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# COMPARING WEEKLY AND WEEKDAY AVERAGED TRAFFIC DATA WHEN MODELLING TRAFFIC NOISE

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**Abstract**
Generally road noise policies, guidelines and standards in Australia either, do not specify what traffic conditions should be used or there are inconsistencies in what is specified for use in noise impact assessments. As a consequence, acoustic consultants tend to use 7-day (Monday to Sunday) averaged traffic data (from Annual Average Daily Traffic, AADT data) when conducting noise assessments rather than 5-day (Monday to Friday) weekday averaged traffic data (from Annual Average Weekly Traffic, AAWT data).

For many arterial roadways (eg motorways, freeways, highways etc) weekend traffic flows tend to be lower than weekday traffic flows, often with lesser heavy vehicles on the road on weekends than on weekdays. Therefore, the question raised on recent road projects is, should 5-day data be used in lieu of 7-day data? The premise behind this question is that 5-day averaged traffic results would better represent the true noise impacts affecting communities than 7-day averaged results. This is because it is considered, by some, that averages over 7-days could potentially 'water-down' and understate the true noise impacts from a road.

This paper investigates this issue by using actual traffic volume and composition data from over 500 different metropolitan and rural arterial roads and sub-arterial roads in various states throughout Australia to carry out noise modelling to compare results and test this premise. This paper also comments on the significance of the difference in impacts in terms of the final reported noise levels, how this may affect the design and selection of road noise mitigation and whether or not this would make a real difference in noise impacts affecting the community.

# 1. INTRODUCTION

## 1.1 Background

Road traffic noise is one of the biggest environmental noise problems in Australia, as it is throughout most of the developed world.

Road traffic noise levels and characteristics depend on many factors which start with the volume, composition and speed of traffic. Traffic may be continuous over a large part of a 24-hour period or it may occur mainly during peak periods. Similarly, traffic volumes may be continuous over the whole week or they may fluctuate between weekdays and weekends, or during other periods. For example, traffic volumes along weekend holiday destination routes or on roads leading to large places of worship may have significantly greater traffic volumes during weekends than during the week. However, traffic volumes along roads leading to commercial / industrial districts or large educational institutions, would have significantly greater traffic volumes during the week than on weekends.

Fluctuations in traffic mix can also change noise levels. For example, some roads may experience a greater number of heavy vehicles during weeknights, than in the day or on weekends, and for other roads the opposite is true. Many interstate highways tend to have a greater number of heavy vehicles during the week than they do on weekends.

Traffic speeds may also be faster during times of low volumes, such as at night or on weekends, but very slow during weekday peak periods. Similarly, some roads may cause little noise disturbance during weekdays, if traffic is traveling at low speeds, but may cause more disturbance at night or on weekends when vehicle speeds are faster.

## 1.2 Policy Inconsistencies

Generally road noise policies, guidelines and standards in Australia, do not specify what traffic conditions should be used in noise impact assessments, and often when they are specified, there are inconsistencies. Inconsistencies occur from one state to the next across Australia and sometimes within the same state, when they relate to what period of traffic conditions a noise impact assessment should apply to. For example, the road authority in Queensland (Queensland Department of Main Roads), requires that a typical weekday's noise monitoring results be reported (ie Monday to Friday only)[1]. Similarly, the road authority in Victoria (VicRoads) requires that measurements should only be carried out between Mondays and Fridays to ensure that average traffic conditions are encountered[2]. As opposed to this, the road authority in NSW (NSW Roads and Traffic Authority) requires that monitored average weekday (Mon-Fri, 5-day average) and the average weekly (Mon-Sun, 7-day average) traffic volumes be presented when undertaking noise monitoring[3]. However, to evaluate likely traffic noise impacts from new and upgraded roads in NSW, AADT data, which is Mon-Sun 7-day averaged data, should be used[3]. For assessing noise impacts on new roads in NSW, the Department of Environment & Conservation (DEC – ex EPA) requires that "*…average weekday volumes*" should be used[4].

Australia's national body on roads, Austroads, in a 2005 publication[5], refers to the use of AADT data, which implies a similar Mon-Sun 7-day average. However, it states that *"Weekends…..…should be avoided…"* and *"It may be prudent to avoid using weekend days, as traffic conditions may be too different from weekday conditions (assuming the noise limits apply to weekdays)"*. The publication also states *"Noise monitors should remain at the noise monitoring sites…3-4 week days (not public holidays). If the conditions (such as traffic*

*volumes…) are likely to affect the important noise indices, up to seven valid days (or more) may be required."*

### 1.3 The Question?

Generally, the author has noticed that acoustic consultants are likely to use Mon-Sun 7-day week averaged traffic data (from Annual Average Daily Traffic, AADT data) when conducting noise assessments rather than Mon-Fri 5-day weekday averaged traffic data (from Annual Average Weekly Traffic, AAWT data). For many arterial roadways (eg motorways, freeways, highways) weekend traffic flows tend to be lower than weekday traffic flows, with often fewer heavy vehicles on the road on weekends than on weekdays.

The question raised on some recent road projects is, should 5-day data be used in lieu of 7-day data? The premise behind this question is that it is considered by some that 5-day averaged traffic results would better represent the true noise impacts affecting communities than 7-day averaged results. This is because averages including weekends, over 7-days, could potentially 'water-down' and understate the true noise impacts from a road.

To investigate this issue, actual traffic volume and composition data from a range of different metropolitan and rural arterial roads and sub-arterial roads in various states throughout Australia, was collated, sorted, categorised and then used to model noise and provide comparisons of results to test this premise.

The significance of the modelled noise differences are evaluated herein in terms of the effect these would have on noise impact studies, in the design and selection of noise mitigation measures, and whether or not the differences are likely to be audible or noticeable in the field amongst the community.

## 2. METHODOLOGY

To obtain traffic data for this study, road authorities throughout Australia were contacted. The data provided by road authorities in a useable format and by a given date, was included in the study and the rest was excluded. Furthermore, where traffic data was not readily available, reference was also made to traffic data from recent road projects that Renzo Tonin & Associates participated in. The traffic data collected was collated and categorised prior to its inclusion in the noise modelling.

In summary, actual traffic volume and composition data from a range of different roads in various states throughout Australia were categorised into two groups:

1. arterial roads (>10,000 vpd), with and without composition data, and
2. sub-arterial roads (2,000 to 10,000 vpd).

Traffic data was collated from a total of:

- 346 arterial road sites (no traffic composition data available)
- 24 arterial road sites (with traffic composition data)
- 161 sub-arterial road sites (no traffic composition data available)

Roads included in this study have traffic volumes ranging from 2,100 to 171,800 vehicles per day.

Tables 1, 2 and 3 below present the details of the traffic information used in this study.

Table 1. Description of Arterial Roads Included in this Study.

| State | No. of Road Sites | Range of Vehicles/Day |
|---|---|---|
| ACT | 76 | 10,700 - 64,800 |
| SA | 15 | 13,000 - 60,100 |
| WA (Perth) | 38 | 15,300 - 51,900 |
| NSW (Sydney/Metropolotan) | 205 | 13,700 - 171,800 |
| NSW (Rural) | 12 | 11,500 - 49,100 |
| **TOTAL** | **346** | **10,700 - 171,800** |

Table 2. Description of Arterial Roads with Heavy Vehicle Data Included in this Study.

| State | No. of Road Sites | Range of Vehicles/Day | Range of Heavy Vehicles (%) |
|---|---|---|---|
| NSW (Sydney/Metropolotan) | 15 | 26,000 - 102,400 | 3 - 6 |
| NSW (Rural) | 9 | 11,500 - 38,300 | 4 - 23 |
| **TOTAL** | **24** | **11,500 - 102,400** | **3 - 23** |

Table 3. Description of Sub-Arterial Roads Included in this Study.

| State | No. of sites | Range of Vehicles/Day |
|---|---|---|
| ACT | 42 | 2,600 - 10,000 |
| SA | 14 | 2,100 - 8,600 |
| WA (Perth) | 19 | 2,300 - 10,300 |
| WA (Rural) | 66 | 2,100 - 9,500 |
| NSW (Sydney/Metropolotan) | 8 | 2,800 - 8,300 |
| NSW (Rural) | 12 | 2,500 - 8,200 |
| **TOTAL** | **161** | **2,100 - 10,300** |

Where overall traffic volume data was available without composition data, it was assumed that the number of heavy vehicles remained constant on weekdays and weekends (a constant 15% heavy vehicles was used in the modelling). All other parameters and model inputs were kept constant between the Mon-Fri 5-day AAWT modelling and the Mon-Sun 7-day AADT modelling, as noise levels were modelled to the same receiver location point.

Noise modelling for this study was conducted using the United Kingdom Department of Transport (1988) procedure, *Calculation of Road Traffic Noise* (CoRTN 88), modified to allow for 3 source heights and corrected for Australian conditions using the standard Australian Road Research Board corrections.

## 3. RESULTS

### 3.1 Arterial Roads - with Assumed Constant Traffic Compositions

Figure 1 below presents the differences found by modelling traffic noise levels on arterial roads using 5-day (AAWT) and then 7-day (AADT) traffic volumes, assuming that traffic compositions between the two periods remains constant.

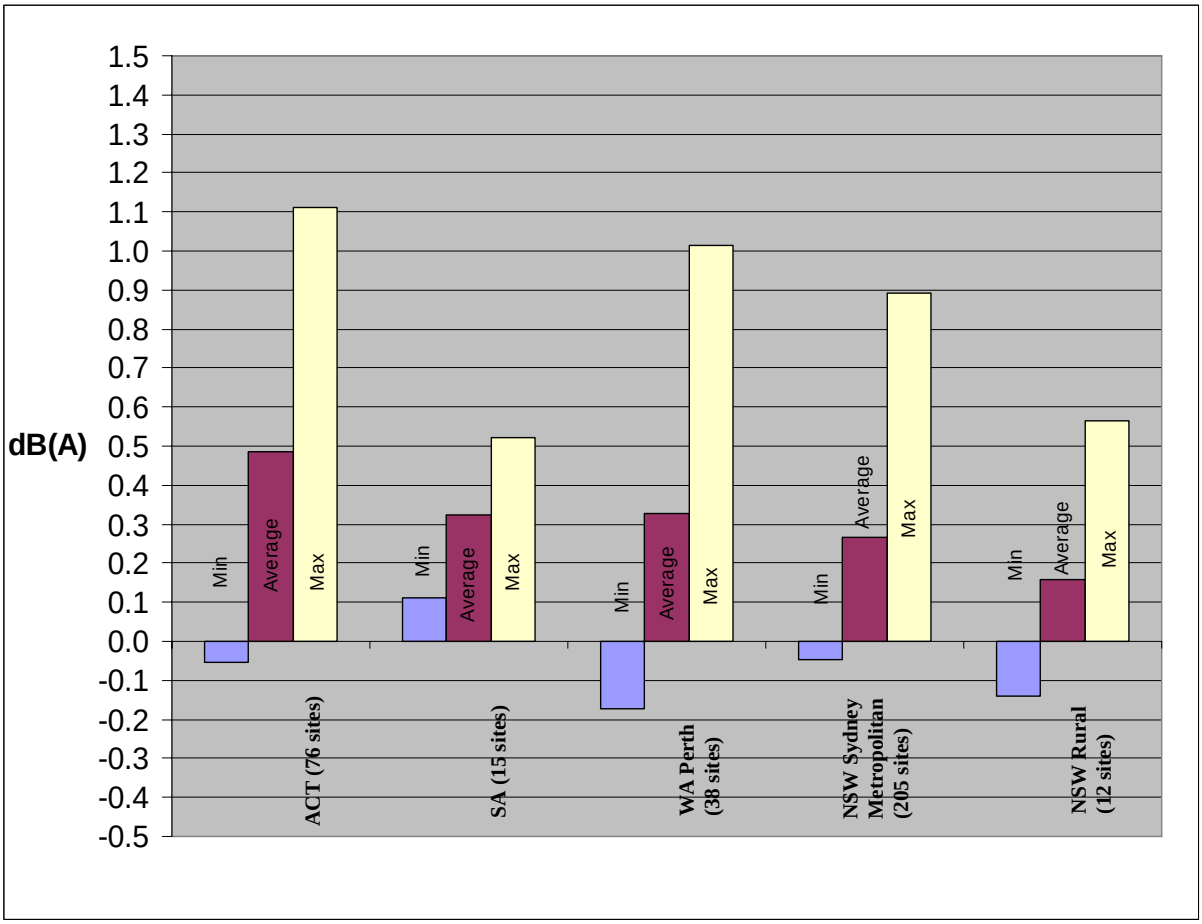


Figure 1. Arterial Roads - Modelled Traffic Noise Level Differences between 5-day and 7-day Averages (assumed Constant Traffic Compositions)

Figure 1 shows that the average traffic noise levels are +0.2 to +0.5dB(A) higher with a maximum of up to +1.1dB(A) higher if 5-day data is used instead of 7-day data. As expected

for some roads, the use of 5-day data instead of 7-day data could present slightly lower noise levels in noise impact assessments.

### 3.2 Arterial Roads - with Actual Traffic Compositions

Figure 2 below presents the differences found by modelling traffic noise levels on arterial roads using 5-day averages and then 7-day averages traffic volumes, using actual traffic composition data from road sites on three major roads in NSW; two near the southern and northern boundaries of NSW and one within the Sydney metropolitan area, respectively.

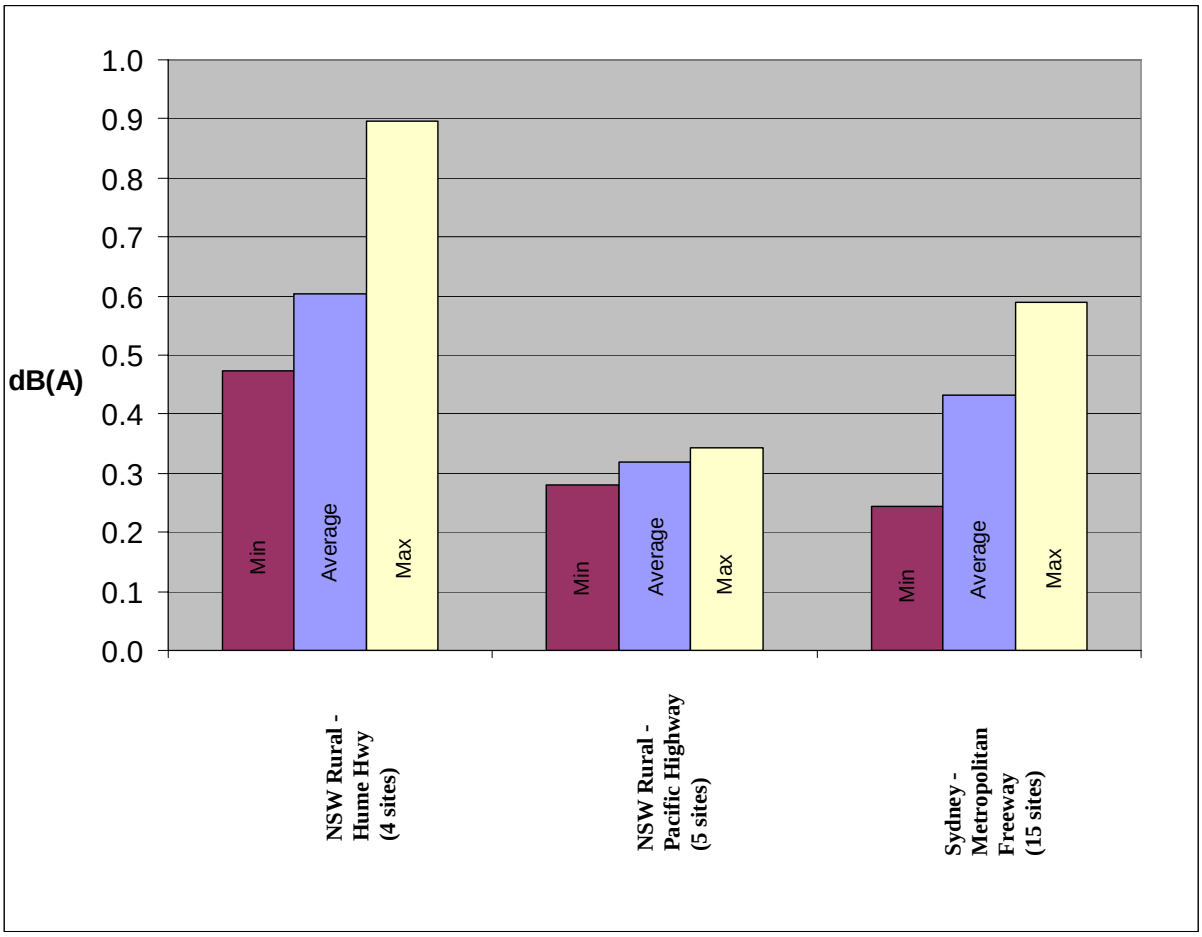


Figure 2. Arterial Roads - Modelled Traffic Noise Level Differences between 5-day and 7-day Averages (with Actual Traffic Compositions)

Figure 2 shows that the average traffic noise levels are +0.3 to +0.6dB(A) higher with a maximum of up to +0.9dB(A) higher if 5-day data is used instead of 7-day data.

### 3.3 Sub-Arterial Roads - with Assumed Constant Traffic Compositions

Figure 3 below presents the differences found by modelling traffic noise levels on sub-arterial roads using 5-day (AAWT) and then 7-day (AADT) traffic volumes, assuming that traffic compositions between the two periods remains constant.

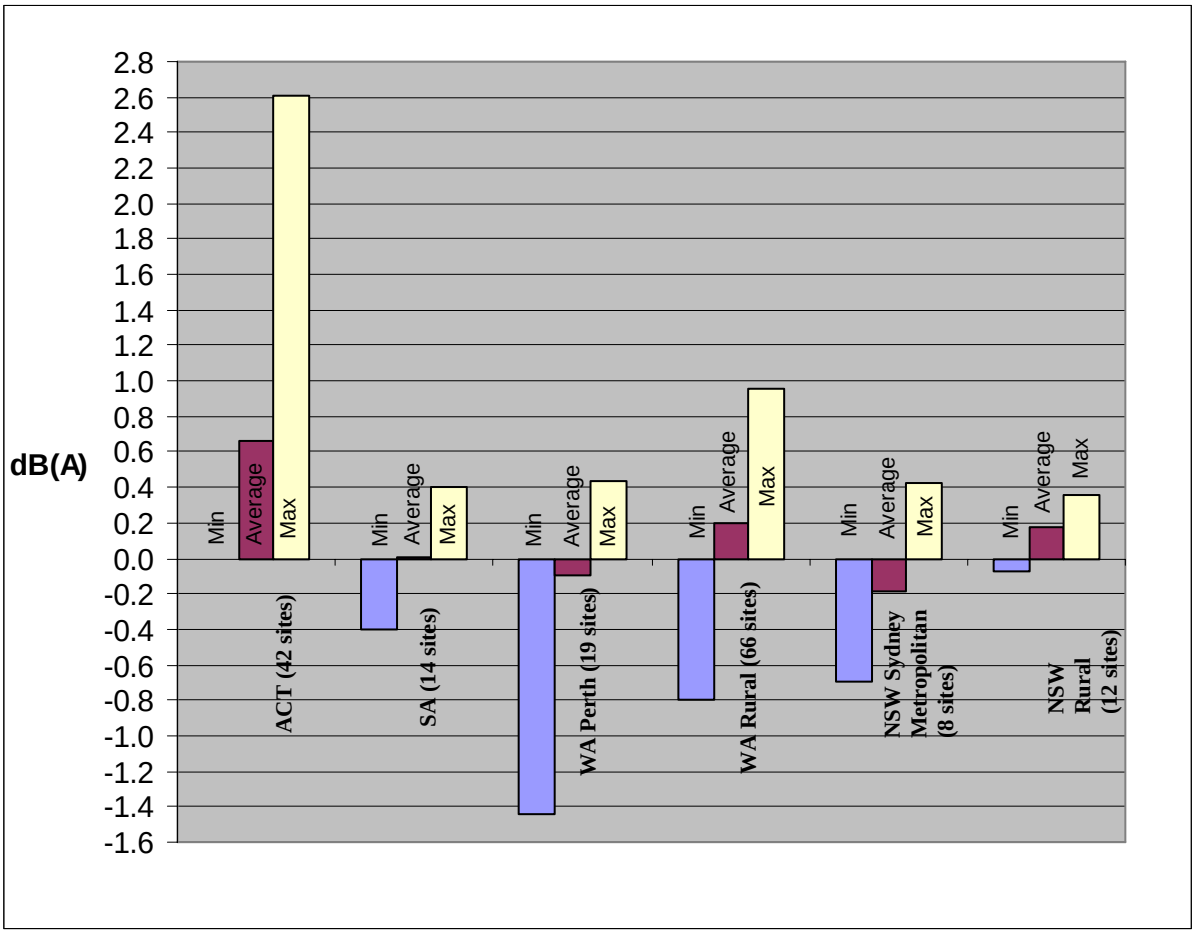


Figure 3. Sub-Arterial Roads - Modelled Traffic Noise Level Differences between 5-day and 7-day Averages (assumed Constant Traffic Compositions)

Figure 3 shows that the average traffic noise levels are -0.2 to +0.7dB(A) higher with a maximum of up to +2.6dB(A) higher if 5-day data is used instead of 7-day data. As expected for some roads, the use of 5-day data instead of 7-day data could present lower noise levels in noise impact assessments.

### 3.4 Discussion of Results and Recent Project Experiences

The results of this study show that using 5-day averages instead of 7-day averages, result in relatively small noise level differences, typically increasing noise levels by less than 1dB(A) in magnitude, with some exceptions. In terms of noise impacts, a noise difference in the order of 1dB(A) is insignificant as it falls within the acceptable tolerances of noise modeling and monitoring, and most importantly, such a small noise level difference would not be audible or noticeable in the field by the human ear.

However, with increasing demands on improved accuracy required when modeling and monitoring noise on road projects, noise level differences of less than 0.5dB(A) can affect the final outcome when it comes to how many and which properties affected by traffic noise from a road project would qualify for noise mitigation treatment. For example, if the noise level, rounded to the nearest whole number, exceeds the noise criteria at a particular property, then that property would qualify for noise mitigation treatment. Equally, if the rounded noise level marginally complies with the noise criteria at a property, then that property does not qualify for noise mitigation treatment. In recent times, our firm has seen several road projects in NSW where such small modeled noise level differences have made a significant difference in the number of properties qualifying for noise mitigation treatment. This is especially the case where there are many properties on the border of the so-called “compliance line”. In such a

case, a small change in modeled / monitored noise levels can translate into a significant change in the number of properties requiring treatment and can subsequently affect the type of treatment selected on a project. For example, on a recent NSW road project, modeled noise level differences of 0.5dB(A) translated into over one hundred properties being affected in terms of whether or not they qualified for noise mitigation treatment.

Of course, whether or not an adequate level of noise mitigation is implemented on road projects relies on many factors, with the most important factor being what noise limits are set on road projects and whether these are mandatory or non-mandatory. However, this study shows that every factor, no matter how small, can make a difference to the final outcomes of noise mitigations that are implemented on road projects today.

## 4. CONCLUSIONS

This study shows that using 5-day averages instead of 7-day averages when modeling / monitoring noise levels and presenting impacts, results in relatively small noise level differences, typically less than 1dB(A) in magnitude. Such small differences are insignificant in terms of actual noise impacts on the community.

However, recent road project experiences in NSW have shown that noise level differences of less than 0.5dB(A) can affect the final outcome when it comes to how many and which properties affected by traffic noise would qualify for noise mitigation treatment.

To answer the question, should 5-day traffic conditions be considered in lieu of 7-day traffic conditions when undertaking noise impact assessments, two conclusions are reached:

1. no, not necessary, as differences in noise impacts are likely to be small and insignificant on the community, and
2. yes, as this could have some bearing on how many and which properties would qualify for noise mitigation treatment.

In order to encompass both of these resolutions into a noise impact assessment both assessments should be conducted using 5-day averages and 7-day averages, and the worst-case should be presented and used as the basis for determining noise mitigation measures on road projects.

## REFERENCES

[1] Queensland Department of Main Roads, *Road Traffic Noise Management Code of Practice, Version 2,* (January 2000).

[2] Victoria, VicRoads, *Road Design Note, RDN 6-1a,* (12 December 2005).

[3] NSW, Roads and Traffic Authority, *Environmental Noise Management Manual* (December 2001).

[4] NSW, Environment Protection Authority (now Department of Conservation), *Environmental Criteria for Road Traffic Noise,* (May 1999).

[5] Austroads, *Modelling, Measuring and Mitigating Road Traffic Noise,* No. AP–R277/05, (2005).

[6] Road Authorities in Australia – NSW, ACT, SA and WA.

[7] Renzo Tonin & Associates (NSW) Pty Ltd – recent road project files.