

**Before a Board of Inquiry
Northern Corridor Improvements Project**

Under the Resource Management Act 1991 ('the Act')

In the matter of a Board of Inquiry appointed under section 149J of the Act to consider notices of requirement for designations and resource consent applications by the New Zealand Transport Agency for the Northern Corridor Improvements Project

Statement of evidence of Siiri Wilkening for the New Zealand Transport Agency (Operational noise and vibration)

Dated 20 April 2017

KENSINGTON SWAN

18 Viaduct Harbour Avenue Ph +64 9 379 4196
Private Bag 92101 Fax +64 9 309 4276
Auckland 1142 DX CP22001

Solicitor: C M Sheard/N McIndoe
christina.sheard@kensingtonswan.com/nicky.mcindoe@kensingtonswan.com

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STATEMENT OF EVIDENCE OF SIIRI WILKENING FOR THE NEW ZEALAND TRANSPORT AGENCY

1 Qualifications and experience

- 1.1 My full name is Siiri Wilkening.
- 1.2 I am an acoustical consultant employed by Marshall Day Acoustics Ltd ('MDA'). I have had more than 20 years' experience in acoustic engineering in Germany and New Zealand, specialising in environmental noise control and computer noise modelling. I hold a Masters degree in Environmental Engineering (Land Improvement and Environmental Protection) from the University of Rostock, Germany. I am a Member of the Acoustical Society of New Zealand.
- 1.3 Over the last 19 years I have been involved in investigating and reporting on traffic noise effects of numerous roading projects, including local roads and State highways. My work has involved all aspects of traffic noise assessments, from route selection and evaluation, through to noise level surveys, computer noise modelling, reporting, community consultation, consenting and compliance noise surveys.
- 1.4 In New Zealand, I have given evidence at Council planning hearings, the Environment Court, the Arbitration Court and before three Boards of Inquiry, and have taken part in Environment Court mediations. My work relates to a wide range of environmental noise sources, such as road traffic, rail, ports, quarries, industrial and power generation activities and educational facilities. Projects I have been involved with include:
 - a Road traffic: Puhoi to Warkworth, MacKays to Peka Peka Expressway, Waterview Connection, Newmarket Viaduct Improvement, Auckland Manukau Eastern Transport Initiative (on behalf of the Applicant); Basin Bridge Wellington (in a peer review role);
 - b Quarries: more than 20 quarries throughout the North Island, acting on behalf of the Applicant or on behalf of the relevant territorial authority in a review and advisory role; and

- c Power generation: Taharoa Wind Farm, Te Mihi Power Station, Turitea Wind Farm (on behalf of the applicant); Te Uku Wind Farm and Hauāuru mā Raki Wind Farm (on behalf of the Council in a review and advisory role).

2 Involvement with the Project

- 2.1 My evidence relates to notices of requirement and resource consent applications lodged by the New Zealand Transport Agency ('**Transport Agency**') with the Environmental Protection Authority on 14 December 2016 for the Northern Corridor Improvements Project ('**Project**').
- 2.2 My role in the Project included undertaking and supervising all aspects of acoustic assessment including noise level surveys, computer modelling, reporting and consultation with residents. I have authored the *Assessment of Operational Noise and Vibration Effects* (Technical Report) that was included in the Assessment of Environmental Effects ('**AEE**').
- 2.3 Construction noise and vibration effects of the Project require separate consideration and have been assessed and reported on by Mr Peter Ibbotson of MDA, with input from myself. I have provided a separate brief of evidence for the construction noise and vibration part of the assessment.¹
- 2.4 My involvement in the alternatives assessment was limited to the multi-criteria analysis of various alignment options. Generally, noise effects can be satisfactorily managed irrespective of alignment, and the alternatives did not include any options that would have resulted in significantly adverse noise effects.

3 Code of conduct

- 3.1 I have read and am familiar with the Code of Conduct for Expert Witnesses in the current Environment Court Practice Note (2014), have complied with it in the preparation of this evidence, and will follow the Code when presenting evidence to the Board. I also confirm that the matters addressed in this statement of evidence are within my area of

¹ Refer **Ms Wilkening's** evidence in chief (Construction Noise and Vibration).

expertise, except where I rely on the opinion or evidence of other witnesses. I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

4 Scope of evidence

4.1 This evidence addresses the following matters:

- a A summary of my evidence;
- b Acoustic performance standards;
- c Assessment methodology;
- d Existing noise environment;
- e Assessment of operational noise effects and proposed mitigation;
- f Assessment of operational vibration effects;
- g Comments on submissions;
- h Response to section 149G(3) key issues report; and
- i Conclusions.

4.2 In preparing my evidence, I have reviewed relevant parts of the following evidence:

- a Mr Glucina, Transport Agency;
- b Mr Moore, Project Design;
- c Mr Hale, Construction;
- d Mr Clark, Transportation;
- e Mr McGahan, Planning (resource consents); and
- f Mr Burn, Planning (designations).

5 Executive summary

- 5.1 I have assessed the operational noise and vibration effects from the Project. The assessment focuses on noise sensitive sites only. It excludes industrial and business sites which are noise producers in their own right and not considered to be noise sensitive.
- 5.2 Noise level surveys and computer noise modelling provided the baseline of the existing environment. In addition, I modelled several scenarios including future do-nothing, do-minimum and several mitigation options. With team input,² we chose the preferred option which in our opinion is the best practicable noise mitigation option.
- 5.3 Mitigation is focused around noise barriers within the designation where practicable and relevant. A number of new dwellings adjacent to SH1 are too high and located in a way that structural mitigation in the form of barriers is impracticable. For those dwellings, building modification mitigation should be considered on a case by case basis.
- 5.4 The road surface material proposed for the Project is a low noise surface (open graded porous asphalt) for the main alignment. For safety reasons, ramps are proposed to be surfaced with dense asphalt, which still achieves low noise levels..
- 5.5 Overall, I consider that the Project will have a neutral effect for the Protected Premises and Facilities ('PPFs') surrounding the Project. The recommended mitigation will reduce noise levels somewhat where practicable, while for some PPFs building modification mitigation will need to be investigated.
- 5.6 Traffic vibration will not cause adverse effects as the road surface will be well maintained. Traffic vibration is generally caused by heavy vehicles driving over dips and bumps in the road, which will not be the case here.

² The following team members have had input into the selection of the preferred mitigation option: Siiri Wilkening (acoustics), Louise Stroger (planning), Chris Bentley (urban design), John Goodwin (landscape), Dillon Smith (constructability), Matthew Yu (stormwater)

6 Acoustic performance standards

Noise

- 6.1 Based on my experience, New Zealand Standard NZS 6806:2010 “Acoustics – Road-traffic noise – New and altered roads” (**NZS 6806**) is the relevant standard when assessing road traffic noise. The standard sets noise criteria categories which are to be achieved progressively with the implementation of the best practicable options mitigation.
- 6.2 Furthermore, I have assessed traffic noise effects on residents by interpreting the common subjective response³ to predicted noise level changes when comparing situations without and with the Project.
- 6.3 In addition, I compared the percentage of people potentially “highly annoyed” by traffic noise along the Project, for the existing and predicted future circumstances.⁴
- 6.4 The criteria I have used to support my assessment are based on the internationally recognised studies by Miedema and Oudshoorn, described in my Technical Report. I acknowledge people will have their own subjective views regarding the impact of a change in noise levels, depending on their perception of the Project.
- 6.5 I consider that the assessment methodology utilised which is in accordance with NZS 6806, and the additional determination of annoyance and response to noise levels changes, is appropriate in assessing the noise effects from the Project in a Resource Management Act 1991 (**RMA**) context, because it allows the examination of several alternative mitigation options and their effects, and the determination of practicability of these mitigation measures, by means of input from other Project disciplines.

Vibration

- 6.6 Together with my colleagues at MDA, I have assessed the traffic vibration risk by reviewing data of heavy vehicles travelling on existing roads with a

³ Refer Section 3.1.1, Table 3, Operational Traffic Noise and Vibration Effects (Technical Report).

⁴ Refer Section 3.1.2, Operational Traffic Noise and Vibration Effects (Technical Report).

range of surface conditions. In addition, I obtained complaints history data from the Auckland Motorway Alliance ('**AMA**') to establish if current traffic vibration levels are acceptable.⁵

7 Assessment methodology

- 7.1 Together with my colleagues at MDA, I undertook both short and long duration surveys to determine the existing noise environment along the length of the Project.⁶
- 7.2 I then developed a computer noise model to predict traffic noise levels at each of the PPFs⁷ within 100 metres of the Project.
- 7.3 Businesses and industrial sites are not PPFs as they are not considered noise sensitive. Generally, these sites are noise generators themselves.
- 7.4 The model takes account of the many factors that affect the propagation of road traffic noise, such as atmospheric spreading, distance attenuation, topography, ground attenuation and meteorological conditions. The information entered in the model includes the terrain, road alignment, barrier heights and locations and building locations. The road information includes traffic volume, speed, road surface material, gradient and percentage of heavy vehicles.⁸
- 7.5 I verified the computer noise model against measured levels to ensure that traffic noise levels are predicted accurately. I found that the computer noise model performed within the required accuracy of ± 2 decibels,⁹ which is within the accuracy expected by NZS 6806.¹⁰
- 7.6 The computer noise model results are expressed as noise levels at individual receivers¹¹ and noise contours over a larger area.¹²

⁵ Refer Section 7, Operational Traffic Noise and Vibration Effects (Technical Report).

⁶ Refer Sections 3.2 and 4.1, and Appendix D, Operational Traffic Noise and Vibration Effects (Technical Report).

⁷ Under NZS 6806 PPFs are: Dwellings (including those not yet built but having obtained building consent); Educational facilities and play grounds within 20m of educational facilities; Boarding houses; Homes for the elderly and retirement villages; Marae; Hospitals that contain in-patient facilities; and Motels and hotels in residential zones.

⁸ Refer Section 4.2, Operational Traffic Noise and Vibration Effects (Technical Report).

⁹ Refer Section 3.3.3, Table 5, Operational Traffic Noise and Vibration Effects (Technical Report).

¹⁰ Refer Section 5.3.4.2, NZS 6806.

¹¹ Refer Section 3.3.4, Operational Traffic Noise and Vibration Effects (Technical Report). Appendix C shows the predicted noise levels and Appendices E and F show the location of all PPFs.

¹² Refer Section 3.3.5 and Appendix G, Operational Traffic Noise and Vibration Effects (Technical Report).

- 7.7 The individual noise levels are more accurate predictions as they do not include interpolation. Therefore, I used these to assess against the noise criteria categories in NZS 6806 (refer paragraphs 7.10a and 7.11 below), to determine the noise level change at each dwelling assessed and to determine the number of people potentially highly annoyed by road traffic noise.
- 7.8 The noise level contours visually represent road traffic noise over the wider area and therefore provide a more general picture of the noise effects from the Project.
- 7.9 Due to the large extent of the Project, I divided the Project into nine distinct assessment areas.¹³ I assessed each area separately to determine the preferred mitigation option,¹⁴ and then recalculated the noise levels with these mitigation measures in place.
- 7.10 My traffic noise assessment was three-pronged:
- a Assessment of compliance with NZS 6806 following the Best Practicable Option ('**BPO**') process outlined in that Standard and focussing on achieving the lowest practicable noise levels in Categories A or B, with Category C as the "backstop;"¹⁵
 - b Assessment of noise effects (both positive and adverse) through determination of noise level changes and likely perception by people;¹⁶ and
 - c Assessment of effects by comparing the number of people that may be highly annoyed by traffic noise with and without the Project. This comparison took account of both noise level reductions and increases within the Project assessment area.¹⁷
- 7.11 In summary, the assessment in accordance with NZS 6806 involved the following steps for PPFs:

¹³ Refer Section 4.2, Table 7 and Appendix B, Operational Traffic Noise and Vibration Effects (Technical Report).

¹⁴ Refer to paragraph 7.11d below.

¹⁵ Refer first subsection of Sections 5.1 to 5.9 and Appendix F, Operational Traffic Noise and Vibration Effects (Technical Report).

¹⁶ Refer second subsection of Section 5.1 to 5.9, Operational Traffic Noise and Vibration Effects (Technical Report).

¹⁷ Refer third subsection of Sections 5.1 to 5.9 and Appendix E, Operational Traffic Noise and Vibration Effects (Technical Report).

- a I determined the existing noise level at each PPF by modelling the existing SH1 and Upper Harbour Highway/SH18 alignment (including ramps), and some local roads for which traffic information was available.
- b I modelled the 'do-minimum scenario', i.e. the Project main alignment with Open Graded Porous Asphalt ('**OGPA**'), all ramps with dense asphalt surfacing, and all solid concrete safety barriers, but no specific noise mitigation measures in place.
- c I developed several noise mitigation options for each assessment area where noise levels were predicted to be able to comply with Category A, which would achieve suitable noise outcomes for the PPFs with noise levels similar to or below the do-nothing noise levels. I then provided these mitigation options to the wider Project team for analysis and feedback, relating to their area of expertise (e.g. urban design, planning and engineering etc).
- d Mitigation options and their implications relating to other Project disciplines were discussed at a meeting with urban design, planning and engineering experts. For each assessment area, a preferred mitigation option was selected that achieved suitable outcomes in relation to noise while avoiding, as far as practicable, other effects. All feedback was compiled in a discussion document.¹⁸
- e I recalculated the noise levels using the preferred mitigation options for the entire alignment.¹⁹

8 Existing environment

- 8.1 The Project comprises a widening to part of the existing SH1, an upgrade to Upper Harbour Highway to full motorway standard and new northbound ramps connecting the extended SH18 with SH1. Both SH1 and SH18 carry significant traffic volumes and adjacent PPFs are affected by traffic noise levels from these roads.

¹⁸ Refer Appendix H, Operational Traffic Noise and Vibration Effects (Technical Report).

¹⁹ Refer Appendices E, F and G, Operational Traffic Noise and Vibration Effects (Technical Report).

- 8.2 Existing ambient noise levels²⁰ at most PPFs are within a mid-range considering the proximity to the State highways, ranging from 60 to 61 dB $L_{Aeq(24h)}$ at the five representative long duration survey locations.²¹ Background noise levels²² for the Project area are also as expected for a busy urban area, for most locations typically between 42 and 57 dB L_{A90} .²³
- 8.3 I predicted existing noise levels at all PPFs within 100 metres of the edge of the road, using a calibrated computer noise model. I then used these levels as the basis of assessing traffic noise levels at all PPFs.
- 8.4 Based on information provided by the AMA, which is responsible for the maintenance of the Auckland State highway network and associated complaints, no complaints have been received in regards to traffic vibration between 2009 and 2015,²⁴ indicating that the existing ambient traffic vibrations are not at levels that cause concern. I conclude, therefore, that the level of vibration generated by the Project will have no significant effects.

9 Assessment of operational noise effects and proposed mitigation

- 9.1 Where PPFs exist within 100m of the Project, the area is generally densely populated, with 304 PPFs within 100 metres of the proposed road edge. I have assessed the traffic noise effects from the Project against the “altered road” criteria in accordance with NZS 6806.²⁵
- 9.2 The ‘altered road’ criteria are set out in the table below. In addition, the number of PPFs within each Category for the existing situation is shown.²⁶

²⁰ Ambient noise includes, and is a composite of, all noise sources that affect the noise level at any given location.

²¹ Refer Section 4.1, Table 6, and Appendix D, Operational Traffic Noise and Vibration Effects (Technical Report).

²² Background noise is the noise that is exceeded for 90 or 95% of the time, so includes continuously present sounds such as distant traffic, wind, water etc.

²³ Refer Appendix D, Operational Traffic Noise and Vibration Effects (Technical Report).

²⁴ Refer Section 7, Operational Traffic Noise and Vibration Effects (Technical Report).

²⁵ Refer Section 1.3.1, NZS 6806.

Category	Altered Roads	Existing 2016
	dB $L_{Aeq(24h)}$	No. of PPFs
A (primary external noise criterion)	≤ 64	285
B (secondary external noise criterion)	64–67	17
C (internal noise criterion) *	40	2

**This criterion is triggered if habitable rooms would receive internal noise levels greater than 45 dB $L_{Aeq(24h)}$ despite structural mitigation (e.g. barriers & road surface) being used.*

- 9.3 The do-nothing scenario, where the Project is not built, and only projected traffic volume changes on SH1 and Upper Harbour Highway/SH18 to the design year of 2031 are applied, showed that the noise levels would generally increase by no more than 4 decibels compared with the current road layout, with some dwellings receiving noise level increases up to 9 decibels, and others noise level decreases up to 5 decibels. Overall, the do-nothing noise level increases are predicted to move some PPFs into the next noise level category, with 276 PPFs in Category A, 23 PPFs in Category B and 5 PPFs in Category C.²⁷
- 9.4 Those PPFs predicted to receive the highest noise levels, are generally multi storey apartment buildings adjacent to SH1. These PPFs are relatively new and have been constructed in recent years, since 2004.
- 9.5 New dwellings adjacent to SH1 and SH18 have been designed and constructed to take account of the existing high noise levels from the existing roads, under the High Noise Route provisions of the then operative North Shore Operative District Plan.²⁸ For those dwellings, if they are predicted to receive noise levels within Category C, no further improvements may be required.

²⁷ Refer Section 4.2, Table 8, Operational Traffic Noise and Vibration Effects (Technical Report).

²⁸ Refer Appendix A, Operational Traffic Noise and Vibration Effects (Technical Report).

Future 'Do-minimum' scenario

- 9.6 The do-minimum scenario, where the Project is built, with traffic volume for the year 2031, but with no specific noise mitigation, already includes OGPA on the main alignment, dense asphalt of the ramps and any concrete edge safety barriers. The Project, particularly the busway, will bring the road closer to some receivers, thus increasing the number of PPFs within Category C to 30, with 21 PPFs in Category B. Still, the majority of PPFs will remain in Category A (253 PPFs of 304).²⁹
- 9.7 The existing, do-nothing and do-minimum scenarios provide the basis of my assessment of potential mitigation options. These are explained below.

Potential mitigation options

- 9.8 Overall, for assessment areas adjacent to SH18 where mitigation is required, the preferred mitigation option involves the use of barriers of varying height between 2 and 3 metres.³⁰ These barriers would result in noise level reductions ranging up to 5 decibels for individual PPFs.
- 9.9 For multi storey apartment buildings adjacent to SH1, where barriers are not effective due to the height of the receiver locations above the motorway, PPFs remain in Category C.³¹ These would be assessed to determine if building modification mitigation is required to ensure compliant internal noise levels.
- 9.10 While a preferred mitigation option has been put forward in my Technical Report, it will need to be refined over time, with input from several parties, e.g. affected residents, contractors etc. Therefore, the heights of the barriers described as “preferred” may be adjusted by a small amount during the detailed design stage. In order to ensure that residents are not further detrimentally affected, proposed conditions ON.4 and ON.5 set out a framework of reassessment.³²

²⁹ Refer Section 4.2, Table 8, Operational Traffic Noise and Vibration Effects (Technical Report).

³⁰ Refer Sections 5.6, 5.7, 5.8 and 5.9, Operational Traffic Noise and Vibration Effects (Technical Report).

³¹ Refer Sections 5.1, 5.2 and 5.4, Operational Traffic Noise and Vibration Effects (Technical Report).

³² Refer AEE, Appendix A – Proposed Conditions.

9.11 I note that my computer model was based on specific terrain heights adjacent to dwellings and the Project. Where these terrain heights change (e.g. because a retaining wall is designed rather than an embankment), the height of the barrier above ground may change. However, I have provided the top edge of the barriers as a reference so that any barrier design can be based on the actual height of the barrier above sea level (rather than ground level). These heights have been provided to the Project Team in digital format for ease of reference, and are not shown in my Technical Report.

Assessment of effects

- 9.12 My assessments, based on the preferred mitigation in place, showed the following results:
- a Based on the NZS 6806 assessment, the number of PPFs within the highest noise criteria Category C would increase to 23 PPFs (compared with 5 PPFs in the do-nothing scenario). Most of these PPFs are new dwellings that were constructed under the requirements of the North Shore District Plan, which required appropriate internal noise levels to be met. I predict that 20 PPFs would be within Category B, similar to the 23 PPFs in the do-nothing scenario (and affecting the same PPFs). I predict the number of PPFs in the preferred noise criteria Category A to be 261, compared with 276 PPFs in the do-nothing scenario. This shows that the Project has an overall neutral to slightly adverse effect on the noise levels received at PPFs near the State highways.³³
 - b In terms of the potential subjective reaction to noise level changes due to the Project, my conclusion is again that the Project achieves an overall neutral outcome. I predicted that the Project with the preferred mitigation measures implemented would result in noise level decreases of up to 5 decibels for individual PPFs. Some PPFs would receive noise level increases up to 9 decibels (adjacent to SH1), with the majority of increases around 3 to 4 decibels. I did not

³³ Refer Section 4.2, Operational Traffic Noise and Vibration Effects (Technical Report). Table 8 shows the number of PPFs in each noise category for each scenario.

determine a practicable mitigation option that would reduce this increase further.

- c My assessment of people potentially highly annoyed by road traffic noise showed that this number would increase slightly to 98, when compared with the do-nothing scenario where 86 people may be highly annoyed.

9.13 Overall, I consider that the Project will have a neutral effect for the PPFs surrounding the Project. The recommended mitigation will reduce noise levels somewhat where practicable, while for some PPFs building modification mitigation will need to be investigated and implemented where required.

10 Assessment of operational vibration effects

10.1 Traffic vibration is usually only generated when heavy vehicles drive over bumps or dips in the road. Based on my assessment of the heavy vehicle data, compliance with the criteria can be achieved at a distance of 25m from the road edge, even for degraded roads. The risk of unacceptable levels of vibration being generated on a new road, such as this Project, is very low.

10.2 I understand that the Transport Agency has appropriate measures in place that ensure the quality of the road will be maintained to a high level. Therefore, by maintaining a smooth surface I do not anticipate that traffic vibration would result in adverse effects.³⁴

11 Comments on submissions

11.1 I have reviewed the submissions received as they pertain to traffic noise and vibration issues. Of the thirty-three submissions received, eight contained noise and vibration concerns, and of those, seven submissions relate to operational traffic noise or vibration. I address these submissions below.

³⁴ Refer Section 2.2.2, Operational Traffic Noise and Vibration Effects (Technical Report).

Auckland Council

- 11.2 Auckland Council provided an extensive submission. I had not had the opportunity for any discussions with Council or its acoustical expert prior to receiving the submission and preparing this evidence. In my opinion, several of the points could have been resolved through my report or in discussion, if this opportunity had been available.
- 11.3 Council agrees with my assessment on several points, including the application of the various acoustical standards, that the Project will have only a small effect on the environment, the mitigation options of road surface, barriers and building modification, and that traffic vibration is not considered to be an issue if the road is properly maintained.
- 11.4 For ease of reference, I respond to Council's submission points of disagreement or outstanding information by labelling them as per the submission.
- 11.5 **6.1.4 Evidence base for assessment** requests additional information on the detailed performance of the road surface types and seeks conditions that ensure that the operational noise will meet a particular level of performance.
- 11.6 I am unsure of the specific details Council is seeking information on. The road surface material proposed for the Project is OGPA on the main alignment and dense asphalt on all ramps and bridges, as described in paragraph 5.4.
- 11.7 If Council's question relates to the road surface correction that is applied to the noise prediction methodology, I note that this is set out in the relevant documentation, most simply accessed on the Transport Agency website.³⁵
- 11.8 The Transport Agency's "Guide to state highway road surface noise", in Section 2.8, and using the formula on page 37, provides the relevant formula that is used to calculate the road surface correction, based on speed and the percentage of heavy vehicles. The formula is shown below:

³⁵ <https://www.nzta.govt.nz/assets/resources/road-surface-noise/docs/nzta-surfaces-noise-guide-v1.0.pdf>

$$R = 10 \times \lg \left[\frac{(1 - p/100) \times 10^{R_c/10} + (p/100 + 5p/V) \times 10^{R_t/10}}{1 + 5p/V} \right]$$

- 11.9 Council seeks to ensure that a particular level of noise performance is achieved. This is anchored in proposed Condition ON.2, which requires that noise levels within the same noise criteria category be achieved as were predicted with the preferred mitigation option.
- 11.10 Proposed condition ON.3 requires that mitigation shall be designed to at least include the preferred structural mitigation measures, i.e. low noise road surface and barriers.³⁶
- 11.11 **6.1.5 Child care centres** questions why a 2.4m barrier is sufficient to shield double storey buildings. I note that the child care centre in Saturn Place has no windows facing SH18. Any windows at the upper floor are perpendicular to SH18 and therefore receive lower noise exposure due to a reduced angle of view. Therefore, the proposed barrier fully shields all façades where building elements such as doors and windows are present (and the playground).
- 11.12 I understand that the child care centre in Omega Place occupies only the ground floor of the building. The upper floor is utilised by a church. Therefore, again, the proposed barrier will provide effective shielding, including of the play area.
- 11.13 In both instances, the same noise criteria category can be achieved with the Project and mitigation in place, as is present in the existing situation.
- 11.14 Therefore, I do not consider that additional mitigation is required.
- 11.15 **6.1.6 Improvements to the existing noise environment** seeks that the Project should include noise barriers for all dwellings abutting the alignment and for open space, i.e. reserve land, to reduce currently existing high noise levels.
- 11.16 I understand that the RMA requires that the effects of a project be managed or mitigated, but does not extend to requiring betterment of

³⁶ Refer Appendix A – Proposed Conditions, AEE.

existing situations. Nevertheless, NZS6806 (which the Transport Agency has adopted) requires that PPFs that receive noise levels within Category C (more than 67 dB $L_{Aeq(24h)}$) be assessed to reduce internal noise levels, even if the PPF is currently in Category C. This is the case for the multi storey apartment buildings adjacent to SH1. However, those PPFs that receive noise levels within Category A do not, in my opinion, require additional mitigation.

- 11.17 I also note that in many instances, noise barriers will not be effective and therefore not practicable, e.g. multi storey buildings or buildings that are elevated above the road due to terrain. Therefore, I disagree with Council's request as I consider it to be not practicable or reasonable.
- 11.18 Open space in any form, including passive and active recreational space, is not included in my operational noise assessment for the Project. NZS6806 does not include open space as a PPF, and the Auckland Unitary Plan (Operative in Part) does not contain any noise criteria to limit noise from any other zone into the Open Space zone.
- 11.19 My assessment focuses on noise effects on locations where people live, learn and sleep. As dwellings and teaching facilities are assessed, any noise mitigation implemented for their protection also benefits other sites in the vicinity. However, I do not recommend mitigation specifically for open space sites.
- 11.20 **6.1.7 Monitoring** seeks to include monitoring of noise levels post construction to validate the computer model that shall be prepared to test if the final "as built" road complies with the relevant noise criteria categories.
- 11.21 I consider that this is a reasonable request and that properly undertaken measurements would ensure that the computer noise model accurately predicts noise levels. Proposed Condition ON.7,³⁷ should be amended as follows:³⁸

³⁷ Refer AEE, Appendix A – Proposed Conditions.

³⁸ Refer to conditions annexed to **Mr Burn's** EIC.

“ON.7 Within twelve months of completion of construction of the Project, a post-construction review report written in accordance with Transport Agency P40 Specification for Noise Mitigation 2014 must be provided to the Team Leader. The review shall include field measurements at a minimum of six representative PPFs within the Project. Monitoring shall be in accordance with the requirements of NZS6806:2010 “Acoustics – Road traffic noise – New and altered roads”.”

C Syddall

- 11.22 Mr Syddall owns two business premises adjacent to SH1, and operates out of one of these. I understand that the premises are at Titoki Place and adjacent to SH1.
- 11.23 Mr Syddall appears concerned that visibility of the businesses may be reduced if barriers are installed in the vicinity. No noise barriers are proposed to be installed in this location, therefore, visibility should not be impeded.

L Shasha

- 11.24 Mr Shasha is concerned about the location of the new Paul Matthews Road bridge in relation to a dwelling at 5 Wren Place, and that noise levels would increase due to the bridge.
- 11.25 Noise level predictions for 5 Wren Place show that noise levels are predicted to increase by just over 1 decibel (an unnoticeable change). A 3 metre high barrier is proposed between SH18 and the Wren Place properties facing the road. The bridge will be elevated and therefore will be well shielded with concrete edge safety barriers, which have been included in the noise modelling.
- 11.26 The predicted traffic noise level of 55 dB $L_{Aeq(24h)}$ is well within acceptable residential noise levels and similar to currently experienced noise levels.
- 11.27 I consider that the mitigation proposed will ensure that the dwelling at 5 Wren Place will not receive unreasonable traffic noise levels.

V Wills (Meadowood Community Crèche)

- 11.28 The submission on behalf of the Meadowood Community Crèche raises concerns about increase in traffic noise levels due to the implementation of the Project. It also raises the issue that no assessment of the crèche has been undertaken in the Technical Report.
- 11.29 I note that I have assessed the crèche in my assessment. In Appendix C, Area 4 – SH18 Cabello Place, the crèche is included with noise level predictions at 56 Meadowood Drive (Childcare). Traffic noise levels are predicted to remain unchanged at 61 dB $L_{Aeq(24h)}$, within Category A. For that reason, no mitigation was proposed.
- 11.30 I note that the barriers recommended for other parts of the Project are due to the fact that these areas would experience noticeable noise level increases or would otherwise receive noise levels above the Category A (i.e. more than 64 dB $L_{Aeq(24h)}$). The noise levels at the crèche are predicted to remain unchanged and would be within Category A (61 dB $L_{Aeq(24h)}$).
- 11.31 The Noise Licensing Criteria for Early Childhood Centres of the Auckland Regional Health Service of 55 dB L_{Aeq} is a criterion applied to new childcare centres. I note that current noise levels at the crèche are above the licensing criterion, and would have been for some time, based on traffic volumes on the surrounding roads.
- 11.32 I do not consider that additional mitigation is required given that the Project will have no noise effect on the crèche.

E Tozer

- 11.33 Mr Tozer lives at one of the apartments at 60 Masons Road. He is concerned about the traffic noise impact from the Project, both from the motorway and the extended busway, and if there will be a commitment to remedy noise effects should these be higher than anticipated.
- 11.34 I note that many of the apartment buildings at Masons Road are predicted to receive noise levels within Category C (more than 67 dB $L_{Aeq(24h)}$). These dwellings will need to be assessed to ensure that internal noise

levels can comply with the 40 dB $L_{Aeq(24h)}$ criterion. This process is anchored in proposed conditions ON.9 to ON.14.³⁹

- 11.35 I have tested options of structural mitigation beyond the use of low noise road surface (e.g. in the form of barriers or bunds) but have not found a practicable solution. The apartments are multi-storey, and upper floors cannot be shielded from road traffic noise by such mitigation. Therefore, building modification mitigation is the recommended mitigation option.
- 11.36 Such mitigation may involve the provision of fresh air intake to allow residents to keep external windows and doors closed, and where necessary, upgraded joinery and/or glazing. The detailed mitigation options will need to be determined on a case-by-case basis which will involve a visit to each identified apartment and habitable rooms facing SH1.

Flourishing Property Company Ltd

- 11.37 The submitter is the owner of the site at 113 McClymonts Road. The site is currently vacant and no details about future use are publicly available. The submitter is concerned about traffic noise effects on any potential future high density residential and mixed use development of the site.
- 11.38 The submitter seeks a comparison of the predicted traffic noise levels with the applicable AUP noise limits for this zone, which is Business – Metropolitan Centre. Operational (zone) noise limits are not comparable with traffic noise predictions, as they are based on different standards, durations and sources. However, I attempt to respond below to alleviate the submitter's concerns.
- 11.39 The noise limits for the Metropolitan Centre zone are 65 dB L_{Aeq} daytime and 60 dB L_{Aeq} night-time (with some low frequency controls).⁴⁰ The predicted traffic noise level on the most exposed part of the site is approximately 60 dB $L_{Aeq(24h)}$. This translates approximately to 62 dB L_{Aeq}

³⁹ Refer Appendix A – Proposed Conditions, AEE.

⁴⁰ Refer Section E25.6.8.1, Auckland Unitary Plan (Operative in Part) ('AUP').

daytime and between 52 and 58 dB L_{Aeq} night-time. These levels are lower than would be permitted by the AUP.

- 11.40 Any noise sensitive activity in a Metropolitan Centre has to be designed to achieve appropriate internal noise levels⁴¹ while still receiving sufficient fresh air intake. These internal noise levels shall be achieved assuming that the permitted zone noise limits are experienced on the façade. Therefore, traffic noise would be mitigated also.
- 11.41 I note that any development adjacent to SH1 can take account of the (currently existing and future) noise levels and avoid reverse sensitivity issues by designing any development appropriately to mitigate noise ingress into noise sensitive spaces, e.g. by insulation, orientation of noise sensitive buildings and rooms away from the motorway, constructing multi storey business buildings to shield the remainder of the site and similar.
- 11.42 I consider that no additional noise mitigation as part of the Project is required for this site.

TK Yen

- 11.43 Mr and Mrs Yen live at 13 Wren Place, Unsworth Heights. They are concerned about traffic noise and vibration increasing when the Project is operational.
- 11.44 I note that a 3 metre high noise barrier is recommended to be installed between SH18 and the property. I predict that this barrier will result in a 3 decibel reduction in noise level compared with current (2016) levels, and a 4 to 5 decibel reduction in noise level when comparing a future situation without and with the Project. The predicted noise level at 13 Wren Place is 59 dB $L_{Aeq(24h)}$, which is well within Category A (up to 64 dB $L_{Aeq(24h)}$).
- 11.45 The barrier would also assist in reducing noise from the petrol station across SH18 which the submitter comments on.
- 11.46 Overall, the implementation of the Project will result in betterment of the noise environment at 13 Wren Place.

⁴¹ Refer Section E25.6.10.1, AUP.

- 11.47 I note that the submitter has already installed double glazing to reduce internal traffic noise. The submission comments that trucks and motorbikes are still audible. I note that any dwelling adjacent to a major road will experience such noise. Even the installation of building modification or barriers will not render the traffic inaudible.
- 11.48 I also note that the submission comments that there are no trees to reduce noise levels. This is a common misconception. A row of trees does not reduce noise levels.
- 11.49 The submitter is concerned about traffic vibration. In response to the submission, ambient vibration monitoring was undertaken on the morning of 27 March 2017, at a time described by Mr Yen as a peak traffic time. Due to time constraints, it was not possible to undertake measurements and analysis of traffic vibration levels in accordance with the Norwegian Standard referenced in the Technical Report in Section 2.2.2.
- 11.50 However, in order to get an understanding of current traffic vibration levels, my colleague Craig Fitzgerald measured vibration levels as peak particle velocity. Measurements were undertaken in the north eastern dining room corner closest to the road (approximately 12 metres to the road edge).
- 11.51 Measured vibration levels ranged from 0.1 to 0.4 mm/s during normal traffic, to 0.5 to 0.7 mm/s during truck passes. The highest vibration level measured was 0.9 mm/s when a truck and trailer unit passed the dwelling. This level was described as Mr Yen as an "8 out of 10, with 10 being the most disturbing".
- 11.52 From experience, comparing these measured levels with those of other Projects, they will likely comply with Class C of the Standard (i.e. 0.3mm/s for the statistical maximum value for weighted velocity $v_{w,95}$ mm/s). The measured levels are peak values. When applying frequency of event and averaging over time provisions, the values to be compared with the Norwegian Standard will be lower than those measured.

11.53 Overall, while vibration can be felt inside, these levels are within reasonable criteria and not unusual for dwellings in an urban environment. I do not recommend any further mitigation

12 Response to section 149G(3) key issues report

12.1 The Section 149G Key Issues Report discusses traffic noise issues at paragraph 147. The report references the objectives and policies relating to traffic noise, and the rules for new and altered roads. I respond to each of these points below.

12.2 The objectives in E25.2 are referenced as key issues, specifically:

(1) People are protected from unreasonable levels of noise and vibration

(2) The amenity values of residential zones are protected from unreasonable noise and vibration, particularly at night

12.3 My assessment of traffic noise effects was undertaken by a three-fold methodology, as discussed in paragraph 7.10 of my evidence and paragraph 144 of the Section 149G report. The noise criteria of NZS 6806 are appropriate for residential use by protecting dwellings and other PPFs. NZS 6806 states in Section 3.3.2: *“The noise criteria contained in section 6 of the Standard are designed to set reasonable criteria for the road-traffic noise from new and altered roads taking into account health issues associated with noise, the effects of relative changes in noise levels on people and communities, and the potential benefits of new and altered roads to people and communities.”*

12.4 I consider that the above objectives have been addressed in my assessment which utilises NZS 6806.

12.5 The policies in E25.3 are referenced as key issues, specifically:

(1) Set appropriate noise and vibration standards to reflect each zone’s function and permitted activities, while ensuring that the potential adverse effects of noise and vibration are avoided, remedied or mitigated.

(2) Minimise, where practicable, noise and vibration at its source or on the site from which it is generated to mitigate adverse effects on adjacent sites.

- 12.6 As discussed above, I consider that following the requirements of NZS 6806 in determining the BPO noise mitigation, and applying the noise criteria of NZS 6806 fulfil the requirement of both policies.
- 12.7 In relation to traffic vibration, well maintained roads do not generate significant traffic vibration and I therefore consider that all objectives and policies are fulfilled in regards to traffic vibration. This is confirmed by the Section 149G report in paragraph 148.
- 12.8 I note that mitigation is applied preferentially, proceeding from the road surface material, to barriers within the designation, and finally with building modification mitigation off site as the last resort.⁴² Accordingly, noise and vibration are mitigated at source where this is practicable.
- 12.9 Standard E25.6.33 requires that new and altered roads within the scope of NZS 6806 shall comply with the requirements of the Standard. My assessment was undertaken in accordance with NZS 6806, and I therefore consider that this Standard of the AUP is fulfilled.

13 Albany Busway changes

- 13.1 After the notices of requirement and resource consent applications were lodged, the Project Team has suggested repositioning the Albany Busway bridge. My colleague Peter Ibbotson and I have considered whether this refinement changes the operational noise effects of the Project (compared to the assessment by the Technical Report).⁴³
- 13.2 Our assessment found:
- a No change to the noise levels calculated in “Area 1 – SH1 north of McClymonts Road” will occur;

⁴² Refer Section 2.1.3.1, last sentence page 13, Operational Traffic Noise and Vibration Effects (Technical Report).

⁴³ Refer section 7 Mr Moore’s evidence in chief; and section 12 of Mr Bray’s evidence in chief. The change to the busway overbridge alignment will reduce the length of the proposed bridge. Instead of the bridge spanning the busway carpark, the bridge will now adjoin the bus terminal road on the northern side of the carpark.

- b No change to the number of PPFs in each NZS6806 Category would occur in Area 1; and
 - c No change to the number of people highly annoyed would occur in Area 1.
- 13.3 The proposed busway overbridge and link road is in the order of 140 metres or greater distance from the closest PPF. The controlling noise source in that area is SH1. For these reasons, and based on the results of our assessment, I conclude the proposed design change will result in an insignificant change in operational noise levels.

14 Conclusions

- 14.1 I have assessed the Project's potential operational noise effects based on three different methodologies: the New Zealand Road traffic noise standard (NZS 6806), the potential subjective response of people to the noise level change due to the Project, and the number of people likely to be highly annoyed by road traffic noise.
- 14.2 I recommend the use of noise barriers where they are effective. These barriers, varying in height from 2 m to 3 m, will result in noticeable noise level reductions for dwellings adjacent to SH18.
- 14.3 The noise level change due to the Project for dwellings will generally be small (up to 4 decibels). This change is either unnoticeable or just perceptible.
- 14.4 Where no noise barriers are proposed, it is not practicable to install barriers because of the height required to achieve sufficient noise level reduction, e.g. where there are multi storey apartment buildings of the buildings are located above the road.
- 14.5 Dwellings that are predicted to remain within the highest noise criteria Category C, will need to be assessed to determine if and what building modification mitigation should be installed.
- 14.6 With the mitigation in place, noise levels are predicted to be generally within the same noise criteria category as would be the case without the

Project (do-nothing scenario). I therefore consider both people and amenity values of residential zones will be protected from unreasonable noise arising from the Project.

- 14.7 I am of the opinion that traffic vibration will have no adverse effects on nearby residents, given that the road surface will be well maintained.
- 14.8 Overall, I predict that this Project will result in similar effects for most people adjacent to the road, compared with current and do-nothing scenarios. While high noise levels cannot be mitigated at all dwellings (usually where the existing noise levels are high), the proposed mitigation will maintain noise levels within the same noise criteria category despite the increase in traffic volume and speed over time.



Siiri Wilkening

20 April 2017