

⁵ <http://www.nzta.govt.nz/assets/resources/audio-tactile-profiled-roadmarkings-guidelines/docs/atp-guidelines.pdf>

Furthermore, the bridge joints have been poorly installed creating significant discontinuities in the vehicle wheel paths. This creates noise both from vehicle tyres impacting steps/dips between the road surface and the joint and the concrete threshold around the joint, and also from the consequential abrupt movement of vehicle bodies causing rattling from trucks in particular.

The Panel considers that noise from some of the bridge expansion joints may be unreasonable and mitigation is needed. For all bridges with mechanical expansion joints the Panel recommends that the road surfaces and concrete joint thresholds be remediated to achieve a smooth transition across the joints, meeting standard tolerance requirements. Where this cannot be achieved due to poor installation, consideration should be given to replacing the joints.

Given that residents have been sensitised to bridge joint noise, the Panel considers that a significant improvement is now required to address the issue. The remedial measures, to smooth the wheel paths across the joints, require extensive works. The Panel recommends that while these works are undertaken it would be prudent to also install absorptive material in the cavity below each joint and to close the cavity with a cover plate. For the Waikanae River Bridge, surface plates should be installed on the joints if practicable.

Traffic profiles

Some complaints have highlighted disturbance from trucks in the early morning and have questioned whether this traffic profile was adequately considered in the noise assessment and mitigation design. The Panel has reviewed the hourly traffic counts and found that while there are heavy vehicle movements in the early morning, the pattern of traffic movements is within expectations for this location. While noise from these vehicles is acknowledged, the Panel considers that this noise was adequately assessed in the overall noise predictions and no additional assessment of this matter is considered necessary.

4. Item C

4.1 Terms of Reference

To recommend what further action, if any, should be undertaken by NZTA in order to confirm:

1. Compliance with operational noise designation conditions and
2. That the effect of operational noise resulting from the Kapiti Expressway project post-opening is reasonable.

4.2 Findings

4.2.1 Compliance with operational noise designation conditions

The Panel has made the following findings with respect to each of the relevant designation conditions (the conditions are provided in full in Appendix A):

Condition	Panel comments	Complies
DC.37A	The project appears to comply with this condition. The condition includes visual/landscape requirements, which is outside the expertise of the Panel. The condition includes ongoing maintenance requirements.	✓
DC.37B	MDA has conducted work in accordance with the definitions specified in this condition.	✓

Condition	Panel comments	Complies
DC.37C	While the minimum mitigation has been implemented, it appears that the detailed design of mitigation was not led by an acoustics specialist. It is recommended that a Noise Mitigation Plan be prepared retrospectively.	✘
DC.38	Adjustments to noise mitigation have not been documented as required by this condition and a Noise Mitigation Plan Set has not been produced that shows changes to the preferred mitigation. It is recommended that changes be documented in a Noise Mitigation Plan with a Noise Mitigation Plan Set appended.	✘
DC.39	The project appears to comply with this condition.	✓
DC.40	MDA identified that there are no Cat C PPFs	✓
DC.41	Not applicable as there are no Cat C PPFs	✓
DC.42	Not applicable as there are no Cat C PPFs	✓
DC.43	Not applicable as there are no Cat C PPFs	✓
DC.44	Not applicable as there are no Cat C PPFs	✓
DC.45	Not applicable as there are no Cat C PPFs	✓
DC.46	The condition relates to ongoing maintenance. Current remedial work on road surfaces demonstrate initial compliance with this condition. The Panel recommends that specific requirements be added to the relevant maintenance contract.	✓
DC.47	The condition relates to ongoing maintenance. It is understood that M2PP will be included in network condition surveys.	✓
DC.48	The project team has kept records of vibration complaints. However, the Panel has not seen a single register that records when each complaint was made, what the nature of the complaint was, and when/what actions were taken. The Panel has not seen evidence of a methodical approach to vibration complaints that includes consideration of the nature of the vibration source reported and inspection of the road surface as an immediate action. The use of monitoring in houses as a universal response to vibration complaints is not considered best practice.	✘
DC.49	The condition relates to future monitoring. The required plan has been prepared and approved.	✓

4.2.2 That the effect of operational noise resulting from the Kapiti Expressway project post-opening is reasonable

Operational noise resulting from the M2PP has affected a number of the residents in the vicinity of the M2PP. This is evident from the number of complaints about noise received by the Transport Agency. When a new road is built in the vicinity of PPFs where there were no major roads previously there is going to be an increase in traffic noise level and there will be people who are adversely impacted. NZS 6806 provides an approach to manage traffic noise levels. It is well known that people display different tolerance levels with respect to road traffic noise depending on many factors and it is acknowledged that some residents will be annoyed even when compliance with NZS 6806 is achieved.

The Panel has found that while noise from the M2PP is clearly noticeable, including in areas that previously experienced minimal road-traffic noise, the noise is generally reasonable. However, as set

out in previous sections, the Panel has found that ATP and bridge joints on M2PP are potentially causing unreasonable noise and require mitigation. The Panel has also found that at least six houses might have unreasonable internal traffic noise and this could be addressed by installation of mechanical ventilation/cooling to allow windows to remain closed.

The Panel has found that the M2PP will require ongoing maintenance and management to address issues such as engine braking noise and road surface deterioration, to avoid potentially unreasonable noise.

4.3 M2PP Actions

As set out in previous sections, the Panel recommends that the Transport Agency takes the following actions:

1. Update the traffic model and review the forecast (made in 2011) for 2026 traffic volumes, to confirm whether they are correct. If the outcome is significantly different and has potentially led to an overly optimistic noise assessment, then the traffic noise assessment should be updated.
2. Conduct new noise measurements in full accordance with Transport Agency requirements for long-term monitoring at: [REDACTED]. Equivalent nearby positions should be used if access cannot be obtained for these nominated locations.
3. Document the M2PP noise mitigation design in a retrospective Noise Mitigation Plan, including a Noise Mitigation Plan Set, and a Post Construction Review Report in accordance with the NZTA P40:2014 specification⁶ (Specification P40).
4. Offer to assess the following houses and install BMM, such as mechanical ventilation/cooling, in accordance with Transport Agency guidelines⁷ if required to achieve an internal level of 40 dB $L_{Aeq(24h)}$ in habitable spaces at: [REDACTED].
5. Give consideration to whether investigation of BMM such as mechanical ventilation/cooling should also be offered for: [REDACTED].
6. Complete the removal of ATP from left-hand edge lines in the vicinity of PPFs.
7. Assess the frequency of vehicles traversing ATP on right-hand edge lines and remove it within 200 m of houses if it is causing regular noise disturbance.
8. Remediate all approach surfaces and thresholds of bridge joints to achieve smooth transitions along wheel paths in accordance with specified tolerances.
9. Fit absorption in the cavity below all bridge joints and fit plates to close the cavities.
10. Fit surface plates to the Waikanae River Bridge joints if practicable.

⁶ <http://nzta.govt.nz/resources/noise-mitigation/>

⁷ <http://nzta.govt.nz/resources/state-highway-guide-to-acoustic-treatment-of-buildings/>



11. Remediate all areas of low-noise surfaces that are deteriorating.
12. Investigate and follow-up engine braking noise complaints and deploy a noise camera in accordance with the Transport Agency standard procedures.
13. Add explicit requirements in the relevant maintenance contract relating to the low-noise surface and noise walls/barriers, including reference to the Noise Mitigation Plan and designation conditions.

4.4 Future opportunities/Lessons Learned

Specification P40

Compliance with Specification P40 (published in 2014) would have avoided some of the noise mitigation issues identified above. In particular, compliance with P40 on current and future projects should ensure:

1. A Noise Mitigation Plan (NMP) is prepared and updated to reflect any changes to mitigation and to record reasons for changes.
2. An as-built acoustic model is made and validated at the conclusion of the project.
3. A post-construction review of noise mitigation is conducted.

The Transport Agency could consider updating the P40 specification to also specifically require:

4. The construction drawings for noise barriers to be reviewed by the acoustics specialist and appended to the NMP prior to construction.
5. Any ATP proposed is assessed by the acoustics specialist and recorded in the NMP.
6. All bridge joints are assessed by the acoustics specialist and recorded in the NMP.

Good practice implementation of P40 should generally include:

7. The acoustics specialist providing an induction/briefing to all design managers at the start of a project. This should identify where and when the acoustics specialist will need to provide input into design changes or development.
8. The acoustics specialist undertaking site inspections of noise mitigation at early stages during construction to check correct implementation, allowing sufficient time for any remedial measures necessary.

Standard NZS 6806

A number of issues have arisen that are related to NZS 6806. While the Transport Agency is not the author/owner of that standard, the following could be considered in its application, and/or for any future revision:

9. For semi-rural environments, classified as 'urban' by Statistics NZ, noise effects at PPFs beyond 100 m should be considered.
10. For Cat B PPFs, whether BMM is appropriate and should be offered.



11. The use of discrete daytime and night-time criteria.
12. Whether the 40 dB $L_{Aeq(24h)}$ internal noise criterion is appropriate (or should it be lower for sleeping areas).
13. The effects of the relative change (increase) in traffic noise levels and how should this be controlled to manage annoyance.
14. Consideration of discrete noise sources such as bridge expansion joints and ATP.
15. Consideration of opportunities for enhanced or extended noise mitigation where it may deliver a material benefit.

Community expectations

Some of the noise complaints reviewed relate to noise from features such as ATP or bridge joints that should not have occurred. However, some complaints appear to relate to the presence of the road traffic of the general order predicted. In those cases, it appears that the community expectations were different to the noise outcome that was known in advance by the Transport Agency. Consequently, the message to the community is not considered to have been adequately effective.

Potentially, messages to the community throughout the designation process and construction have focussed on compliance with NZS 6806, rather than explaining that residents would experience a change and in some cases a significant change in their noise environment. Improved communications and information for future projects might help residents understand and adjust to changes that arise from new major roads in their communities.



Appendix A: Designation Conditions with respect to operational noise

<p>DC.37A</p>	<p>a) In managing noise and vibration arising from the operation of the Project, the Requiring Authority shall achieve the following outcomes:</p> <ul style="list-style-type: none"> i) To use low noise road surface material (Open Graded Porous Asphalt or equivalent) on those parts of the Expressway that are adjacent to residential neighbourhoods; ii) To design and build noise attenuation structures (including earth bunds), in conjunction with the retention of natural dunes, to provide further noise mitigation; iii) To ensure noise mitigation measures are designed and maintained with reference to the specific character and context of residential neighbourhoods and other areas along the route to protect individual, and groups of, houses; iv) To provide landscape planting wherever practicable to visually screen or soften noise reducing structures; v) To maintain noise mitigation measures, including low noise road surface material, to ensure their noise reducing capabilities are retained over time; and vi) To maintain the road pavement to avoid vibration effects on adjacent buildings. <p>b) In achieving these outcomes, the Requiring Authority shall apply the following standards:</p> <ul style="list-style-type: none"> i) Achieve the relevant noise criteria categories for noise sensitive activities in accordance with <i>NZS 6806:2010 Acoustics – Road Traffic Noise – New and Altered Roads</i>. ii) Achieve Class C of Norwegian Standard NS8176.E:2005 (Vibration and Shock – Measurement of vibration in buildings from land-based transport and guidance to evaluation of its effects on human beings) in relation to any expert report prepared pursuant to DC.48 below.
<p>DC.37B</p>	<p>For the purposes of Conditions DC.37C – DC.49, the following terms will have the following meanings:</p> <ul style="list-style-type: none"> a) BPO – means Best Practicable Option b) Building-modification Mitigation – has the same meaning as in NZS6806:2010 c) Habitable space – has the same meaning as in NZS6806:2010 d) Noise Criteria Categories – means groups of preference for time-averaged sound levels established in accordance with NZS6806:2010 when determining the selected mitigation option considered to be the BPO; i.e. Category A – primary noise criterion, Category B – secondary noise criterion, Category C – internal noise criterion. e) NZS6806:2010 – means NZS 6806:2010 Acoustics – Road-traffic noise – New and altered roads. f) PPFs – means Protected Premises and Facilities, and has the same meaning as in NZS6806:2010, and are generally identified in green, yellow or red in Appendix B of Technical Report 15. g) Sector – means Sectors 1 to 4 of the Project as set out in the AEE. h) Structural Mitigation – has the same meaning as in NZS6806:2010, which includes bunds, barriers and low noise road surfaces; i) Traffic Noise Assessment – means Technical Report 15 submitted as part of the AEE for this Designation.



<p>DC.37C</p>	<p>The detailed design of any structural mitigation measures (detailed mitigation measures) shall be undertaken by a suitably qualified acoustics specialist prior to construction of the Project, in consultation with an urban designer and landscape architect, and, subject to Condition DC.38, shall include, as a minimum, the following:</p> <ul style="list-style-type: none"> a) This row is intentionally left blank. b) The location, length and height of noise barriers in general accordance with Appendix B of the Traffic Noise Assessment; and c) A requirement that Open Graded Porous Asphalt ("OGPA") or equivalent low-noise generating road surface be used in general accordance with Appendix B of the Traffic Noise Assessment.
<p>DC.38</p>	<ul style="list-style-type: none"> a) Following detailed design, and as required during construction, where a need is identified to revise any structural mitigation measure as identified in Appendix B of the Traffic Noise Assessment (for example, because it is either not practicable to implement a particular mitigation in the same location, length, or height, or because of changes arising from residents' feedback in preparing the SSLMPs under Condition DC.57 or SSUDPs under DC.59A): <ul style="list-style-type: none"> i) If the changed design of the structural mitigation measure would still achieve the same Noise Criteria Category at all relevant PPFs, and a suitably qualified acoustic specialist certifies to the Council that the changed structural mitigation measure would be consistent with adopting the BPO in accordance with NZS6806:2010, the detailed mitigation measures may be amended to include the changed structural mitigation measure, or ii) If the changed design of the structural mitigation measure would change the Noise Criteria Category at any PPF to a less stringent Noise Criteria Category, but a suitably qualified acoustic specialist confirms that the changed structural mitigation measure would be consistent with adopting the BPO in accordance with NZS6806:2010, the detailed mitigation measure may be amended to include the changed structural mitigation measure. The Requiring Authority shall consult with affected property owners prior to amending the detailed mitigation measures to include the changed structural mitigation measure. b) The information submitted with the Detailed Mitigation Measures shall include information to demonstrate that: <ul style="list-style-type: none"> i) The BPO process was followed, involving acoustic, landscape, urban design, and other relevant expertise; and ii) The principles of the Landscape and Urban Design Framework have been applied through the SSUDPs under condition DC.59A. c) The Detailed Mitigation Measures shall include a Noise Mitigation Plan Set, which shall include the location and details of the structural measures, including any potential changes to the preferred mitigation.



<p>DC.39</p>	<ul style="list-style-type: none"> a) The Requiring Authority shall implement the structural noise mitigation measures identified as the “Selected Mitigation Options” in Appendix B of the Traffic Noise Assessment as part of the Project, in order to achieve the Noise Criteria Categories indicated in Appendix B (“Identified Categories”), where practicable and subject to Conditions DC.37C to DC.38 above. b) The Detailed Mitigation options shall be implemented prior to completion of construction of the Project. c) Prior to the Project becoming open for traffic, the Requiring Authority shall engage a suitably experienced independent acoustics specialist to inspect the “as built” structural noise mitigation measures and issue a signed certificate to the Manager that the noise mitigation measures identified within DC.37C and DC.38 have been properly installed and constructed. The certificate is to be provided at least 15 working days before the opening of the Project for traffic. For the purpose of this condition, “independent person” shall be a suitably qualified and experienced acoustic specialist who is not an employee of the Requiring Authority and does not work for any of the companies contracted to design and construct the Project. d) A noise mitigation barrier shall be implemented between Mazengarb Road and the properties of [REDACTED] which shall, at a minimum, result in a noise level at the design year of no more than 63 dB $L_{Aeq(24h)}$ at 1 metre above the floor levels of interest at any of the following properties: [REDACTED]. The height, length and location of the barrier shall be generally in accordance with the drawing Appendix D of the AEE (Marshall Day Acoustics Memorandum, dated 24 December 2013). At a minimum, the barrier shall be constructed of a solid material with a surface weight of no less than 15 kg/m², and without gaps between panels. e) The barrier referenced to in DC.39(d) shall be designed and installed in accordance with the relevant designation conditions including DC.37, DC.39(b) and DC.39(c) and the mitigation shall be maintained pursuant to designation condition DC.46.
<p>DC 40</p>	<p>Prior to construction of the Project, the Requiring Authority shall engage a suitably qualified acoustic specialist to identify those PPFs which, following implementation of all the Structural Mitigation measures included in the Detailed Mitigation Options, are not in Noise Criteria Categories A or B in accordance with NZS6806:2010 and where Building-modification Mitigation may be required to achieve 40 dB $L_{Aeq(24h)}$ inside habitable spaces (“Category C Buildings”).</p>
<p>DC41</p>	<ul style="list-style-type: none"> a) Prior to commencement of construction of the Project in the vicinity of a Category C Building, the Requiring Authority shall write to the owner of each Category C Building seeking access to such building for the purpose of measuring internal noise levels and assessing the existing building envelope in relation to noise reduction performance. b) If the owner(s) of the Category C Building approve the Requiring Authority’s access to the property within 12 months of the date of the Requiring Authority’s letter (sent pursuant to Condition DC.41(a)), then no more than six months prior to commencement of construction of the Project in any Sector, the Requiring Authority shall instruct a suitably qualified acoustic specialist to visit the building to measure internal noise levels and assess the existing building envelope in relation to noise reduction performance.



DC42	<p>a) Where a Category C Building is identified, the Requiring Authority shall be deemed to have complied with Condition DC.41 above where:</p> <ul style="list-style-type: none"> i) The Requiring Authority (through its acoustic specialist) has visited the building and has carried out the assessment specified in DC.41; or ii) The owner of the Category C Building consented to the Requiring Authority's request for access, but the Requiring Authority could not gain entry for some reason (such as entry being denied by a tenant); or iii) The owner of the Category C Building did not approve the Requiring Authority's access to the property within the time period set out in Conditions DC.41(b) (including where the owner(s) did not respond to the Requiring Authority's letter (sent pursuant to Condition DC.41(a) within that period)); or iv) The owner of the Category C Building cannot, after reasonable enquiry, be found prior to completion of construction of the Project. <p>b) If any of (ii) to (iv) above apply to a particular Category C Building, the Requiring Authority shall not be required to implement any Building-modification Mitigation at that Category C Building.</p>
DC 43	<p>Subject to Condition DC.44, within six months of the assessment required under Condition DC.41(b), the Requiring Authority shall give notice to the owner of each Category C Building identified under Condition DC.40:</p> <ul style="list-style-type: none"> a) Advising of the options available for Building-modification Mitigation to the building; and b) Advising that the owner has three months within which to decide and advise the Requiring Authority whether to accept Building-modification Mitigation for the building, and if the Requiring Authority has advised the owner that more than one option for Building-modification Mitigation is available, to advise the Requiring Authority which of those options the owner prefers.
DC 44	<p>Once an agreement on Building-modification Mitigation is made between the Requiring Authority and the owner of an affected building, the mitigation shall be implemented by the Requiring Authority in a reasonable and practical timeframe agreed between the Requiring Authority and the owner.</p>
DC 45	<p>Subject to Condition DC.44, where Building-modification Mitigation is required, the Requiring Authority shall be deemed to have complied with DC.41(b) above where:</p> <ul style="list-style-type: none"> a) The Requiring Authority has completed Building-modification Mitigation to the Category C Building; or b) The owner(s) of the Category C Building did not accept the Requiring Authority's offer to implement Building-modification Mitigation prior to the expiry of the timeframe stated in Condition DC.41(b) above (including where the owner(s) did not respond to the Requiring Authority within that period).
DC 46	<p>The Requiring Authority shall manage and maintain the Detailed Mitigation Options to ensure that those mitigation measures retain their noise reduction capabilities and performance (as required by these conditions) for the life of the Project.</p>
DC.47	<p>The NZTA system for monitoring and maintaining the condition of State Highway pavements and road surfaces shall be applied in order to minimise the risk of operation vibration issues.</p>



DC.48	<ul style="list-style-type: none">a) The Requiring Authority shall keep a register of all vibration complaints received in the first two years of operation and the Requiring Authority's response to the complaints.b) The register will be available to the Manager (the Council compliance) upon request. If the Manager considers that the Requiring Authority's response to a complaint has been unreasonable and that the complaint is a result of discernible vibration attributable to traffic on the Expressway, the Manager may require in writing the Requiring Authority to engage a suitably qualified expert to measure and assess traffic vibration levels for compliance with the Class C criteria of Norwegian Standard NS 8176.E:2005 "Vibration and shock – Measurement of vibration in buildings from land-based transport and guidance to evaluation of its effect on human beings". A report describing the findings shall be provided to the Manager within one month of the assessment being completed, including whether there is vibration exceeding Class C criteria caused by the operation of the Expressway and, if so, the remedial measures the Requiring Authority is proposing to implement.c) For the purpose of this condition "unreasonable" means the vibration can be attributed to traffic on the Expressway and the complaint has not been satisfactorily addressed or remedied.
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<p>DC.49</p>	<p>a) The Requiring Authority shall arrange for a suitably qualified and experienced acoustic specialist to prepare a Noise Monitoring Plan to be submitted to the Manager for certification at least 15 Working Days before the commencement of construction. The Requiring Authority shall implement the certified Plan, and monitoring shall not commence until the Requiring Authority has received the Manager's written certification of the Noise Monitoring Plan. The purpose of the Noise Monitoring Plan is to confirm where, when and how operational noise monitoring shall occur to ensure that the survey results are suitable for calibration and verification of the computer noise model, which is used to check compliance with the noise criteria categories for the PPFs. The Noise Monitoring Plan shall address the following:</p> <ul style="list-style-type: none"> i) The number and location of monitoring sites, including requirements that: <ul style="list-style-type: none"> A. no more than 40% of monitoring sites shall be sites currently experiencing a moderate to high ambient sound level (i.e. more than 50 dB $L_{Aeq(24h)}$) from existing sources; and B. at least 40% of monitoring sites shall be sites currently experiencing a low ambient sound level (≤ 50 dB $L_{Aeq(24h)}$) but with a predicted significant increase in noise level due to the operation of the Project, and where mitigation of this noise relies on proposed barriers or bunds as identified in the Structural Noise Mitigation plans in the Traffic Noise Assessment, Technical Report 15; ii) The timing and frequency of surveys. This will include a requirement that ambient sound level data from Technical Report 17 "Pre-Construction Sound Level Survey" shall only be used where the data has been collected not more than 24 months prior to the preparation of the Monitoring Plan, and shall only be data collected at "long term" sites; iii) Methods and standards to be followed. This will include methods used to identify and remove measurement results for time periods affected by sound associated with any temporary events or activities (such as noise from construction activities), and during periods where wind speeds exceed 5 m/s or the rainfall rate exceeds 6 mm/hour; and iv) Timeframes for reporting to the Council. <p>b) The results of the Post-Construction operational noise level monitoring undertaken in accordance with Condition DC.49(a) above shall be used to verify the computer noise model of the Detailed Mitigation Options and to make any necessary alterations required to the structural mitigation measures required by Condition 37C. A report describing the findings of the verification and the work associated with any necessary alterations to the structural mitigation measures shall be provided to the Manager within one month of the final monitoring being completed.</p>
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