

# The M2 Noise Problem - An Engineering Perspective

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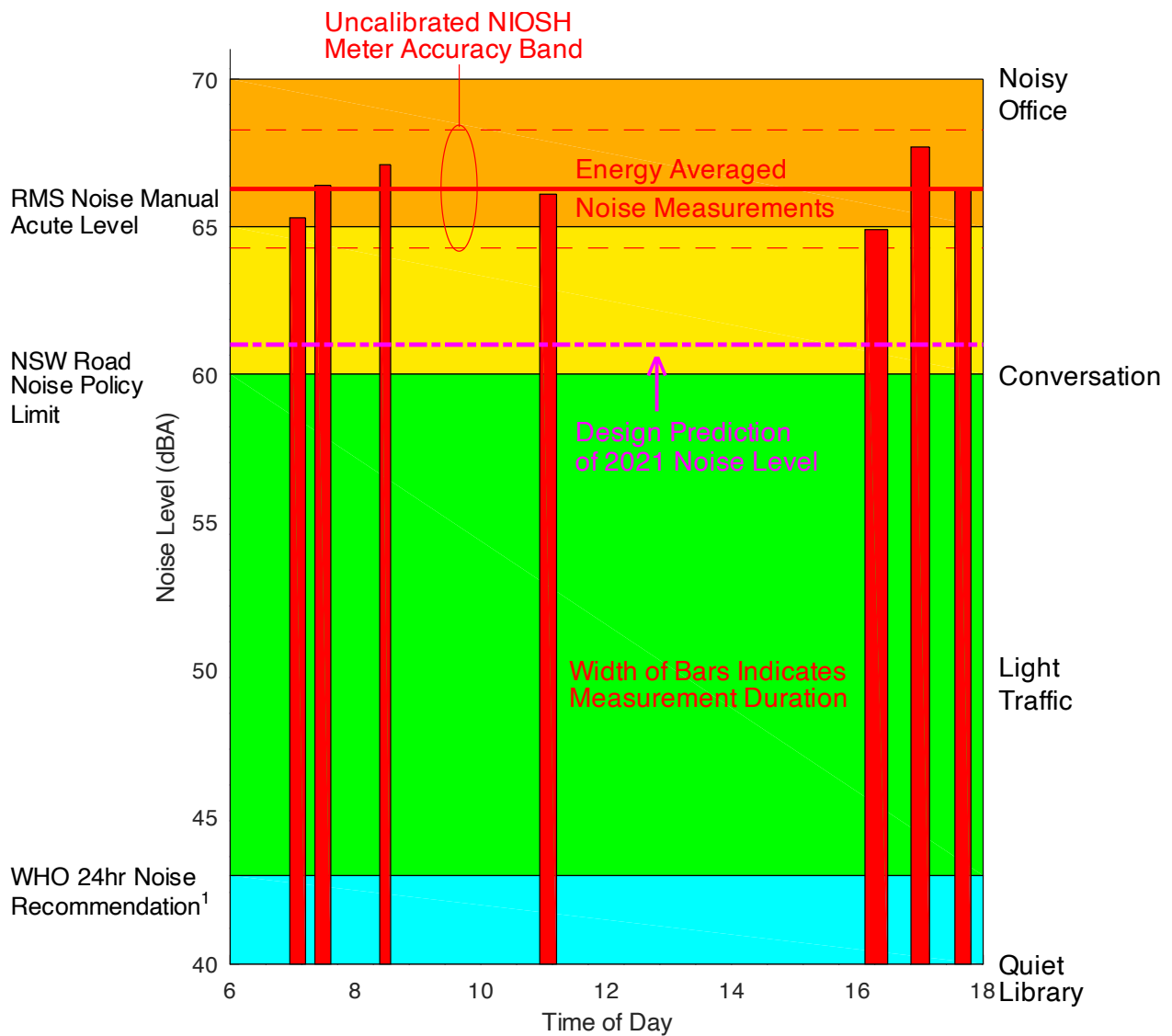
## Introduction

1. Firstly, the Transurban documents state that the M2 “was bought by Transurban in 2005. It is 100% Transurban owned and is under concession until 2048.” Furthermore the M2 Upgrade Environmental Assessment, Vol 1, May 2010, states that the M2 Extension “would be funded by the M2 Motorway operator (Hills M2) and the funds would be recouped from tolls imposed on the M2 Motorway over the concession period.”
2. An operational traffic noise assessment was performed as part of the M2 Extension design process. This assessment utilised accepted software packages and was based on an acoustic analysis of the M2 physical environment as well as predictions of traffic volumes. Design decisions on noise mitigation were based on the noise predictions from this computer model.
3. The need for additional noise mitigation beyond that for the existing M2 was examined by comparing the predicted noise levels from the extended M2 in 2021 with the predicted noise levels in 2011 without the extension. This comparison was done for most of the residences along the M2.
4. With two exceptions near Windsor Rd, the noise level difference at any residence did not exceed the 2dBA requirement for additional noise mitigation specified in the “M2 Upgrade Project Environmental Assessment Vol. 2 (2010)” design document.
5. Consequently, because noise walls are the principal noise mitigation method for the M2, it was decided during the design process that increasing the height of any of the noise walls was not required.
6. Various explanations have been offered for the perceived increase in noise levels post widening, for example, that the traffic is now visible from Austral Av as well as the effect of reflections from the relocated southern noise wall. All of these geometric factors should have been accounted for in the modelling which has been validated by the post widening compliance monitoring referred to in the email response to the Trust’s questions from Minister Graham’s office.
7. The central issue is that noise mitigation measures for the M2 Extension were analysed using the results of the noise modelling in accordance with the design methodology and the design decisions validated by the compliance monitoring. Consequently there is no room to argue against the statements in the email to the Trust from the Minister’s Office that
  - “THML (Transurban) are compliant with the requirements of the Project Deed, the M2 Motorway Upgrade Environmental Impact Statement, and the Minister of Planning Conditions of Approval” and
  - “THML are under no obligation to amend or increase noise mitigation beyond what has been approved.”
8. However, all of this is *inconsistent* with the experience of residents bordering the M2 in Beecroft and Cheltenham and, in particular, the noise level measurements made, with advice from the Trust, by the residents of 34 Castle Howard Rd and 78 Cheltenham Rd, Cheltenham. These measurement were made using the Sound Level Meter App released by the US National Institute for Occupational Safety and Health (NIOSH) and developed specifically for the stable audio environment of the iPhone to be used for industrial noise monitoring. Uncalibrated, it is claimed to have an accuracy of +/- 2dB.

9. These measurements are presented as a bar graph in the accompanying Figure which also provides a graphical representation of the noise assessment context described above. The major features are the 'energy' average of the residents measurements and the 2021 model results. Clearly, the resident's measurements are much higher (5.3dBA) than the model's 2021 predicted noise levels.
10. The most plausible explanation for at least the major part of this difference is the increase in noise level because of deterioration of the original M2 road surface that is present in the current eastbound lanes. There is no indication that the modelling process took this into account.
11. If this explanation is correct than it seems clear that the Trust's activities would be best directed towards requesting Transport for NSW to require Transurban to resurface the M2 between Beecroft and Pennant Hills Roads using an effective low noise road surface.
12. The response to the Trust's GIPA application provided access to the document referred to as "Transurban – SMA Resurfacing Proposal M2 Asphalt Resurfacing Stage 1 dated 7 September 2023". SMA (Stone Mastic Asphalt) is regarded as a low noise road surface but measurements made by the NSW RTA and reported in Proceedings of Acoustics 2006 indicate that it is not particularly effective. Those measurements indicated that the proprietary LoNoise asphalt (Boral) generated significantly lower noise levels.
13. There are indications that some resurfacing activity is currently occurring. However the email from the minister's Office states that Transurban "... are trialling a new asphalt surface that should result in better noise absorption. The trial is expected to be rolled out around end of this year (2023)." The current resurfacing may be part of that trial. If so, inclusion of the LoNoise asphalt or equivalent in the trial would seem to be highly desirable - perhaps this is an issue the Trust can take up with either Transurban or Transport for NSW with some urgency.

### **Analysis of the Design Methodology and Its Consequences**

14. An operational traffic noise assessment was performed as part of the M2 Extension design process. This assessment utilised a standard software package and was based on an acoustic analysis of the M2 physical environment as well as predictions of traffic volumes. Three design situations were modelled:
  - i. **Future existing** (2011) - the future road traffic noise that would have occurred at the proposed year of opening of the upgraded roadway assuming the extension did not occur.
  - ii. **Future Design** (2021) - incorporating the alterations which would result from the proposed extension and 10-year post-opening traffic levels.
  - iii. **Base Model** (2008) - intended to 'validate' the modelling process by comparison with the results of measuring noise levels at a set of locations along the M2.
15. The NSW Road Noise Policy (RNP) defines noise level limits for various circumstances and describes the mitigation actions that are required to be considered when any of these limits are exceeded. These limits are not mandatory but may form part of conditions of approval. Additional limits are defined in the Roads and Maritime Services Environmental Noise Management Manual (ENMM).



16. The “M2 Upgrade Project Environmental Assessment Vol. 2 (2010)” defines two operational noise mitigation scenarios:
- i. “Scenario 1- The predicted 2021 Future Design noise level exceeds the RNP base criteria for redeveloped roads **and** the predicted noise level increase between the Future Design and Future Existing scenarios due to the M2 Upgrade project is greater than 2 dB(A); or
  - ii. Scenario 2 - The predicted 2021 Future Design noise levels are Acute as defined in the ENMM regardless of the incremental impact of the M2 Upgrade project.”

17. The need for additional noise mitigation for the M2 Extension was examined within Scenario 1 during the design process by comparing the Future Design and Future Existing noise levels predicted by the modelling.
18. The difference between the two predicted noise levels was calculated for most of the residences along the M2 corridor. This calculation showed that the difference was less than the 2 dbA required for mitigation by Scenario 1 for all residences with two exceptions near Windsor Rd.
19. Consequently, because noise walls are the principal noise mitigation method for the M2, it was decided during the design process that increasing the height of any of the noise walls was not required.
20. As stated in the May 2010 document (P84) the modelling " ....includes no correction factor for the road way surface." It was believed by the consultants during the design phase that "the proposed upgrade of the M2 Motorway will take place concurrently with a full re-sheeting of the existing road surface ..... (which) is expected to provide a significant noise benefit over the existing cracked and substantially degraded surface." However for various good reasons they decided to take no account of it in the modelling. In any case it appears that the full resheeting did not eventuate.
21. An email from Minister Graham's Office to the Trust claimed that "independent post construction operational noise compliance monitoring was completed one year after opening to ensure the noise model used to predict the future noise impacts was valid. The compliance monitoring also tested the performance and effectiveness of the noise mitigation measures. *The results of the compliance monitoring indicated the noise mitigation measures were performing as intended and there is no requirement to assess additional noise mitigation for the project within the period of the environmental assessment.*" (Emphasis added)
22. The last sentence is essentially meaningless in the absence of any description of how "the performance and effectiveness of the noise mitigation measures" were tested. The design decision on noise mitigation was based on a comparison of the Future Existing and Future Design model results without any reference to compliance monitoring one year after opening. This comparison then defines how the noise mitigation measures were intended to perform. However there is no actual Future Existing situation to perform compliance monitoring on. It can only be assumed that extra modelling was done using the traffic levels at the time of monitoring to compare with the modelling results and it was this that provided the validation.
23. Now that the M2 Extension is operational, it would seem that the only meaningful test of the success of the design methodology would be to also perform compliance monitoring at the present time. Then perform the comparison by substituting those results and the one year monitoring results for the Future Design and the Future Existing modelling results. However this does not appear to have been done so the implication that "the noise mitigation measures (are) performing as intended" is, at best, dubious.
24. The important point is that all of this is *inconsistent* with the experience of residents bordering the M2 in Beecroft and Cheltenham and, in particular, the noise level measurements made, with advice from the Trust, by the residents of 34 Castle Howard Rd and 78 Cheltenham Rd, Cheltenham. These measurement were made using the Sound Level Meter App released by the US National Institute for Occupational Safety and Health (NIOSH) and developed specifically for the stable audio environment of the iPhone to be used for industrial noise monitoring. Uncalibrated, it is claimed to have an accuracy of +/- 2dB.
25. These measurements are presented as a bar graph in the accompanying Figure which also provides a graphical representation of the noise assessment context described above. The major features are the 'energy' average of the residents measurements and the equivalent Future Design (2021) model results derived from Appendix E of M2 Upgrade – Part 1

Environmental Assessment Vol. 2 – Technical Papers, May 2010 (EA2). Clearly, the resident's measurements are much higher (5.3dBA) than the model's 2021 predicted noise levels.

- 26.** Indeed, the measured results would demand noise mitigation action by both of the criteria in Scenarios 1 and 2 because -
- a.** they exceed the NSW Road Noise Policy base criteria references in Scenario 1, and they exceed the 2dBA threshold of Scenario 1 and,
  - b.** they are above the Scenario 2 acute threshold as defined in the Roads and Maritime Services Environmental Noise Management Manual.
- 27.** This *major difference between the measured and predicted results* invites explanation. There appear to be four possibilities.
- i.** The measured results are very inaccurate. Given the extensive testing of the Sound Level Meter App by NIOSH, any major accuracy issues would need to lie with the measurement methodology. Because two sets of measurements giving essentially the same results were made at two separate locations on two different iPhones this explanation seems unlikely.
  - ii.** The Future Design (2021) modelling is badly wrong. Given the close agreement between the 2008 modelling results and the validation measurements as well as the implied agreement between the modelling and measurements post opening, this again would seem unlikely because the physical environment has not changed significantly.
  - iii.** The 2021 modelling results are sound but the traffic levels have increased significantly above those assumed for the 2021 noise modelling. However, the daily traffic levels for the Future Design model in EA2 are approximately 90,000 whereas the 2023 traffic levels reported by Transurban are approximately 135,000. This could be expected to increase the traffic noise level by approximately 2dBA which is not enough to explain the difference between the measured and predicted results in the Figure.
  - iv.** Road noise at moderate to high speeds is predominantly generated by the interaction of the vehicle tyres and the road surface. There is now considerable evidence that the type of road surface has a significant effect on the level of noise generated. Furthermore, there is some data which suggests that, as the original surface of the M2 road surface has deteriorated, the noise level could have increased sufficiently to account for at least the major part of the difference between the measured and predicted noise levels.
- 28.** Inspection of the M2 surface between Beecroft and Pennant Hills Roads using the imagery in Apple Maps shows that the new surface of the westbound lanes is in good condition whereas that of the eastbound lanes is not and is presumably mainly the repaired 'cracked and substantially degraded surface' referred to in the 2010 Technical Papers document. *It seems reasonable to infer that the poor condition of the eastbound road surface explains at least the major part of the elevated noise levels measured by the Cheltenham residents above those predicted by the modelling.* While this increase would have been occurring gradually over time, it is possible that the traffic reduction during the COVID lockdown and the sudden increase afterwards made the residents more conscious of the noise levels.
- 29.** If this inference is plausible than it seems clear that the Trust's activities would be best directed towards requiring Transurban to resurface the M2 between Beecroft and Pennant Hills Roads using an effective low noise road surface rather extending the noise wall structure. The Trust should also argue that noise monitoring be performed in the areas effected by the resurfacing to ensure that the conditions of Scenarios 1 and 2 (¶16 above) have been met with corrective action taken if not.