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ALBURY-WODONGA HUME FREEWAY (ETTAMOGAH TO MURRAY RIVER, NSW)

POST-CONSTRUCTION OPERATIONAL NOISE ASSESSMENT

TB271-06F02 POST-CONSTRUCTION OPERATIONAL NOISE ASSESSMENT.DOC

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Prepared for:

ABIGROUP

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EXECUTIVE SUMMARY

Introduction - Objectives

Renzo Tonin & Associates (NSW) Pty Ltd has been engaged by Abigroup to monitor and assess road traffic noise at dwellings along the alignment of the Albury-Wodonga Hume Freeway, Ettamogah to Murray River, NSW (the Project) and on adjacent roads upgraded as part of the Project.

The objectives of the post-construction operational noise monitoring of the Project are to measure the levels of traffic noise after opening the road to traffic, and to use these measurements to check the actual traffic noise outcomes against the predicted outcomes and noise level objectives.

Road Traffic Noise Level Objectives

The noise objectives for the Project are fully detailed in the Operational Noise Management Procedure (ONMP) and were based on the NSW 'Environmental Criteria for Road Traffic Noise' (ECRTN) and the recommendations and procedures in the RTA's 'Environmental Noise Management Manual' (ENMM).

Monitoring and Assessment Procedures

The operational noise compliance monitoring and assessment studies addressed all residences potentially impacted by the Project and adjacent upgraded roads. These assessment procedures involve many steps and are not simply a case of deploying noise survey equipment and observing the measured noise levels.

Upon the completion of traffic noise and traffic flow monitoring, supplementary computer modelling of the design year (2017) traffic noise levels was conducted. The variances between the originally-intended acoustical outcomes (as per the ONMP) and the actual traffic noise level conditions achieved in practice (based on measurements and investigations) were quantified.

Consideration was given to the reasons for any discrepancies in accordance with the ENMM. The modelling algorithms and data inputs were checked and found to be in order. On-site visual checks established that the as-built in-corridor road noise mitigation measures aligned with those used in the noise model.

The variances were therefore attributed (in general) to residual uncertainties associated with the modelling, road design and traffic noise monitoring processes. These variances then become the basis upon which further noise mitigation measures are considered. This approach is in accordance with the ENMM and was identified in the ONMP as follows:

> *'If the "measured noise levels" exceed the "design noise levels" by more than 2 dBA, the adequacy of the noise mitigation needs to be reviewed, and if problems are identified, steps are required be taken to rectify the situation. Additional noise treatments to achieve*

the design noise level will be identified where they are both feasible and reasonable in accord with the RTA ENMM.'

Further to evaluating where premises exceed the predicted noise levels in the design year by more than 2dB(A), additional modelling and assessment work was conducted to:

1. identify premises that may marginally exceed the Project noise goals, and
2. evaluate impacts at newly assessed premises due to complaints or issues raised post-construction.

Analysis and Assessment Processes

Detailed traffic noise measurement and analysis processes were applied to 339 dwellings nearest to the Project carriageways, ramps and nearby local roads (where road upgrading was implemented as part of the Project works). This involved all of the potentially affected dwellings and beyond, with traffic noise measurements and assessments undertaken at large distances from the Project corridor.

No dwellings outside the set of specific 339 residences included in the post-construction operational traffic noise assessment qualify for further consideration of additional noise treatment.

The 339 dwellings in the post-construction operational traffic noise assessment were grouped into nineteen (19) different Noise Catchment Areas (NCAs). Maps of these NCAs, along with the summary findings of the noise studies are presented in separate documents for each NCA to facilitate public dissemination.

Assessment Outcomes

The findings of the monitoring and assessment study presented in this Report identified that:

- the actual road traffic noise outcomes at 319 of the 339 dwellings in the assessment localities conform to the predicted outcomes within appropriate margins - and no further acoustical study or treatments are warranted

- at the remaining 20 of the 339 dwellings, the actual outcomes varied from the predicted outcomes to an extent that warrants more detailed on-site assessment of noise exposure and potential provision of additional noise treatments.

At the 20 dwellings selected for additional treatment, the indicative categories of possible treatment are identified, however further investigation and consultation with the dwelling owners will be required to determine the specifics of each dwelling and extent of treatment necessary. Some of these dwellings were already identified for fresh air ventilation at the design stage, and therefore may only require sealing their facade (eg seal wall vents where they exist) to complete the treatment.

Investigations at these dwellings have found that the treatment of individual dwellings is more effective than in-corridor noise mitigations.

The noise control treatment categories that will now need to be considered and investigated in consultation with the owners are shown in the table below.

Types of Additional Noise Control Treatments to be Considered

Potential Type of Noise Control Treatment	Number of Dwellings
Fresh Air Ventilation System	16
Fresh Air Ventilation System + Sealing of Facade	4
Fresh Air Ventilation System + Sealing of Facade + Upgrade of Windows & Doors	0
Total Number of Dwellings Identified for Further Consideration	**20**

In some cases, consideration for additional treatment may apply to both floors of a two-storey dwelling.

Although 20 dwellings have been nominated for consideration of further treatment, issues that may arise to determine whether these dwellings receive further treatment are:

- the dwellings may already have the nominated treatment (eg fresh air ventilation and sealed facades)
- the noise-exposed facades may not be “habitable rooms” (eg bedrooms, living rooms, etc)
- there may not be any windows or doors on the exposed facades
- the dwellings may not have wall vents
- the property owners reject the offers of additional treatment.

In summary, all dwellings found through this assessment as exceeding the Project’s noise level objectives, are identified for acoustic treatment.

Conclusions

At 20 dwellings, the predicted outcome was such that consideration of further acoustical treatment is warranted. The final acoustical treatment to be offered will require detailed inspections of each dwelling to determine the appropriate extent of treatment.

Investigations at these dwellings have found that the treatment of individual dwellings is more effective than implementing in-corridor noise mitigation measures.

Other conclusions that can be drawn from the analysis of the operational noise outcomes at the 339 dwellings in the 19 NCAs are:

- 12 of the 19 NCAs contain no dwellings which qualified for additional treatment consideration.

- About 203 of the 339 dwellings received a lower level of traffic noise than was predicted in the ONMP.
- Approximately 333 of the 339 dwellings experience traffic noise levels that do not exceed those predicted in the ONMP by more than +2dB(A).
- Only 6 of the 339 dwellings have variances exceeding +2dB(A).

The close agreement between predicted and actual operational noise outcomes indicates the robustness of the acoustical design and construction of the roadway as described in the ONMP.

No *"clear trend in traffic noise levels which are higher than the general predictions"*[1] made during the design stage was found. Notwithstanding this, noise mitigation measures are recommended for consideration at a total of 20 additional dwellings to those identified during the design stage and reported in the ONMP.

In regard to the noise issues of concern raised by the community in the period post-opening the Project, the following observations have emerged during the study and comments are provided below:

- Parts of this Project involved the redevelopment of an existing highway corridor, through areas where receivers were previously affected by traffic noise and ambient noise levels were generally moderate to high. For these parts noise receptors were previously exposed to significant road traffic noise and therefore less complaints have arisen post-opening.
- A large part of the Project involved the construction of a new road through an area where receivers were not previously exposed to significant road traffic noise. Therefore, in such areas complaints arose once the Project was completed and in operation. Although traffic noise levels may comply with the Project's noise level objectives and goals, the increase in the ambient noise levels may have been significant and initial complaints may have occurred as a result of residents suddenly being exposed to a significant increase in ambient noise levels.
- A high proportion of complainants were concerned about the noticeable change in the character of the traffic noise environment in areas where little or no traffic noise existed prior to the Project. This issue is recognised as a consequence of traffic thoroughfares constructed through road reservations that have developed quiet characteristics over many years.
- Some complaints related to the disturbance caused by heavy vehicles, particularly at night-time. Background noise levels at night-time fall to low levels (possibly even similar to the low background levels prevailing prior to the freeway). This low background noise environment is then punctuated by high noise levels of individual trucks travelling along

1. *Ministers Condition of Approval No.35*

the highway, including the use of engine brakes. The issue of night-time sleep disturbance is recognised as a major problem along major arterial roads, especially in rural or quiet suburban areas where the emergence of truck engine and engine-brake noise levels punctuate low background noise environments. National Standards and draft regulations aim to address heavy vehicle noise over time. In the meantime, some acoustical management is achieved through driver education programs and the use of advisory signage warning drivers not to use engine-brakes in built-up residential areas.

Noise impacts examined in relation to rail noise potentially having been affected by the Project show no increase in train pass-by noise levels have occurred before and after the Project and train noise levels are compliant with relevant noise guidelines.

Some complaints received from Tribune Street residents and Scots School, claim that train noise has worsened since the freeway noise barriers have been installed along the eastern side of the rail line and western side of the freeway. Chapter 10 examines noise impacts at Scots School in relation to rail noise and the findings show no increase in train pass-by noise has occurred before and after the noise walls were installed and train noise levels are compliant with relevant noise guidelines. Given that the distance and general layout of the land between the rail line and the monitoring location at the School is similar to the residential area north along the rail line at Tribune Street, the results and findings of this assessment are directly applicable to the Tribune Street area. The change in train noise reported by the community in these areas may have arisen as a result of the community noticing a change in the character and not necessarily a change to the overall level of train noise.

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1. INTRODUCTION

Renzo Tonin & Associates (NSW) Pty Ltd has been engaged by Abigroup to monitor and assess road traffic noise at dwellings along the alignment of the Albury-Wodonga Hume Freeway, Ettamogah to Murray River, NSW (the Project) and on adjacent roads upgraded as part of the Project.

The primary purpose of carrying out a post-construction operational noise assessment of the Albury-Wodonga Hume Freeway is that there is an environmental commitment under the Ministers Condition of Approval No.35 to assess the accuracy of the noise modelling undertaken during the design stage and subsequently assess the effectiveness of the implemented traffic noise mitigation measures.

The purpose of this report is to:

- outline the objectives of the post-construction operational traffic noise monitoring program
- describe the methodology of the post-construction operational traffic noise monitoring and assessment study
- compare monitored noise levels to modelled noise levels
- assess the accuracy of the noise modelling undertaken during the design stage
- assess the adequacy of the implemented traffic noise mitigation measures
- address community complaints regarding noise
- an assessment of noise results against the Project's environmental noise criteria
- present the results, findings and conclusions of the post-construction operational traffic noise assessment

In preparing this report, reference has been made to the following documents:

- Minister's Condition of Approval No.35 for the Albury-Wodonga Hume Freeway project
- Albury-Wodonga Hume Freeway Scope of Work and Technical Criteria (SWTC) - Appendix 4
- Renzo Tonin & Associate's 'Operational Noise Management Procedure' (ONMP) and accompanying technical memos for each Noise Catchment Area (NCA)
- NSW Government 'Environmental Criteria for Road Traffic Noise' (ECRTN) Policy
- NSW RTA's 'Environmental Noise Management Manual' (ENMM)

2. OBJECTIVES OF POST-CONSTRUCTION NOISE MONITORING PROGRAM

The environmental requirements for the acoustical design of a large, high speed roadway like the Albury-Wodonga Hume Freeway need to be comprehensive in order to address the potential environmental noise effects of sensitive noise receivers potentially affected by traffic noise from the roadway. These requirements were implemented during the design and construction phase of the Project and were documented in the ONMP with all of the Project noise objectives, procedures and design outcomes.

The following outlines the actions of the post-construction operational noise assessment of the Albury-Wodonga Hume Freeway:

- Measure actual traffic noise and traffic volumes after the opening of the road.
- Use measured actual traffic noise and volume data to validate the noise prediction model implemented during the design and construction stage of the Project.
- Where the noise prediction model and input data are found to validate correctly, then previous predicted noise levels presented in the ONMP are considered to be correct and noise mitigation measures presented in the ONMP are applicable.
- Where the validation process indicates differences then validation corrections are applied to the noise prediction model and future traffic noise levels (10 years after opening – year 2017) are predicted with the corrected model.
- Re-modelled year 2017 traffic noise levels are compared to previously modelled 2017 traffic noise levels, and compared against the Project's environmental noise criteria to determine the adequacy of the noise mitigation measures implemented.

Furthermore, following the completion of the above process additional mitigation measures to those already implemented to date would, according to MCoA No.35, be considered 'should the assessment indicate a clear trend in traffic noise levels which are higher than the general predictions made in the noise impact report' (ONMP). That is additional noise mitigation measures would only be considered where a 'clear trend' of shortfalls is found between measured outcomes and modelled outcomes, where 'practical and cost effective to the satisfaction of the EPA, and after community consultation'.

The information provided by this post-construction operational noise assessment will also confirm the need for treatment of properties that were modelled as marginally compliant or non-compliant [within 2dB(A) of the set noise criteria] and therefore may not have been offered architectural (or at-house) noise treatment prior to this stage of the Project.

Additional mitigation measures to those already implemented to date is therefore recommended only where the noise criteria for the project are determined to be exceeded

(including ‘acute’ noise levels affected by the Project) to address any shortfalls between measured and modelled outcomes.

3. ENVIRONMENTAL OBLIGATIONS

3.1 Ministers Conditions of Approval

As part of the Ministers Conditions of Approval (MCoA) relating to the operation of the Albury-Wodonga Hume Freeway, post-construction operational noise monitoring is required to be undertaken. Table 1 summarises the MCoAs.

Table 1 – Ministers Conditions of Approval

MCoA No.	MCoA (summary)	Addressing of MCoA
27	A detailed Noise and Vibration Management Procedure must be prepared as part of the EMP's referred to in Conditions 10 and 13 to the satisfaction of the EPA. The Procedure must provide details of noise and vibration control measures to be undertaken during both the construction and operation stages sufficient to address the technical requirements for any EPA approvals/licences, including a Noise Impact Report required in Condition No.34. The Procedure must include, but not be limited to, tests for ascertaining acoustic parameters; anticipated airborne noise and vibration for all major noise and vibration generating activities and locations and duration of these activities; impacts from site compounds/construction depots; location, type and timing of erection of temporary and permanent noise barriers; specific physical and managerial measures for controlling noise and vibration, noise and vibration control equipment to be fitted to machinery; predicted noise and vibration levels at sensitive receivers; noise and vibration monitoring and reporting procedures (including monitoring locations, techniques and relevant criteria); measures for dealing with exceedances; arrangements to inform residents of construction activities likely to affect their noise amenity; contact point for residents; complaints handling system; reporting complaints and response actions. The Procedure must be prepared prior to the construction and operation (as appropriate) of the proposal and must be made publicly available.	The ONMP submitted to DECC, DoP and RTA addresses the operational traffic noise requirements of this clause. It addresses the operational traffic noise aspects of the Noise and Vibration Management Procedure (separate to construction) and the Noise Impact Report.
34	A noise impact report, on the operation of the proposal, must be prepared as part of the Noise and Vibration Management Procedure. The report must be prepared in consultation with the local community, relevant councils and must be to the satisfaction of the EPA. The report must include the following:	The ONMP and technical memos submitted to DECC, DoP and the RTA address all of the requirements of the noise impact report.
	(a) identification of noise catchments and predicted noise levels;	
	(b) specific consideration of noise sensitive receptors;	
	(c) relationship of predicted noise levels to the environmental criteria for road traffic noise endorsed by the EPA;	
	(d) available noise control measures and those proposed to be used including consideration of their likely effectiveness. The urban design principles identified in Condition No. 40 must be addressed in the assessment of noise control measures.	
	The report must address traffic noise associated with the proposal, including the traffic noise on Hume Highway and local streets affected by traffic redistribution as a result of proposal. The report should demonstrate that the proposal will comply with the environmental criteria for road traffic noise endorsed by the EPA in all areas, unless the EPA agrees otherwise taking into account community views, and the practicality of achieving the noise criteria.	

MCoA No.	MCoA (summary)	Addressing of MCoA
35	**Monitoring of the operational traffic noise on both the proposed highway and the affected local roads must be undertaken as part of the Noise and Vibration Management Procedure. A monitoring program for at least 12 months from commencement of operation should be established. The monitoring program shall include measuring background noise (both Leq 15 hr and Leq 9 hr) immediately before construction begins and traffic noise levels of normal operational traffic flows. The Proponent must, in consultation with the EPA, assess the adequacy of the traffic noise mitigation measures. Should the assessment indicate a clear trend in traffic noise levels which are higher than the general predictions made in the noise impact report, the Proponent must ensure the implementation of further noise mitigation measures if practicable and cost effective to the satisfaction of the EPA, and after community consultation.**	**This post-construction operational noise assessment addresses this clause.**
36	Prior to installation of permanent noise control measures the Proponent shall, in consultation with the EPA and the community, ensure that further investigations are conducted into the feasibility and cost effectiveness of additional noise mitigation measures using the EPA's noise criteria as the target.	The technical memos submitted to DECC, DoP and RTA address this clause.

3.2 SWTC – Appendix 4

The Project's 'Scope of Work and Technical Criteria' (SWTC), Appendix 4 states the following:

Table 2 – Scope of Work and Technical Criteria – Appendix 4 Noise Requirements

Clause No.	Appendix 4 – Noise Requirements	Addressing of Clause
4.14	**Noise Impact Reports** The noise impact report referred to in Condition of Approval (CoA) 34 of the Planning Minister's Approval must, as a minimum, use the input variables of traffic volume, composition and growth identified in Appendix 20 of this Scope of Works. The noise impact reports referred to in CoA 27 and 34 must be formatted consistent with the model operational noise report and the model construction noise and vibration report in Sections 7 and 9 respectively of the RTA's Environmental Noise Management Manual (ENMM). More specifically, the noise impact report required by CoA 34 must contain the following details:	The ONMP and technical memos submitted to DECC, DoP and the RTA address all of these requirements.
	A brief description of the prevailing ambient noise environment;	
	Documentation of the location of noise monitors, including an indication of the distance to the nearest road, where a road is located close to the noise monitors;	
	A site plan showing the locations of noise monitoring;	
	Aerial photographs showing the locations of the noise monitoring;	
	Location details of any noise loggers, including site photographs identifying the noise loggers;	
	Using 15-minute intervals, charts of noise parameters, including the LAmax, LA10, LAeq and LA90, for each 24-hour period of the monitoring survey;	
	A table summarising the noise parameters measured;	
	Tabulations of Average Annual Daily Traffic (AADT) predictions for the day and night periods;	
	If classified counts are conducted as part of the noise model verification or maximum noise level assessment process, the report must include a summary of the traffic volumes and percentages;	

Clause No.	Appendix 4 – Noise Requirements	Addressing of Clause
	Summaries of the computational algorithms used and justification for their selection, the location of noise-sensitive dwellings and details of the modelling considerations and assumptions applied in the noise assessment. The modelling considerations to be addressed must, as a minimum, include the screening effects associated with rows of houses and all of the modelling considerations identified in Appendix A, page 171 of the ENMM;	
	A table summarising the relevant noise parameters computed at the monitoring locations and comparing them with the design noise objectives;	
	Sensitivity and statistical analysis of key data in order to estimate confidence interval and reliability;	
	The calculated LAeq (15 hour) and LAeq (9 hour) levels for each identified noise sensitive dwelling/location in tabular format;	
	The noise environment predicted for the future existing situation (time of project opening assuming the project is not proceeding); the time of project opening; and 10 years following project opening (the design year);	
	Well presented noise contour maps for the LAeq (15 hour) Day, LAeq (9 hour) Night for 2008 and 2017 noise environment identifying all noise-sensitive locations in the study area. The contour maps must be presented for intervals of not greater than 5 dB(A), and the contour values must be clearly identified;	
	An evaluation of prevailing maximum noise level impacts and changes in impacts attributable to the Project Works in accordance with Practice Note III of the ENMM. This evaluation must include the tabulation of representative monitored/predicted maximum noise levels, showing maximum noise levels, the value of Lmax-LAeq and the number of noise events;	
	A table identifying for each prediction site/location the change in noise level from the 'future existing' to the 'design year' and whether or not the Environmental Criteria for Road Traffic Noise (ECRTN) base noise criteria and allowance noise goals are predicted to be exceeded in the absence of any noise mitigation additional to the road design;	
	An evaluation of all available noise management options and a detailed evaluation of the noise treatment options selected, in accordance with Practice Note IV of the ENMM. This evaluation must include calculations and graphical representation of the Practice Note IV(a) cost effectiveness analysis, where required to be conducted;	
	Tabulation against each prediction site/location, with all proposed noise management measures in place, the predicted noise levels for the future existing situation, project opening and 10 years following project opening, and the noise reductions associated with additional noise management measures;	
	Clear identification of all operational noise treatments.	
4.16	**RTA Environmental Noise Management Manual** Compliance with the noise assessment criteria identified in the Environmental Documents, including the criteria identified in Conditions of Approval Nos 29 and 34, must not be constrained by the limitations on funding for acoustic screen walls and/or building treatments for individual dwellings identified in Practice Note iv (b) of the RTA Environmental Noise Management Manual (ENMM) which is referenced in Appendix 9 of the Scope of Works and Technical Criteria.	The ONMP and technical memos submitted to DECC, DoP and the RTA address this requirement.

4. PROJECT NOISE LEVEL OBJECTIVES

In determining which noise level criteria apply along the Albury-Wodonga Hume Freeway route, guidance was taken at the design stage from the NSW 'Environmental Criteria for Road Traffic Noise' (ECRTN) and the RTA's 'Environmental Noise Management Manual' (ENMM) and presented in the ONMP. The noise level objectives for the Project are fully detailed in the Operational Noise Management Procedure (ONMP) [ref: TB271-02F11(rev8), 16 August 2006].

4.1 Residential Noise Receptors

According to the ECRTN and ENMM, this Project has two (2) noise criteria categories with respect to Table 1 of the ECRTN:

- **Category 1 –** New Freeway or Arterial Road Corridor: generally from Murray River to Davey Road, where the route is entirely new and mostly goes through a built-up or urban type area, although some residences in this section were previously exposed to significant traffic noise levels.
- **Category 3 –** Redevelopment of Existing Freeway / Arterial Road: generally from Davey Road to Ettamogah, where the route is very close to the existing Hume Highway with several residences previously exposed to significant traffic noise levels.

The relevant noise criteria for this Project are presented in Table 3 below.

Table 3 - NSW Environmental Criteria for Road Traffic Noise

Category / Type of Development	Criteria		
	Day, dB(A)	Night, dB(A)	Where Criteria are Already Exceeded
1. New freeway or arterial road corridor	LAeq(15hr) 55	LAeq(9hr) 50	The new road should be designed so as not to increase existing noise levels by more than 0.5 dB(A). Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In some instances this may be achievable only through long-term strategies such as improved planning, design and construction of adjoining land use developments; reduced vehicle emission levels through new vehicle standards and regulation of in-service vehicle; greater use of public transport; and alternative methods of freight haulage.
3. Redevelopment of existing freeway/arterial road	LAeq(15hr) 60	LAeq(9hr) 55	In all cases, the redevelopment should be designed so as not to increase existing noise levels by more than 2 dB(A). Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may be achievable only through long-term strategies such as improved planning, design and construction of adjoining land use developments; reduced vehicle emission levels through new vehicle standards and regulations of in-service vehicles; greater use of public transport; and alternative methods of freight haulage

Source: 'Environmental Criteria for Road Traffic Noise' (May 1999).

'Feasibility' relates to engineering considerations and what can practically be built. 'Reasonableness' is judged in terms of noise mitigation benefits and costs, and many other aspects such as community views, aesthetic impacts, existing and future noise levels at the affected sites and the benefits arising from the development.

To establish the most reasonable and feasible noise mitigation treatment in areas affected by significant traffic noise levels, reference is made to Practice Note IV of the RTA's 'Environmental Noise Management Manual' (ENMM).

The Project noise level objectives applied for residential noise receivers are set out in the ONMP and apply to all residential premises in the road traffic Noise Catchment Areas, as defined in Practice Note IV of the ENMM [2]:

> *"The road traffic noise catchment area will generally not extend beyond a setback of 300m from the road alignment, as beyond this distance most noise models are not capable of producing reliable predictions."*

At distances beyond 300m, road traffic noise levels are influenced by meteorological effects, in particular, due to wind and night-time temperature inversions. For example a slight breeze (from roadway to receiver or vice versa) or temperature inversion can cause traffic noise levels to vary from traffic noise levels under calm or isothermal conditions, and such effects can vary significantly from night to night and from season to season.

However, despite the inability to predict noise levels accurately beyond the road traffic Noise Catchment Areas, it is inappropriate to ignore noise impacts at those residences.

In such circumstances, it is considered reasonable to allow a 2dB(A) margin in the modelled noise levels because of the inaccuracies involved. An allowance of 2dB(A) is consistent with approaches taken in the ENMM for other circumstances such as in addressing:

a) the reasonableness in not taking action where the target noise levels are exceeded by no more than 2dB(A), which is justified on the basis of *"the insignificant exceedances of the target noise levels"*; [3] and
b) the reasonableness in not providing further noise barrier measures where the increased benefit would be only 2dB(A) or less, it is concluded that *"the provision of additional architectural treatments would normally not be cost-effective"*.[4]

These circumstances are considered to be consistent with the principles of *"reasonableness"* and *"feasibleness"* in Section 1.3 of the NSW Government's ECRTN.

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[2] ENMM Page 97 Step 1

[3] ENMM Page 98 Sub Clause (1)

[4] ENMM Page 100 Second Bullet Point

Therefore, for dwellings located outside of the Noise Catchment Areas (ie at distances greater than 300m from the road corridor), provided that operational noise levels predicted in 2017 do not exceed the 'target' noise levels set out in Table 3 by more than 2dB(A), that noise mitigation works would not reasonably be required.

This assessment approach applies after all "feasible and reasonable" traffic management and other road design opportunities for reducing traffic noise have been exhausted.

In addition, on the other end of the scale, where the predicted design year noise levels at residences exceed 65dB(A) Day and 60dB(A) Night as a result of the Project, then the noise exposure is considered to be 'acute' and noise control measures are considered.

4.2 Non-Residential Land Use Developments

The ECRTN also sets guidelines for the assessment of traffic noise on sensitive land use developments.

Table 4 – NSW Environmental Road Traffic Noise Criteria for Sensitive Land Use Developments

Type of Development	Criteria		
	Leq(1hr) ,dB(A)		Noise Mitigation Measures
	Day	Night	
Proposed school classrooms	40 [1]	-	To achieve internal noise criteria in the short-term, the most practicable mitigation measures are often related to building or facade treatments. In the medium to longer term, strategies such as regulation of exhaust noise from in-service vehicles, limitations on exhaust brake use, and restricting access for sensitive areas or during sensitive times to low noise vehicles can be applied to mitigate noise impacts across the road system. Other measures include improved planning, design and construction of sensitive land use developments; reduced new vehicle emission standards; greater use of public transport; and alternative methods of freight haulage. These medium to long-term strategies apply equally to mitigating internal and external noise levels. Where existing levels of traffic noise exceed the criteria, all feasible and reasonable noise control measures should be evaluated and applied. Where this has been done and the internal or external criteria (as appropriate) cannot be achieved, the proposed road or land use development should be designed so as not to increase existing road traffic noise levels by more than 0.5dB(A) for new roads and 2dB(A) for redeveloped roads or land use development with potential to create additional traffic.
Existing school classroom	45 [1]	-	
Hospital wards	35 [1]	35 [1]	
Places of worship	40 [1]	40 [1]	
Active recreation (eg golf courses)	Leq(15hr)= 60[2]	-	
Passive recreation and school playgrounds	Leq(15hr)= 55[2]	-	

Source: 'Environmental Criteria for Road Traffic Noise' (May 1999).

Note: 1. Internal noise criteria

2. External noise criteria

So in summary, for non-residential noise receptors, the following 'target' noise criteria were applied:

- School classrooms: $L_{Aeq,1hr}$ = 45dB(A) inside classrooms [equivalent to 55dB(A) outside classrooms assuming open windows]
- School outdoor play areas: $L_{Aeq,15hr}$ = 55dB(A)
- Passive Recreational Areas: $L_{Aeq,15hr}$ = 55dB(A)
- Active Recreational Areas: $L_{Aeq,15hr}$ = 60dB(A)

4.3 Discussion

The ONMP was issued to the relevant regulatory authorities including the Roads and Traffic Authority (RTA), the Department of Environment and Climate Change (DECC) and the Department of Planning (DoP). Comments received by the relevant regulatory authorities were incorporated into the ONMP. During the design consultation process, project-specific criteria were developed in consultation with the RTA and DECC. These are all set out in the ONMP.

The approach followed during the design stage of the Project is in line with the ECRTN which states:

- *"The framework embodies a non-mandatory performance-based approach." (p. 2)*
- *"The non-mandatory nature of the criteria implies a process that needs to be followed to derive achievable noise levels for specific projects. That process commences with the criteria providing the target level that should be sought to be met and then incorporates considerations of cost, feasibility, equity and community preferences. Where it can be demonstrated that the target is not practicable, feasible or reasonable to achieve within the project planning, design and implementation for justifiable reasons, then the criteria should be approached as closely as possible, with the aim of adopting broader supporting strategies for achieving the criteria in the longer term.*

  In this context, feasibility relates to engineering considerations and what can be practically be built.

  Reasonableness relates to the application of judgement, taking into account the following factors:

  - *Noise mitigation benefits - amount of noise reduction provided, number of people protected*
  - *Cost of mitigation - total cost and cost variation with benefit provided*
  - *Community views - aesthetic impacts and community wishes*
  - *Noise levels for affected land uses - existing and future levels, and changes in noise levels*
  - *Benefits arising from the development*

Although the criteria are non-mandatory, they provide the basis for establishing appropriate noise levels that can be incorporated into conditions in development consents issued by consent authorities (such as NSW Planning)….Where noise level conditions are set, they would result from starting with the noise criteria as the targets and then applying all feasible and reasonable measures. Noise levels higher than the criteria may need to be applied as a condition of consent where it is demonstrated that the criteria cannot be met by applying all feasible and reasonable mitigation measures." (ECRTN, p15)

The approach followed during the design stage of the Project is also in line with the ENMM which states:

"It is generally not 'reasonable' to take action to reduce predicted noise levels through the adoption of measures (such as noise barriers/mounds, architectural treatments and quieter pavement surfaces) beyond the adoption of all feasible and reasonable traffic management and other road measures:

[1] For proposed "new" roads and road "redevelopments" the RTA believes it is generally not "reasonable" to take action to reduce predicted noise levels to the target noise levels if the noise levels with the proposal, ten years after project opening, are predicted to be:

- *Within 2 dBA of "future existing" noise levels (the noise levels from existing sources of road traffic noise predicted for the time of project opening), and*
- *No more than 2 dBA above the target noise levels set out in columns 2 and 3 of Table 1 in ECRTN.*

This approach is based on the insignificance of the changes in noise levels involved and the insignificant exceedances of the target noise levels."

(RTA Environmental Noise Management Manual, Practice note iv, p 98)

It should also be noted that in line with the Minister's Conditions of Approval for the Albury-Wodonga Hume Freeway Project, dwellings that received Development Approval after the Project Approval Date of 1998 did not qualify for consideration in the acoustical design of the project. This is in line with RTA ENMM Practice Note 2 wherein the Developers, and not the RTA or AbiGroup, are responsible for noise mitigation at 'post-approval' developments.

5. PROJECT NOISE MITIGATION MEASURES

The following summarises the noise mitigation measures implemented on this project to reduce noise impacts to receivers.

There are a number of methods used on this project to mitigate traffic noise, and these include:

1. road design features;
    - increased distance between the road and receivers (eg optimising road alignment, inclusion of landscaped areas and parklands to act as buffers between road and receivers, etc)
    - use of cuttings in road to provide noise shielding
    - shielding provided by road structures (eg retaining walls, bridge structures etc)
    - selection of quiet expansion joints for bridges and ramps
2. low-noise pavement,
3. roadside noise mounds, barriers and walls,
4. fences along residential property boundaries, and
5. architectural or at-dwelling noise control treatment.

5.1 Road Design Features

Road design features of this Project which assist in reducing traffic noise impacts include:

- Various cuttings which shield the road from residences
- Linear park along NCA 14 (East Albury) providing a buffer to residences
- Retaining walls along NCA 14 (East Albury) which shield the road from residences
- South Albury park with noise mounds and walls along NCA 18 which shield the road from residences
- Quiet expansion joints for bridges and ramps to reduce peak noise levels.

The expansion joints applied are:

- Small movement joints – located at Seven Mile Creek, Corrys Rail and Thurgoona Rail bridges. The joint blends in with the asphalt surface generating minimal noise.
- Large movement joints – located at North St and Fallon St bridges. Finger plate expansion joints used to allow for large movement. The joints have no metal to metal contacts with the 'fingers' providing a smooth transition over expansion gap therefore minimising noise.
- Medium movement joints – located at all other bridges. The expansion joints used were the Granor strip seal systems. It contains an elastomeric gland between aluminium retainers that is cast into the concrete with the gland capable of the required movement.

The joint was installed to provide a flush surface true to the profile of the finished bridge deck surface, thus reducing noise impact.

5.2 Low-Noise Pavements

Approximately 7km of the Freeway, between the Murray River and Corrys Road, was paved with Stone Mastic Asphalt (SMA), as this section is the most densely populated section of the Freeway. SMA provides significant and worthwhile noise reduction benefits.

5.3 Noise Mounds, Barriers and Walls

Noise mounds, barriers and walls were constructed in accordance with the requirements of the MCoAs and the SWTC.

A detailed feasibility analysis was completed during the design phase in accordance with Practice Note IV of the ENMM at representative noise affected dwellings within each NCA at both the Ground Floor (ie. 1.5m above ground level) and First Floor (ie. 4.5m above ground level). The analysis determined the optimum noise mitigation requirements, including the appropriate mix of at-road and at-residence treatment. In some areas, due to the topography surrounding the project, it was found that at-residence treatment was required either in addition to or in preference to at-road treatment.

Noise barriers are most feasible where residences are closely grouped, where the barriers do not cause access difficulties to properties, and where they are visually acceptable. To derive the most appropriate height for noise barriers (walls and mounds) for each NCA, a feasibility analysis was undertaken in accordance with Practice Note IV of the ENMM. A summary of the feasibility analysis and assessment outputs is presented in Appendix D of the ONMP.

In summary, the Project's noise barriers have been constructed in accordance with the requirements of the MCoAs, the SWTC, the ECRTN and the ENMM. The ONMP presents the schedule of the noise barriers that have been installed as part of the Project, detailing their location, lengths and heights of and the type of noise barriers constructed. **Appendix B** includes a summary of the noise barriers that have been installed as part of the Project.

5.4 Architectural or At-dwelling Noise Control Treatment

During the detail design phase, an analysis into the design of feasible and reasonable mitigation measures was undertaken in accordance with Practice Note IV of the ENMM. The analysis determined the optimum noise mitigation requirements, including the appropriate mix of at-road and at-residence treatment. In some areas, due to the topography surrounding the project, it was found that at-residence treatment was required either in addition to or in preference to at-road treatment. Owners of buildings with habitable rooms overlooking the freeway and not able to benefit substantially from at-road noise mitigation, were offered noise mitigation in the form of architectural treatment where required.

The following building treatments were considered and offered where appropriate to property owners affected by the Project's traffic noise:

- Fresh air ventilation systems (to allow existing windows and doors to be kept shut)
- Sealing of wall vents
- Upgrading of window seals and door seals
- Upgraded of windows and glazing and solid core doors on the exposed facades of masonry structures only
- Installation of external screen walls

6. NOISE CATCHMENT AREAS

To facilitate the assessment of noise impacts from the Project, residential and other noise sensitive areas along the route were divided into Noise Catchment Areas (NCAs).

The NCAs identified along the Project route are as follows:

Table 5 – Location of Noise Catchment Areas

NCA ID	Location		
	Start Station	End Station	Side of Road
Ettamogah to Corrys Road			
NCA 1	164 100	164 500	East
NCA 2	166 200	166 600	East
NCA 3	166 000	166 800	West
NCA 4	167 600	168 400	East
NCA 5	167 900	169 200	West
NCA 6	169 900	170 500	West
NCA 7	171 300	171 700	East
NCA 8	171 300	172 100	West
NCA 17	167 600	169 600	East
Corrys Rd to Murray River			
NCA 9	171 800	172 700	East
NCA 10	172 900	173 800	West
NCA 11	174 300	175 000	West
NCA 12	175 000	175 550	West
NCA 13	174 650	175 550	East
NCA 14	175 550	177 300	East
NCA 15	178 100	179 000	West
NCA 16	176 800	177 300	West
NCA 18	177 300	178 000	East

Appendix A presents Figures which show the locations and extent of each NCA.

7. NOISE MONITORING

Clause 35 implies a period of 12 months from commencement of operation for noise monitoring. However, given that driving patterns do not need to stabilise on the Albury-Wodonga Hume Freeway, as there is no alternative route for through traffic using the new freeway, and given that all relevant traffic characteristics (volumes, compositions, speeds etc) are measured concurrently with the traffic noise monitoring, allowing the measured noise levels to be confidently 'normalised' to Average Annual Daily Traffic (AADT) flow figures, then noise monitoring was commenced without delay. Furthermore, the early commencement of the noise monitoring was to benefit the community as the community would receive the benefits of the outcomes of the study earlier rather than later and community complaints would be addressed sooner.

Guidance is taken from the RTA's 'Environmental Noise Management Manual' (ENMM) for the timing and duration of monitoring, and monitoring was undertaken in accordance with Australian Standard 2702-1984 'Acoustics- Methods for The Measurement of Road Traffic Noise'.

The ENMM also recommends the following timing and duration for monitoring:

> *"…The monitoring is generally conducted to give a minimum of seven consecutive days of data.*
>
> *Classified traffic monitoring needs to be conducted simultaneously with the noise monitoring, to identify traffic flows and mixes."*

Practice Note VIII of the ENMM gives further guidance for post-construction noise monitoring and states:

> *"Post-construction monitoring is undertaken to determine whether the mitigation measures have been adequate for the predicted design noise levels to be met.*
>
> *The "Design Noise Level for Year 1" is the noise level for the road development at project opening, after all feasible and reasonable mitigation strategies have been applied.*
>
> *Provided traffic flows and mixes following the road's opening are in line with those used for the predictions, it can be expected that if the predicted noise levels for Year 1 are achieved the predicted Year 10 noise levels will also be achieved.*
>
> *It should be recognised that noise prediction modeling has some accuracy limitations and will commonly produce acceptable errors of around 2 dB(A). In addition, when noise levels for a new road are being monitored short-term and uncharacteristic variations in traffic flow need to be taken into account when comparing the measured and predicted noise levels."*

As stated in the 'Operational Noise Management Procedure' (ONMP) and accompanying technical memos for each Noise Catchment Area (NCA):

> *"For residences where the predicted noise levels are within 2dB(A) of the criteria, post-construction noise monitoring is to be conducted…"*

Noise predictions for the design year (year 2017) were conducted along the route and those residences where noise predictions are within 2dB(A) of the noise design criteria were identified. Based on the noise prediction results, noise monitoring locations were selected to represent the potentially most affected noise sensitive receptors in each NCA, and to correlate with noise monitoring conducted prior to the road opening to traffic to enable direct comparisons where possible. Furthermore, additional noise monitoring locations were selected based on comments and complaints received from the community.

With all of the above in mind, a noise monitoring program was prepared entitled "Albury Wodonga Hume Freeway – Post-Construction Noise Monitoring Program" which outlined the proposed post-construction noise monitoring program and was submitted to the RTA and DECC for comments. After incorporating comments received from the RTA and DECC, the final program was released dated 22 May 2007.

7.1 Noise Monitoring Methodology

The assessment of road noise post-construction is more complex than simply measuring noise levels and comparing these to the project's noise criteria.` An integrated approach is required which includes long-term and short-term noise monitoring, traffic counting, and noise modelling. While noise measurement can quantify the current traffic noise levels produced by the current volume of traffic, noise modelling is also required to determine future noise levels for the design year (year 2017), and noise levels at locations where noise monitoring is not conducted. Traffic count data is used as an input to the noise model therefore traffic count data (vehicle volumes, composition and speeds) were collected concurrently with the noise monitoring.

Furthermore, comparison of measured and modelled noise levels also allows validation of the noise model used during the design phase of the project and enables the adequacy of the implemented noise mitigation to be thoroughly assessed.

The noise monitoring and assessment procedures followed in this study are in accordance with the requirements of the RTA's ENMM's 'Practice Note VIII - Post Construction Noise Monitoring', and where variations were necessary, these are noted and justified.

7.1.1 Long-Term Noise Monitoring

All long-term noise monitoring was conducted using Renzo Tonin & Associates' noise loggers. This noise monitoring equipment complies with Australian Standard 1259.2-1990 "Acoustics - Sound Level Meters" and is designated as a Type 2 instrument suitable for field use.

A noise monitor consists of a sound level meter and a computer housed in a weather resistant enclosure. Ambient noise levels are recorded at a rate of 10 samples per second. Every 15 minutes, the data is processed statistically and stored in memory.

A noise monitor was installed at each nominated monitoring location positioned 1m from the most affected facade and at a height of 1.2m to 1.5m above the floor level for a minimum of 7 consecutive days in accordance with the RTA's ENMM. In some instances, where access restrictions were found in the field, the noise monitor was positioned at the next best location and appropriate adjustments were made to the measured noise levels.

7.1.2 Short-Term Noise Monitoring

Short-term noise monitoring used Type 1 sound level meters. Short-term monitoring was conducted at selected 'satellite' locations nearby to the long-term monitors, and concurrently with the long-term noise monitoring. Short-term noise monitoring was undertaken for a minimum of two consecutive 15-minute sample periods at each 'satellite' location.

This type of attended monitoring allows for qualitative assessments to be conducted, which assists in characterising the ambient noise environment of each area and notes were made on any acoustically significant issues found at each subject site.

7.1.3 Noise Monitors

All acoustic instrumentation employed for the noise monitoring program are designed to comply with the requirements of AS 1259.2-1990 "*Acoustics - Sound Level Meters Part 2: Integrating - Averaging*" and carry appropriate and current NATA (or manufacturer) calibration certificates.

7.1.4 Meteorology During Monitoring

Measurements affected by extraneous noise, wind (greater than 5m/s at the microphone) or rain were excluded from the recorded data. Meteorological data supplied by The Bureau of Meteorology was analysed for this purpose.

Noise enhancing or noise diminishing meteorological conditions from winds and temperature inversions do not form part of the requirements of the ECRTN. Furthermore, the ENMM states the following:

> *'…in most cases the distances involved in traffic noise impact assessments are less than 300 metres from the road, and meteorological conditions have little impact on traffic noise problems over these short distances'.*

Given that the ECRTN, the ENMM and importantly the Project's previous environmental documents (eg EIS), do not stipulate the evaluation of road traffic noise under noise enhancing/diminishing meteorological conditions, and the worst affected residences are typically closer than 300 metres, the inclusion of weather effects in assessing noise levels is not a requirement. Also, given that most of the traffic noise monitoring was undertaken at distances within 300m from the Project, noise enhancing or noise diminishing meteorological

conditions would have little impact on the measured traffic noise levels. Notwithstanding the above, at the few locations where noise monitoring was conducted beyond 300m from the road, due consideration was given to the meteorological effects occurring during the noise monitoring period.

7.1.5 Noise Monitoring Outputs

Noise monitoring stored L_{A90}, $L_{Aeq,15hr}$, $L_{Aeq,9hr}$ and $L_{A,max}$ noise levels as a minimum on a continuous basis at 15-minute intervals. While measurement results for all these indices are retained, the study primarily focuses on the L_{Aeq} results as this is the noise assessment index embodied in the NSW Government 'Environmental Criteria for Road Traffic Noise'.

Upon processing the noise monitoring data, any 'suspect' data influenced by factors other than road traffic noise such as adverse weather conditions, industrial, commercial, domestic, insects, fauna or other extraneous noise sources unrelated to the project were excluded.

7.2 Noise Monitoring Locations

Long term and short term 'satellite' noise monitoring was undertaken at locations selected to represent:

- each Noise Catchment Area (NCA),
- previously monitored locations,
- the same locations used for the pre-construction and pre-opening noise monitoring where possible,
- areas where noise modelling for the future year, 10 years after road opening (year 2017) had indicated that noise levels would be marginally within 2dB(A) of the set noise criteria, and
- areas where noise complaints have been received.

Where possible, priority and focus for selection of measurement locations was given to properties where complaints had been received from the community. This provides an opportunity to address specific areas of concern raised by the community promptly and responsively. As far as practical, measurement locations were also selected at complainant's properties in order to provide information that would be most relevant to addressing the specific issues raised by these residents. Complainant's properties were also considered in prioritising the short-term 'satellite' monitoring locations.

Once these complainant locations were identified, additional locations were selected to achieve a relatively even distribution of survey locations within each NCA. Close spacing of locations ensured confidence in the interpolation of noise levels at intervening properties where no specific noise measurements were conducted.

As well as having regard to the pre-construction and pre-opening measurement locations and the prioritisation of complainant residences, the noise monitoring locations were selected with the aim of providing relatively evenly-spaced coverage of affected properties nearest to the

road corridor (including project-affected adjoining roads). Various noise monitoring locations were selected to represent properties located behind noise barriers. These locations would provide an indication of the adequacy of the traffic noise mitigation measures provided (ie. the acoustic benefits provided by the noise barriers).

In a few situations where it was not possible to conduct noise monitoring at the previously chosen locations, noise monitors were setup within close proximity to the originally selected locations. In these few situations, noise monitoring was not conducted at the pre-selected locations because of issues concerning accessibility, availability of a secure location for equipment, potential influences from extraneous local non-traffic noise sources (eg domestic animals, residential air-conditioning units, pool pumps, etc), the Project causing different locations to be worst-affected than before, the Project causing a different façade at the same address to be worst-affected, presence of architectural elements that may impact on the measurements (such as newly constructed out-buildings, covered verandahs, large awnings etc) and the like.

7.2.1 Pre-Opening Long-term Noise Monitoring Locations

Noise monitoring was conducted after the road was constructed but prior to the road opening to traffic at a number of locations along the route. Pre-opening monitoring was completed in February 2007 just prior to the road opening, and once temporary road closures had ended and local traffic was flowing normally.

The intention of undertaking this noise monitoring was to allow comparisons to be made 'before' and 'after' project opening to assist in quantifying the noise attributable to the project.

Given that some minor construction work was still underway during that monitoring period only night-time noise levels were analysed as construction did not generally occur during night time in the vicinity of the noise monitoring.

7.2.2 Post-Construction Operational Long-term Noise Monitoring Locations

Following a review of the proposed monitoring program by the RTA and DECC, post-construction operational noise monitoring commenced in May 2007 and ended in August 2007.

The monitoring was generally conducted in four zones, with one zone monitored at a time. The zones are as follows, starting at the southern end of the Freeway:

- Zone 1 – Murrray River to Kenilworth St
- Zone 2 – Kenilworth St to North St
- Zone 3 – North St to Corrys Rd
- Zone 4 – Corrys Rd to northern limit of works

The selected locations for post-construction operational long-term (unattended) noise monitoring are listed in Table 6 below. The long-term (unattended) monitoring locations are marked in 'blue' on the maps contained within **Appendix C**.

Table 6 – Post-Construction Operational Long-term Noise Monitoring Locations

NCA	Long Term Monitoring Locations
1	Maryvale
2	residential property *(address intentionally removed from public display)*
3	151 Hume Hwy
Thurgoona	19 Winnel Court
	residential property *(address intentionally removed from public display)*
7	16 Corrys Road
8	12 Mountain View Drive
9	23 Horan Court
	296 Racecourse Road
10	997 Carcoola St reet
	919 Tullimbar St
11	Albury Central Tourist Park, 286 North St - Managers residence
	318 Tribune Street
12	Scots School – Demountable classroom
	Scots School – amenities block
13	634 Short St- Borella Rd facade
	331 Cadell Street
	307 Cadell Street
14	349 Borella Road
	614 Broad Street
	587 Broad Street
	495 Hanel Street
	2/ 377 Woodstock Court
	384 Amatex Street
	residential property *(address intentionally removed from public display)*
	26 Pilbara Place
15	185 Olive Street
	443 Atkins St
16	328 Macauley Street
	355 Charles Street
18	257 East Street
	31 Alison Court

7.2.3 Short-term Noise Monitoring Locations

The selected 'satellite' locations for post-construction operational short-term (attended) noise monitoring are listed in Table 7 below. Short-term monitoring locations are shown in 'orange' on the maps contained within **Appendix C**.

Short term monitoring conducted in four zones in conjunction with the long-term monitoring. The zones are identical to those chosen for the long-term monitoring locations and are presented in Table 7.

Table 7 – Post-Construction Operational Short Term Attended 'Satellite' Noise Monitoring Locations

NCA	Short Term Monitoring
2	Lot 11 Davey Road
5	507 Hume Hwy
Thurgoona	41 Daysdale Way
	residential property *(address intentionally removed from public display)*
7	48 Corrys Road
8	22 Mountain View Drive
9	65 Dowling Court
	5 Hicky Lane
10	959 Carcoola Street
	120 Wantigong Street
11	338 Tribune St reet
	Albury Central Tourist Park, 286 North St – van sites
13	322 Borella Road
14	362 Wilson Street
	379 Wilson St reet
	378 Rau Street
	376 Kenilworth Street
	383 Centenary Street
	1/366 Woodstock Court
	358 Amatex Street
15	3/186 Abercorn Street
	2/156 Abercorn Street
	1/450 Nurigong Street
16	residential property *(address intentionally removed from public display)*
	367 Charles Street
18	9 Alison Court
	44 Alison Court
	6 Murray View Road

7.2.4 Complaints-Driven Noise Monitoring Locations

Consideration was given to monitoring of noise levels where complaints of traffic noise have been received and the monitoring locations listed above include locations selected based on complaints. The noise complaint database held by Abigroup was reviewed and each complaint location was sighted to determine the appropriateness of that location for monitoring. In areas where monitoring was to take place, a complainants house was selected if suitable.

In order to provide noise monitoring data at as many complaint locations as possible, a long term noise monitor along with short term 'satellite' locations were used where monitoring was required at several locations within the same NCAs.

7.3 Traffic Volumes, Classification and Speed Monitoring

7.3.1 2007 Traffic Data

Traffic volumes, classification of vehicles and vehicle speeds were monitored concurrently with the noise monitoring. This is a requirement of Practice Note VIII of the RTA's ENMM and the data allows final noise levels to be compared to the SWTC traffic data used as inputs to the noise modelling.

The locations where traffic counting was conducted are listed below.

Main Alignment

Site 1 –	on Hume Freeway north of Davey Road
Site 2 –	on Hume Highway between Davey Road and Thurgoona Drive
Site 3 –	on Hume Highway between Thurgoona Drive and Corrys Road
Site 4 –	on Hume Highway between Corrys Road and Borella Road
Site 5 –	on Hume Highway between Borella Road and East Street
Site 6 –	on Hume Highway between East Street and Murray River

Ramps

Site 7 –	all 4 ramps at Borella Rd interchange
Site 8 –	all 4 ramps at Bridge St interchange

Local roads

Site 9 –	Borella Road just South of Electra Street
Site 10 –	Atkins St Link Road (north)
Site 11 –	Atkins St Link Road (south)
Site 12 –	Thurgoona Dr (east of freeway before roundabout)
Site 13 -	Elizabeth Mitchell Dr (north of Thurgoona Dr)
Site 14 -	Elizabeth Mitchell Dr (south of Thurgoona Dr)
Site 15 -	Union Road Link

Table 8 presents the counted 2007 night-time (9hr) traffic volumes at various locations along the upgrade used to validate the noise model against the concurrently measured 2007 monitored noise levels. The dates shown represent the specific periods that the noise monitoring was conducted for each monitoring zone.

The night-time (9hr) volumes are presented herein because it is the night-time noise criteria that control the design of noise mitigation measures for this Project, as discussed in the ONMP.

Table 8 – Counted 2007 Night-time (9hr) Traffic Volumes used for Noise Model Validation

Location	Counted 2007	
	Total Vehicles	Heavy Vehicles
Zone 1 - 22 to 28 May 2007		
Northbound off ramp to Bridge St	277	28
Northbound on ramp from Bridge St	91	23
Southbound off ramp from Bridge St	127	25
Southbound on ramp from Bridge St	309	34
Old Albury Hwy North of Bridge St	493	30
Old Albury Hwy South of Bridge St	336	91
Hume Freeway between Bridge St and Murray River	3283	1116
Hume Freeway between Bridge St and Borella Rd	2947	1120
Zone 2 - 29 May to 4 June 2007		
New Albury Fwy Northbound Off Ramp	462	79
New Albury Fwy Northbound On Ramp	185	9
New Albury Fwy Southbound Off Ramp	155	25
New Albury Fwy Southbound On Ramp	351	39
Riverina Hwy East of Short St	923	83
New Albury Freeway North of Riverina Hwy	2634	922
New Albury Freeway South of Riverina Hwy	3107	1025

Location	Counted 2007	
	Total Vehicles	Heavy Vehicles
Zone 3 - 12 June to 18 June 2007		
New Albury Fwy Off Ramp to Racecourse Rd	339	41
New Albury Fwy On Ramp to Racecourse Rd	390	39
Union Rd 500m South of Racecourse Rd	601	60
New Albury Freeway South of Racecourse Rd	3106	652
Zone 4 - 22 June to 29 June 2007		
New Albury Northbound Entry Ramp	151	77
New Albury Northbound Exit Ramp	329	69
New Albury Southbound Entry Ramp	407	94
New Albury Southbound Exit Ramp	112	64
Elizabeth-Mitchell Dr North of Thurgoona Dr	75	7
Elizabeth-Mitchell Dr South of Thurgoona Dr	227	23
Thurgoona Dr West of Elizabeth-Mitchell Dr	708	42
New Albury Fwy North of Thurgoona Dr	1620	875
New Albury Fwy South of Thurgoona Dr	2092	900

7.3.2 2017 Traffic Data

It is noted that the assessment of noise from the Project is based on predicted traffic volumes for 10 years after the opening of the Project. Traffic data presented in the SWTC is for a design year of 2017.

Once the noise model was validated using the 2007 noise monitoring results and the 2007 traffic volumes presented above, noise predictions for year 2017 were conducted using the night-time (9hr) 2017 traffic volumes provided by the RTA in the SWTC and presented below in Table 9.

Table 9 – 2017 Night-time (9hr) Traffic Volumes used for Post-Construction Noise Assessment

Road Section	SWTC 2017	
	Total Vehicles	% Heavy Vehicles
New Albury Freeway		
Hume Hwy	2364	70
Hume Hwy to Thurgoona Drive	2154	77
Thurgoona Drive to Corrys Rd	3339	51
Corrys Rd to Borella Rd	3777	45
Borella Rd to Bridge St	3921	44
Bridge St to Murray River	5516	33
Major Adjoining Streets		
Thurgoona Dr	1422	5

Road Section	SWTC 2017	
	Total Vehicles	% Heavy Vehicles
Union – Dallinger Link Road	534	2
Borella Rd	1757	5
Bridge St	2058	5
Young – Atkins Link	2142	5
Corrys Road Ramps		
Southbound On Ramp	242	2
Northbound Off Ramp	195	5
Thurgoona Drive Ramps		
Southbound Off Ramp	45	31
Southbound On Ramp	666	5
Northbound Off Ramp	335	5
Northbound On Ramp	36	21
Borella Road Ramps		
Southbound Off Ramp	507	3
Southbound On Ramp	562	6
Northbound Off Ramp	578	7
Northbound On Ramp	481	3
Bridge Street Ramps		
Southbound Off Ramp	104	8
Southbound On Ramp	998	6
Northbound Off Ramp	905	3
Northbound On Ramp	102	4

8. NOISE ASSESSMENT METHODOLOGY

8.1 Overview

The steps followed in this post-construction operational noise assessment process were:

- Measure traffic noise levels during operation of the road at locations representative of a group of properties located in the vicinity of the noise monitoring location,
- Measure traffic volumes, classifications and speeds concurrently with noise monitoring,
- Validate the noise model that was established during the design phase of the project using the measured noise levels and measured traffic data,
- Using the validated noise model, determine the post-construction 2017 noise levels at the sensitive receivers and determine the difference between the post-construction 2017 noise levels and the design stage predicted 2017 noise levels for each sensitive receiver,
- Determine where the variance between the design noise model and the post-construction noise model are greater than +2dB(A) [representing acceptable error for noise prediction modelling as per Practice Note VIII of ENMM],
- Using the validated noise model, compare the 2017 post-construction noise assessment traffic noise levels against the Project's noise objectives to determine the adequacy of the implemented noise mitigation for the design year, and
- Determine if there is a clear trend in traffic noise levels being higher than predictions and where additional noise treatments may be required if reasonable and feasible.

More details are provided below on the handling of measured noise levels and in assessing compliance and outcomes of this study.

8.2 Measured Noise Levels

To determine 'measured' (year 2007) noise levels at potentially affected properties in each NCA, generally the following steps were carried out:

- The recorded short-term $L_{Aeq(15\ minute)}$ noise level measured over two 15minute periods at each 'satellite' location were correlated to the closest and/or most representative long-term noise monitoring location where $L_{Aeq(9hour)}$ noise levels were measured over 7 nights. This was done by obtaining the difference between the corresponding L_{Aeq} noise levels recorded at the closest and/or most representative long-term location and the L_{Aeq} levels recorded at the 'satellite' or short-term locations on the same night during the corresponding 15 minute periods.

- These differences (whether positive or negative) were then applied to the overall night-time year 2007 long-term $L_{Aeq(9hour)}$ noise level to give a correlated $L_{Aeq(9hour)}$ at the 'satellite' noise monitoring locations. That is, as if there had been a long-term noise monitor at the 'satellite' or short-term measurement location.
- Thereby, an equivalent, year 2007 $L_{Aeq(9hour)}$ noise level was derived for each 'satellite' noise measurement location.
- Where no noise monitoring was undertaken at a property which is considered sensitive and relevant, an effective year 2007 $L_{Aeq(9hour)}$ noise level was modeled to that location using a noise model calibrated to the results of the nearest measurement locations.

Furthermore, it is also noted that in this assessment, a greater emphasis was placed on long-term noise monitoring results rather than on short-term monitored results when determining outcomes, because long-term monitoring better handles short-term sporadic traffic fluctuations.

8.3 Compliance Assessment

8.3.1 General

Noise predictions are based on a method developed by the United Kingdom Department of Environment entitled "Calculation of Road Traffic Noise (1988)" known as the CoRTN (1988) method. This method has been adapted to Australian conditions and extensively tested by the Australian Road Research Board and as a result it is recognised and accepted by the RTA, DECC and DoP. The model predicts noise levels for steady flowing traffic and noise from high truck exhausts is also taken into account.

The CORTN algorithms are contained within the 'SoundPLAN' noise modelling software. SoundPLAN noise level calculations consist of a source model and propagation calculations. SoundPLAN can generate noise levels at single points in the model with roads as noise sources. It can also generate noise contours by performing point receiver calculations on a grid of points and interpolating for noise levels between the grid points.

The Renzo Tonin & Associate's SoundPLAN noise model, using the Calculation of Road Traffic Noise (CoRTN, 1988, UK) road traffic noise prediction algorithms, was used during the project's design phase to predict the design year (2017) noise levels. This same SoundPLAN model was used in the 'normalising' process (incorporating any changes to as-built roadway acoustical features that changed from the original design features). The model includes inputs of topography, buildings, road surface, road design, landscape/noise mounds and noise walls.

To assess compliance and outcomes, the general approach followed was:

- Measure road traffic noise levels over a representative survey period as described above and averaging the noise levels logarithmically over that period where appropriate (long term surveys).
- Measure the traffic flow and mix characteristics prevailing at the exact time as the noise measurements (averaging over several days for the long term surveys).
- Calibrate the measured noise levels to the traffic flows, compositions and speeds measured on the same nights as the noise measurements.
- Enter the actual 2007 traffic flow data into the project's SoundPLAN computer model, to determine the difference between the measured 2007 noise levels and the SoundPLAN-generated 2007 noise levels.
- Apply the difference to the 2017 modelled noise levels (using the design traffic flow figures provided in the SWTC for year 2017), to arrive at the 2017 post-construction assessment noise levels.
- Compare the 2017 post-construction assessment traffic noise levels with the 2017 traffic noise levels predicted during the design stage noting any variances greater than +2dB(A).
- Where exceedances to the project noise criteria are found and/or shortfalls to the applied noise mitigation treatments, additional noise treatments are identified and to be offered where reasonable and feasible.

8.3.2 Step-by-Step Description of Methodology

The operational noise compliance monitoring procedures involve many steps and are not simply a case of deploying noise survey equipment and observing the measured noise levels. Site inspections were conducted to check that the *as-built* form of in-corridor noise mitigation measures conformed to the original *as-modelled* design (which eliminates significant physical discrepancies as a possible cause of any variances).

Below is a step-by-step description of the methodology that was applied once the noise survey equipment had been retrieved from a residence and the results were downloaded and analysed:

In order to take into account:

- Variances in traffic flows during the noise survey periods at different residences; and
- Variances in traffic flows on the nights of measurement and the 2017 ONMP predicted traffic flows,

the following formulae has been used at all residences in the assessment:

2017 A = (2007 M - 2007 C) + 2017 D

where:

- **2007 M** = “Measured 2007” - the noise level measured over the noise survey period.
- **2007 C** = “Computed 2007” - this involves entering the actual traffic volumes, compositions and speeds measured during the noise survey period into the Project SoundPLAN model and computing the traffic noise level.
- **2017 D** = “Design 2017” - the noise level from the Project SoundPLAN design model with the 2017 traffic volumes, compositions and speeds (ie as per the ONMP).
- **2017 A** = “Assessed 2017” - this is the bottom line noise level on which conformance with design intent is determined and consideration of possible further acoustical treatment is based.

The variance or difference found between the measurements and the model, which establishes the accuracy of the noise model used in the acoustic design of the Project is determined by:

2017 V = (2017 D - 2017 A)

where:

- **2017 V** = “Variance” or difference between measurements in the field and the model
- **2017 D** = “Design 2017 SoundPLAN Noise Level from ONMP” - the noise level from the Project design model (ie as per the ONMP).
- **2017 A** = “Assessed 2017 Noise Level” - this is the noise level on which conformance with design intent is determined and consideration of possible further acoustical treatment is based.

Worked Example

▪ 2007 M = 52.0 dB(A)	traffic noise level measured over the noise survey period in 2007 relevant to the assessment location
▪ 2007 C = 51.1 dB(A)	computed 2007 SoundPLAN raw traffic noise level using the actual traffic volumes, compositions and speeds measured during the noise survey period at the same assessment location
▪ (2007 M - 2007 C) = (52.0 – 51.1) = 0.9dB(A)	traffic noise modelling adjustment (physical discrepancies between computer model and 'real-life' situation with same traffic flows) at the assessment location
▪ 2017 D = 52.8 dB(A)	design 2017 traffic noise level from the SoundPLAN design model with the 2017 traffic volumes, compositions and speeds (ie as per the SWTC and ONMP) at the assessment location
▪ 2017 A = 0.9 + 52.8 = 53.7 dB(A)	'assessed 2017' noise level on which conformance with design intent is determined and consideration of possible further acoustical treatment is based upon at the assessment location

Conformance with the design intent (and consideration of possible further acoustical treatment) is determined by comparing 2017 A with 2017 D and calculating the variance 2017 V and comparing the final 2017 A traffic noise level to the project noise level objectives:

2017 V = (2017 M - 2017 D)

2017 V = 53.7 - 52.8 dB(A) = 0.9 dB(A)

In this case therefore, the "Design 2017" traffic noise level of 52.8 dB(A) was an under-prediction of the actual acoustical outcome of 53.7 dB(A) - ie the "Assessed 2017" of 53.7 dB(A) at this residence is 0.9 dB(A) higher than the 52.8 dB(A) level predicted during the design stage of the Project. However, given that the "Design 2017" level is within an accepted tolerance of 2dB(A) to the "Assessed 2017" level, then this is deemed to conform to the design

intent. Furthermore, this residence would not require consideration for an increase in the noise treatment nominated for it during the design stage (as per the ONMP).

9. RESULTS OF ROAD TRAFFIC NOISE ASSESSMENT

9.1 Model Evaluation

The graph below shows the accuracy of the design noise model in terms of the variance between the post-construction assessment model and the design model, ie 2017 'Assessed' noise levels compared to the 2017 'Design' noise levels at the monitored locations. The graph shows that:

- The traffic noise level outcomes achieved at approximately 87% of monitored locations were within plus or minus 2 dB(A) of the design noise levels.
- About 40% of monitored locations received an acoustical outcome lower than the design noise levels.
- Approximately 96% of monitored locations experience traffic noise levels that do not exceed the design noise levels by more than +2 dB(A).
- Only 4% of monitored locations have variances exceeding +2 dB(A).

The close agreement between predicted and actual operational noise outcomes indicates the robustness of the acoustical design and construction of the roadway as described in the ONMP.

No *'clear trend in traffic noise levels which are higher than the general predictions'* [5] made during the design stage was found.

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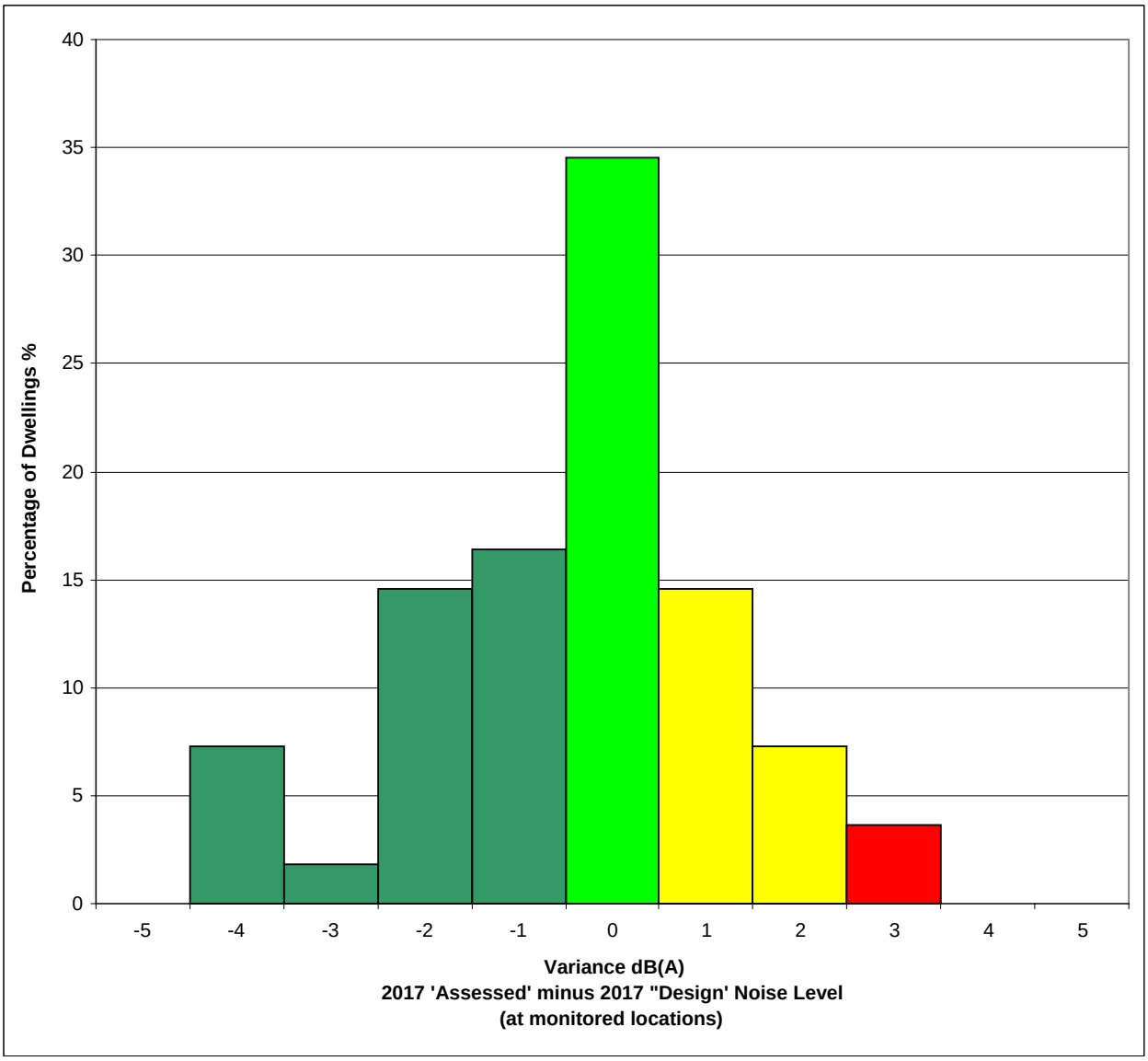
Figure 1 – Design Model Accuracy: Variance of 2017 'Assessed' and 2017 'Design' Noise Levels (at monitored locations)



9.2 Summary of Post-Construction Noise Assessment

The post-construction noise assessment conducted at the 339 dwellings in the 19 NCAs shows the following operational traffic noise outcomes:

- 12 of the 19 NCAs contain no dwellings which qualified for additional treatment consideration.
- About 203 of the 339 dwellings received a lower level of traffic noise than was predicted in the ONMP.
- Approximately 333 of the 339 dwellings experience traffic noise levels that do not exceed those predicted in the ONMP by more than +2dB(A).
- Only 6 of the 339 dwellings have variances exceeding +2dB(A).

A summary of the results of this post-construction traffic noise assessment and treatments is shown in the table below. Detailed results are contained in Appendix C.

The results show that at 20 dwellings, the predicted outcome was such that consideration of further acoustical treatment is warranted.

Table 10 – Summary Results of Dwelling Assessment for Further Treatment

NCA	Number of dwellings assessed	No further treatment required	Fresh air ventilation only	Fresh air ventilation + sealing of facade	Fresh air ventilation + sealing of facade + upgrade of windows and doors
1	1	1	0	0	0
2	3	2	1	0	0
3	2	2	0	0	0
4	No Dwellings				
5	1	0	0	1	0
Thurgoona	4	4	0	0	0
6	No Dwellings				
7	8	3	4	1	0
8	33	30	3	0	0
9	24	20	4	0	0
10	5	5	0	0	0
11	10	10	0	0	0
12	4	4	0	0	0
13	31	29	0	2	0
14	117	113	4	0	0
15	28	28	0	0	0
16	40	40	0	0	0
17	No Dwellings				
18	28	28	0	0	0
TOTALS	**339**	**320**	**16**	**4**	**0**

Although 20 dwellings have been nominated for consideration of further treatment, issues that may arise to determine whether these dwellings receive further treatment are:

- the dwellings may already have the nominated treatment (eg fresh air ventilation and sealed facades)
- the noise-exposed facades may not be “habitable rooms” (eg bedrooms, living rooms, etc)
- there may not be any windows or doors on the exposed facades
- the dwellings may not have wall vents
- the property owners reject the offers of additional treatment.

The final acoustical treatment to be offered will require detailed inspections of each dwelling to determine the appropriate extent of treatment. In some cases, consideration for additional treatment may apply to both floors of a two-storey dwelling.

In summary, all dwellings found through this assessment as exceeding the Project's noise level objectives, have been identified and are to be offered acoustic treatment. In this entire Project, only one dwelling was found to have 'acute' noise levels and this is also offered acoustic treatment.

Investigations at these dwellings have found that the treatment of individual dwellings is more effective than in-corridor noise mitigations. For example, additional noise barriers were considered and found to not provide significant benefits at the above listed locations due to various factors including:

- Layout and vertical alignment positions of dwellings in relation to the road
- Large distances to roadway
- Dispersed positions of dwellings identified for treatment
- Not feasible due to less than 5dB(A) attenuation required for the majority of dwellings identified for treatment

9.3 Discussion on Complaints

In regard to the noise issues of concern raised by the community in the period post-opening the Project, the following observations have emerged during the study and comments are provided below:

- Parts of this Project involved the redevelopment of an existing highway corridor, through areas where receivers were previously affected by traffic noise and ambient noise levels were generally moderate to high. For these parts noise receptors were previously exposed to significant road traffic noise and therefore less complaints have arisen post-opening.
- A large part of the Project involved the construction of a new road through an area where receivers were not previously exposed to significant road traffic noise. Therefore, in such areas complaints arose once the Project was completed and in operation. Although traffic noise levels may comply with the Project's noise level objectives and goals, the increase in the ambient noise levels may have been significant and initial complaints may have occurred as a result of residents suddenly being exposed to a significant increase in ambient noise levels.
- A high proportion of complainants were concerned about the noticeable change in the character of the traffic noise environment in areas where little or no traffic noise existed prior to the Project. This issue is recognised as a consequence of traffic

thoroughfares constructed through road reservations that have developed quiet characteristics over many years.

- Some complaints related to the disturbance caused by heavy vehicles, particularly at night-time. Background noise levels at night-time fall to low levels (possibly even similar to the low background levels prevailing prior to the freeway). This low background noise environment is then punctuated by high noise levels of individual trucks travelling along the highway, including the use of engine brakes. The issue of night-time sleep disturbance is recognised as a major problem along major arterial roads, especially in rural or quiet suburban areas where the emergence of truck engine and engine-brake noise levels punctuate low background noise environments. National Standards and draft regulations aim to address heavy vehicle noise over time. In the meantime, some acoustical management is achieved through driver education programs and the use of advisory signage warning drivers not to use engine-brakes in built-up residential areas.

10. RAIL TRAFFIC NOISE ASSESSMENT

The Great Southern Rail Line is located adjacent between the Scots School boundary and the new freeway. During the early planning stages of the project it was agreed that part of the acoustic design would include a noise wall along the boundary of Scots School that was intended to provide both traffic noise mitigation for the new freeway, as well as some reduction in rail noise.

However, during the detailed design of roadside noise walls for the new freeway, it was determined that a noise wall at the rear boundary of Scots School would not provide sufficient traffic noise attenuation, mainly due to the height of the roadway and Borella Road ramps relative to the school.

As part of the noise mitigation strategy for the Albury-Wodonga Hume Freeway road project, noise barriers were erected at various locations along the road corridor to enable the traffic noise goals for the project to be met. This includes noise barriers along the northbound on ramp to the new bypass at the Borella Road interchange, which are adjacent to the Scots School.

Noise monitoring was first conducted at the school in March 2005 and train passby noise levels were recorded. Recently, in February 2007, noise monitoring was conducted again at the same location, this time with the freeway noise barriers in place. Since the new freeway was not yet in operation during the recent monitoring period, noise levels can be compared with and without the freeway barriers.

This Chapter examines noise impacts at the Scots School in relation to rail noise. Given that the distance and general layout of the land between the rail line and the School's nearest receiver locations and monitoring location is very similar to the residential area north along the rail line at Tribune Street, the results and findings of this assessment are also directly applicable to the Tribune Street area.

10.1 Rail Noise Criteria

Since the Albury-Wodonga Hume Freeway project is a road project, no specific rail noise levels are required to be achieved at Scots School. However, to allow for an assessment of train noise, current NSW rail noise criteria are presented below.

10.1.1 SRA / RIC Criteria

Part B, Section 7 of the State Rail Authority (SRA) / Rail Infrastructure Corporation (RIC) "Guidelines for Councils - Consideration of Rail Noise and Vibration in the Planning Process" states that:

> *"It is recommended that new residential buildings be designed and constructed to comply with the following design criteria in habitable rooms, with external*

windows and doors closed. If noise levels with windows or doors open exceed these criteria by more than 10dB(A), the design of ventilation of these rooms should be such that occupants can leave windows closed, if they so desire."

The noise criteria provided by the SRA/RIC are internal criteria with windows closed. The equivalent external noise criteria, assuming 20dB(A) reduction outside to inside with windows closed, is presented in Table 11.

Furthermore, the SRA / RIC noise goals apply to residences and not schools. Since a classroom is not residential, an adjustment to the external criteria has been made taking guidance from AS2107 "*Acoustics – Recommended design sound levels and reverberation times for building interiors*" and DECC's '*Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects'* dated April 2007.

Table 11 – Train Noise Criteria for Scots School

Internal Space	Time Period	Internal Goal for School Classrooms (Based on SRA / RIC Guidelines for residences, with windows and doors closed) 1 LAeq, (1 hour)	Equivalent External Goal for School Classrooms 2 LAeq, (1 hour)
Living and Sleeping areas	Day (7am to 10pm)	45dB(A)	65dB(A)

Note: 1. Acceptable maximum classroom levels are 5dB(A) greater than the recommended maximum noise levels in residential living areas according to AS2107 and Schools are permitted noise trigger levels up to 45dB(A) LAeq(1hr) according to DECC's Interim Guideline referred to above.

2. Assuming a conservative 20dB(A) noise reduction from outside to inside through a closed window.

Also, an external noise goal of 65dB(A) for rail noise corresponds well to the 45dB(A) internal goal for existing classrooms from p12 of the NSW EPA's (now DECC) 'Environmental Criteria for Roads Traffic Noise (ECRTN)' assuming 20dB(A) reduction with windows closed.

Since the school classrooms are in use only during the day period, rail noise assessment here applies to the day period only.

10.1.2 DECC Criteria

Reference is made to the NSW Department of Environment and Climate Change (DECC) '*Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects'* dated April 2007. External trigger levels for noise from rail traffic for residential receivers are presented for both new and redeveloped existing rail lines.

As the Great Southern Railway is an existing rail line and rail noise is being assessed to an existing school and residences, guidance is obtained in setting the applicable noise assessment criteria based on the redeveloped existing rail line noise trigger levels as presented in DECC's interim guideline.

Residential

DECC's interim guideline suggests the following noise trigger levels for residences along existing rail lines:

Day $L_{Aeq(15h)}$ = 65dB(A)

Night $L_{Aeq(9h)}$ = 60dB(A)

L_{Amax} = 85dB(A)

Importantly, the interim guideline defines the L_{Amax} as the maximum noise level not exceeded for 95% of rail pass-by events, which means that up to 5% of rail pass-by events can exceed 85dB(A).

The interim guideline also defines an 'increase' in existing rail noise levels to be *'an increase of 2dB(A) or more in L_{Aeq} in any hour or an increase of 3dB(A) or more in L_{Amax}'*.

Schools & Educational Institutions

DECC's interim guideline also suggests the following internal noise trigger level for schools and educational institutions along existing rail lines:

$L_{Aeq(1h)}$ = 45dB(A)

Assuming 20dB(A) noise reduction with windows closed, the equivalent external noise trigger level for schools and educational institutions along existing rail lines is $L_{Aeq(1h)}$ = 65dB(A), which generally aligns with the daytime noise trigger level for residences.

The interim guideline also describes an increase in existing rail noise levels to be *'by 2dB(A) or more in L_{Aeq} in any hour'*.

Places of Worship

DECC's interim guideline also suggests the following internal noise trigger level for places of worship (applicable to the Chapel Hall at Scots School) along existing rail lines:

$L_{Aeq(1h)}$ = 45dB(A)

This is the same noise trigger level set for schools and educational institutions along existing rail lines.

Assuming 20dB(A) noise reduction with windows closed, the equivalent external noise trigger level for places of worship along existing rail lines is $L_{Aeq(1h)}$ = 65dB(A), which generally aligns with the daytime noise trigger level for residences.

The interim guideline also describes an increase in existing rail noise levels to be *'by 2dB(A) or more in L_{Aeq} in any hour'*.

Summary

Due to the low number of train pass-bys, the external $L_{Aeq(1h)}$ 65dB(A) for schools is considered more stringent than both the Day $L_{Aeq(15h)}$ 65dB(A) and Night $L_{Aeq(9h)}$ 60dB(A) for residences, therefore is used in this assessment.

Importantly, there is no L_{Amax} noise trigger level suggested for schools and educational institutions and places of worship, however L_{Amax} noise levels are assessed herein as the assessment would apply to residences located north of Scot School with a similar distance and view to the rail line.

An 'increase' in existing rail noise levels to be *'an increase of 2dB(A) or more in L_{Aeq} in any hour or an increase of 3dB(A) or more in L_{Amax}'*.

10.2 Rail noise assessment

It is estimated from freight and passenger train timetables that up to approximately 22 trains pass the Scots School site in a 24 hour period on the busiest weekday, with typically up to one train pass-by, and at worst two train pass-bys, per hour occurring during school hours.

10.2.1 March 2005 Train Noise Monitoring Results

Long term noise monitoring was carried out on the roof of the demountable classroom nearest to the railway during March 2005. The demountable classroom is located near to the rail line and is representative of the worst affected building at the School. This location is closer to the rail line than the facade of the Chapel Hall. The measured levels from this location would be representative of the highest noise levels at any 2nd storey building facade in close proximity to the rail line. At the ground level train noise levels are expected to be slightly lower than those measured.

Given that noise loggers are unattended instruments left in the field to monitor total noise levels in an environment, and cannot identify noise sources, then not all high noise levels can automatically be attributed to train passbys. For example, a bird perched on the microphone, a screeching bird or flock of birds flying past the microphone, a ball landing on the metal roof next to the logger, a mechanical noise from nearby workshops or vehicles along the driveway or any number of other noise events, can generate high instantaneous peak noise levels.

To determine which peaks were due to trains and which were not, train timetables were referred to so to correlate the train passby times with the times of the measured maximum noise events. In addition to this, it is expected that a noise event caused by a train passby would have a high L_{Aeq} noise level corresponding to a high L_{Amax} noise level. Therefore, through the use of these two methods, the maximum levels from train pass-bys were commonly found to be between L_{Amax} 84 – 88dB(A) at the monitored location, and more likely 85dB(A) at the ground floor (due to this location having less exposure to the rail line and more acoustic shielding).

The measured levels correspond well to the predicted L_{Amax} noise levels of 85dB(A) during the design stage of the Project and confirmed that train pass-by noise levels at that time complied with the set criteria.

10.2.2 Comparison of March 2005 to February 2007 Train Noise Monitoring Results

In addition to conducting noise monitoring on top of a school demountable in March 2005, noise monitoring was again conducted in February 2007. The noise monitor was set up in the same location each time, using photos as a reference. No changes were noticed on the school grounds that might significantly affect the measured noise levels.

The noise monitoring data has been analysed and summarised into Table 12 below. Inclusion of any particular noise peaks from the monitoring results into the data analysis was based on the following:

- The noise peak must coincide with the timetabled train passby, within 15minutes.
- Any L_{Amax} peak must coincide with an elevated L_{Aeq} during the same 15 minute period

Table 12 – Comparison of train Noise Levels

March 2005			Feb 2007		
Date	**Average LAeq,15min**	**LAmax range**	**Date**	**Average LAeq,15min**	**LAmax range**
Thur 17th	64	79 – 87	Thur 8th	61	74 – 87
Fri 18th	64	79 – 88	Fri 9th	62	81
Mon 21st	65	79 – 89	Mon 12th	55	75 – 79
Tue 22nd	63	79 – 90	Tue 13th	59	76 – 83
Wed 23rd	65	77 - 89	Wed 14th	59	74 - 75
Average	**64**	**77 - 90**	**Average**	**60**	**74 - 87**

- The tabulated data shows a decrease in both L_{Aeq} and L_{Amax} noise levels. There is no obvious reason for this decrease. Rather, it is likely just a reflection of the normal variation in noise emission from various trains.
- Even to analyse the noise data without reference to train timetables, and to include all noise peaks assuming all are due to trains, there is no obvious increase in noise levels. In fact the overall ambient L_{Aeq} noise levels have reduced slightly, which may be a result of the freeway noise barriers providing some shielding of Borella Road traffic.
- The measured levels both in 2005 and 2007 correspond well to the predicted L_{Amax} noise levels of 85dB(A) during the design stage of the Project.
- The measured train noise levels with the freeway barriers in place comply with the $L_{Aeq,1hr}$ 65dB(A) criteria and the L_{Amax} 85dB(A) criteria outlined in the rail criteria section above.

10.3 Conclusion

Noise impacts examined at Scots School in relation to rail noise show no increase in train pass-by noise occurred before and after the Project's noise walls were installed and train noise levels are compliant with relevant noise guidelines.

Given that the distance and general layout of the land between the rail line and the monitoring location at the School is similar to the residential area north along the rail line at Tribune Street, the results and findings of this assessment are directly applicable to the Tribune Street area.

The change in train noise reported by the community in these areas may have arisen as a result of the community noticing a change in the character and not necessarily a change to the overall level of train noise.

11. CONCLUSION

Renzo Tonin & Associates (NSW) Pty Ltd completed the compliance monitoring and assessment of road traffic noise at dwellings along the alignment of the Albury-Wodonga Hume Freeway, Ettamogah to Murray River, NSW (the Project) and on adjacent roads upgraded as part of the Project.

Detailed traffic noise measurement and analysis processes were applied to 339 dwellings nearest to the Project carriageways, ramps and nearby local roads (where road upgrading was implemented as part of the Project works). This involved all of the potentially affected dwellings and expanding beyond, with traffic noise measurements and assessments undertaken at large distances from the Project corridor. Assessment areas have been predetermined to include the 339 residences in the post-construction operational traffic noise assessment.

The variances between the originally-intended acoustical outcomes (as per the ONMP) and the actual traffic noise level conditions achieved in practice (based on measurements and investigations) were quantified.

Consideration was given to the reasons for any discrepancies in accordance with the ENMM. The modelling algorithms and data inputs were checked and found to be in order. On-site visual checks established that the as-built in-corridor road noise mitigation measures aligned with those used in the noise model.

The 339 dwellings in the post-construction operational traffic noise assessment were grouped into nineteen (19) different Noise Catchment Areas (NCAs).

The findings of the monitoring and assessment study identified that:

- the actual road traffic noise outcomes at 319 of the 339 dwellings in the assessment localities conform to the predicted outcomes within appropriate margins - and no further acoustical study or treatments are warranted.
- at the remaining 20 of the 339 dwellings, the actual outcomes varied from the predicted outcomes to an extent that warrants more detailed on-site assessment of noise exposure and potential provision of additional noise treatments.

At the 20 dwellings selected for additional treatment, the indicative categories of possible treatment are identified, however further investigation and consultation with the dwelling owners will be required to determine the specifics of each dwelling and extent of treatment necessary. Some of these dwellings were already identified for fresh air ventilation at the design stage, and therefore may only require sealing their facade (eg seal wall vents where they exist) to complete the treatment.

Investigations at these dwellings have found that the treatment of individual dwellings is more effective than in-corridor noise mitigation measures. The noise control treatment categories

that will now need to be considered and investigated in consultation with the owners are shown in the table below.

Types of Additional Noise Control Treatments to be Considered

Potential Type of Noise Control Treatment	Number of Dwellings
Fresh Air Ventilation System	16
Fresh Air Ventilation System + Sealing of Facade	4
Fresh Air Ventilation System + Sealing of Facade + Upgrade of Windows & Doors	0
Total Number of Dwellings Identified for Further Consideration	**20**

In some cases, consideration for additional treatment may apply to both floors of a two-storey dwelling.

Although 20 dwellings have been nominated for consideration of further treatment, issues that may arise to determine whether these dwellings receive further treatment are:

- the dwellings may already have the nominated treatment (eg fresh air ventilation and sealed facades)
- the noise-exposed facades may not be “habitable rooms” (eg bedrooms, living rooms, etc)
- there may be no “acoustically weak” windows or doors on the exposed facades
- the property owners reject the offers of additional treatment.

In summary, all dwellings found through this assessment as exceeding the Project’s noise level objectives (including any exposed to ‘acute’ noise levels), were identified for acoustic treatment.

Other conclusions that can be drawn from the analysis of the operational noise outcomes at the 339 dwellings in the 19 Noise Catchment Areas are:

- 12 of the 19 NCAs contain no dwellings which qualified for additional treatment consideration.
- About 203 of the 339 dwellings received an acoustical outcome lower in noise impact than was predicted in the ONMP.
- Approximately 333 of the 339 dwellings experience traffic noise levels that do not exceed those predicted in the ONMP by more than +2dB(A).
- Only 6 of the 339 dwellings have variances exceeding +2dB(A).

The close agreement between predicted and actual operational noise outcomes indicates the robustness of the acoustical design and construction of the roadway as described in the ONMP.

It was found that there was no *'clear trend in traffic noise levels which are higher than the general predictions'*[6] made during the design stage. Notwithstanding this, noise mitigation measures are recommended for consideration at 20 additional dwellings to those identified during the design stage and reported in the ONMP.

Noise impacts examined in relation to rail noise potentially having been affected by the Project show no increase in train pass-by noise levels have occurred before and after the Project and train noise levels are compliant with relevant noise guidelines.

2. Ministers Condition of Approval No.35