Review of NSW Speed Zoning Guidelines

Project No: 003863

by David McTiernan, Peter Croft, Ganesh Vengadasalam

for Transport for NSW, Roads and Traffic Authority
Review of NSW Speed Zoning Guidelines

for Transport for NSW, Roads and Traffic Authority

Reviewed

Project Leader
David McTiernan

Quality Manager
Arjen Rensen

003863-1
August 2011
SUMMARY

Transport NSW, Roads and Traffic Authority has undertaken a review of the NSW Speed Zoning Guidelines and underlying policies. The purpose of the review was to address issues relating to speed limits in the areas of consistency, frequency and impact on mobility.

This report outlines the consultation and investigations that were completed by ARRB Group as a part of the RTA review. Specifically, this report discusses a review of four policy options:

- Policy Option 1: Increase the minimum length for speed zones to reduce complexity.
- Policy Option 2: Use of shorter speed zones to address isolated at-risk points in the road network to reduce impact on mobility.
- Policy Option 3: Consideration of the removal of 70 km/h and 90 km/h from the list of available speed limits to promote simplification of the speed limit regime.
- Policy Option 4: Implement a strict speed limit regime in urban areas to promote simplification and consistent application of speed limits.

The policy options are not listed in any particular priority order and they are not considered to be mutually exclusive.

The objectives of each policy option, the relationships between them and the implications of them were discussed in stakeholder workshops. A review of literature, focusing on the four policy options and speed management practices across Australia and overseas was undertaken. The discussion at the stakeholder workshops together with the findings of the literature review were important components of the formulation of the conclusions and recommendations of this review.

The following alternative policy options are put forward to the RTA for consideration:

**Policy option 1:** Create speed zones that are as long as reasonably practicable to balance road user safety and mobility and reduce the complexity of the speed limit regime on the road network.

**Policy option 2:** Consider short lengths of lower speed limit less than the specified minimum as a means for improving road safety at hazardous locations in high speed environments, without unduly affecting mobility objectives.

**Policy option 3:** Rationalise existing and restrict the ongoing use of 70 km/h and 90 km/h speed limits as viable speed management options applicable for road environments and infrastructure that does not meet the requirements of higher speed limits, i.e. 80 km/h and 100 km/h respectively.
Policy Option 4: Strictly implement the 50 km/h default general urban speed limit (GUSL) in built-up areas with consistent application of other speed limits within those areas.

The following additional recommendations are also put forward to the RTA for consideration:

Recommendation 1: Transport NSW, Roads and Traffic Authority undertake a review of speed limits in built-up areas to confirm the application of the 50 km/h default GUSL. Roads in built-up areas that are to be designated a speed limit higher than the 50 km/h default GUSL should be thoroughly reviewed and reasons for the higher speed limit documented.

Recommendation 2: Transport NSW, Roads and Traffic Authority develop and disseminate information for the public addressing the:

- rationale behind the setting of speed limits
- 50 km/h default GUSL and its application on NSW roads
- implementation of speed zones.

Recommendation 3: Transport NSW, Roads and Traffic Authority develop a process involving authorised expert assessment and review for speed zone setting. This process should clearly document the decision making process, referencing relevant policy and technical guidelines in support of the speed limit being recommended.

Recommendation 4: Transport NSW, Roads and Traffic Authority develop a revised NSW Speed Zoning Guideline document that clearly states government policy and objectives for speed management and speed zone setting. The revision of these guidelines should:

- Outline how the principles of the harm minimisation and harm reduction are to be applied to support NSW policy for setting speed limit.
- provide practitioners with information that gives clear advice for the establishment of speed zones that meet government policy objectives.
- outline a route based review process for speed zone assessments.
4.5 Summary of policy option impact assessment .......................................................... 29
4.6 Testing the policy options ......................................................................................... 29
  4.6.1 Lane Cove/Ryde and Mona Vale Roads, Meadow Bank to Mona Vale .............. 30
  4.6.2 King Georges/Roberts/Richmond Roads/Centenary/Homebush Bay Drive, Church
      Street from Blakehurst to Ryde .............................................................................. 33
  4.6.3 Fairfield Local Government Area .................................................................... 35

5 CONCLUSIONS AND RECOMMENDATIONS ................................................................. 37
5.1 Conclusions .............................................................................................................. 37
5.2 Recommendations .................................................................................................. 37
  5.2.1 Policy option 1: Increase the length of speed zones ........................................ 37
  5.2.2 Policy option 2: Use of shorter speed zones at isolated locations .................... 38
  5.2.3 Policy option 3: Removal of 70 km/h and 90 km/h speed limits ...................... 38
  5.2.4 Policy option 4: Strict speed limit regime in urban areas ................................ 39
5.3 Additional recommendations .................................................................................... 39

REFERENCES ................................................................................................................. 40
APPENDIX A EXTERNAL AND INTERNAL STAKEHOLDER CONSULTATION ............ 42
TABLES

Table 2.1: Policy options – objectives and rationale .......................................................... 3
Table 2.2: Impact assessment criteria and subcriteria ......................................................... 4
Table 2.3: Impact assessment scale ................................................................................... 4
Table 3.1: Application of speed limits in Australia ............................................................ 6
Table 3.2: Minimum lengths of speed zones specified in Australia and New Zealand .......... 7
Table 3.3: Typical speed limits application in NSW ........................................................... 8
Table 3.4: Length of speed limits in NSW by rural/urban road .......................................... 9
Table 3.5: Percentage change in crashes for 1 km/h change in average speeds ................. 11
Table 3.6: Harm minimisation impact speeds .................................................................. 12
Table 3.7: Relationships between road infrastructure, speed limits, speeds and casualty crashes .............................................................................................................. 13
Table 4.1: Policy option 1 impact assessment .................................................................. 22
Table 4.2: Policy option 2 impact assessment .................................................................. 24
Table 4.3: Policy option 3 impact assessment .................................................................. 26
Table 4.4: Policy option 4 impact assessment .................................................................. 28
Table 4.5: Policy option impact assessment summary ..................................................... 29
Table 4.6: Lane Cove/Ryde and Mona Vale Roads - Speed zone configuration ................... 30
Table 4.7: King Georges Road speed zone configuration .................................................... 33

FIGURES

Figure 3.1: Nilsson’s ‘Power Model’ .................................................................................. 10
Figure 3.2: Relationship between traffic flows and speeds along an urban motorway ........ 14
Figure 3.3: Relationship between traffic flows and speeds along an urban road ............... 14
Figure 3.4: Gaseous emissions as a function of speed ...................................................... 15
Figure 4.1: Policy options modelling – Mona Vale Road .................................................. 32
Figure 4.2: Policy options modelling - King Georges Road ............................................... 34
Figure 4.3: Policy options modelling – selected precinct Fairfield LGA (Policy Option 4) .... 36
1 INTRODUCTION

Transport NSW Roads and Traffic Authority (RTA) Centre for Road Safety engaged ARRB Group (ARRB) to assist in the review of the NSW Speed Zoning Guidelines (RTA 2009). This review involved scoping four new speed zoning policy options and included consultation with key stakeholders and RTA personnel to investigate the risks in four specific areas of impact.

1.1 Background

The NSW Government released its 100 Day Action Plan on 4 April 2011. The plan identified six actions that assigned responsibility to NSW Transport. One of the six actions involves undertaking an audit of the speed zones on the NSW road network which falls under the responsibility of the RTA Centre for Road Safety.

The review of the NSW Speed Zoning Guidelines (RTA 2009) and key underlying policy areas form an integral component of the audit of speed zones.

1.2 Project brief

The project brief from the RTA, dated 20 May 2011, stated that the RTA needed to investigate the feasibility of incorporating four new speed zoning policy options to rationalise the number of speed limits on the NSW road network (RTA 2011). The four policy options being investigated were:

- **Policy Option 1**: Increase the minimum length for speed zones to reduce complexity.
- **Policy Option 2**: Use of shorter speed zones to address isolated at-risk points in the road network to reduce impact on mobility.
- **Policy Option 3**: Consideration of the removal of 70 km/h and 90 km/h from the list of available speed limits to promote simplification of the speed limit regime.
- **Policy Option 4**: Implement a strict speed limit regime in urban areas to promote simplification and consistent application of speed limits.

ARRB was tasked with scoping the four speed zoning policy options and to consider the impact of each on speed zone management across the NSW road network.

1.3 Project scope

The project scope as outlined in the project brief included:

- detailed scoping of the policy options
- a risk assessment of each policy option in order to assess the:
  - impact on the network
  - impact on safety
  - Impact on mobility
  - impact on road users
- application of the risk analysis across one metropolitan and one rural NSW local government area
- development of possible hybrid policy options
• consultation with stakeholders through a workshop to gather input into the development of the policy options and the risk analysis process
• submission of a final report outlining the findings of the project
• final incorporation of all the four policy options into the revised NSW Speed Zoning Guidelines.

Discussion with the RTA as the project proceeded clarified some of the above tasks, resulting in some minor variation, while still delivering the stated outcomes.

The review of the policy options was applied to fixed speed limits on the NSW road network; it did not include consideration of the policy options at the following speed zone treatments:

• variable speed limits
• school zone speed limits
• 40 km/h high pedestrian activity speed zones
• shared zones.

1.4 Project report structure

This report presents the findings from the review of the four speed zoning policy options for consideration as a part of the review of the NSW Speed Zoning Guidelines. The report includes the discussion of the risk assessment process adopted, the results from the detailed risk assessment of each policy option, the input received at the stakeholder workshops and the application of the risk analysis across existing speed zones in a metropolitan and in a rural local government area.

The structure of the report is as follows:

• Section 1 – provides a brief introduction and outline of the scope of the project.
• Section 2 – outlines the policy options that are the subject of this project and the areas of impact the RTA has sought to include in the risk assessment.
• Section 3 – is a discussion of literature that was found and considered relevant to the four policy options and the areas of impact that were investigated in this project.
• Section 4 – discusses the risk assessment process developed for this project, the input and outcome of the stakeholder workshops and the rationale behind the conclusions and recommendations of this project.
• Section 5 – outlines the conclusions and presents recommendations about each policy option. Additional recommendations relating to the policy options and the speed zoning review are provided for consideration by the RTA.
2 SPEED ZONING POLICY OPTIONS

The NSW Government has ordered a comprehensive audit of speed zones in NSW and the manner in which speed zones are considered and implemented. In part, this involves reviewing the existing NSW Speed Zoning Guidelines and the policies that underpin the objectives and technical criteria contained in it.

The RTA has developed four speed zoning policy options for scoping and investigation as indicated in Section 1.2.

Discussion with the RTA sought to examine in more detail the objectives and rationale behind each of these policy options. The potential impact on speed management, speed zone setting, mobility, enforcement and importantly the effect on road safety of each of these policy options was also examined. Due to time constraints for delivering the project, analysis of the impacts on the road network was considered at a general and high level only. The risk management approach that was applied and the outcome of this process is discussed in more detail in Section 4.

2.1 Objectives and rationale

In discussion with the RTA, the objectives and rationale behind the four policy options were clarified and are summarised in Table 2.1.

<table>
<thead>
<tr>
<th>Policy option</th>
<th>Objective and rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase the minimum length for speed zones to reduce complexity.</td>
<td>A reduction in the number and frequency of changes in speed limits along a given route to provide a more uniform speed regime.</td>
</tr>
<tr>
<td>Use of shorter speed zones to address isolated at-risk points in the road network to reduce impact on mobility.</td>
<td>To improve road safety at specific locations by managing vehicle speeds through at-risk locations without adversely impacting on the mobility of motorists.</td>
</tr>
<tr>
<td>Consideration of the removal of 70 km/h and 90 km/h from the list of available speed limits to promote simplification of the speed limit regime.</td>
<td>A simplification of the speed limit regime across the road network by reducing the number of speed limits that may be used.</td>
</tr>
<tr>
<td>Implement a strict speed limit regime in urban areas to promote simplification and consistent application of speed limits.</td>
<td>A consistent application of the default urban speed limit in NSW and a reduction in the number of exceptions to the 50 km/h for roads in built-up areas so a simpler speed management regime exists for motorists.</td>
</tr>
</tbody>
</table>

2.2 Areas of impact

Four areas of impact were nominated by the RTA for the risk assessment process that was to be applied to the four policy options. Three sub-areas were identified for each impact area to assist defining the range of impacts to be assessed. The impact area and sub-areas are summarised in Table 2.2.
Table 2.2: Impact assessment criteria and subcriteria

<table>
<thead>
<tr>
<th>Impact area</th>
<th>Impact sub-areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact on the network</td>
<td>Mean speeds</td>
</tr>
<tr>
<td></td>
<td>Environmental impact</td>
</tr>
<tr>
<td></td>
<td>Congestion levels</td>
</tr>
<tr>
<td>Impact on safety</td>
<td>Frequency of crashes</td>
</tr>
<tr>
<td></td>
<td>Severity of crashes</td>
</tr>
<tr>
<td></td>
<td>Pedestrian and cyclist crashes</td>
</tr>
<tr>
<td>Impact on mobility</td>
<td>Journey travel time</td>
</tr>
<tr>
<td></td>
<td>Fuel consumption</td>
</tr>
<tr>
<td></td>
<td>Travel flows</td>
</tr>
<tr>
<td>Impact on road users</td>
<td>Compliance</td>
</tr>
<tr>
<td></td>
<td>Enforcement</td>
</tr>
<tr>
<td></td>
<td>Public acceptability</td>
</tr>
</tbody>
</table>

A descriptive scale of impact for each sub-area was used in the risk assessment process. This scale is presented in Table 2.3.

Table 2.3: Impact assessment scale

<table>
<thead>
<tr>
<th>Impact level</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slightly positive</td>
<td>✔️</td>
<td>May produce positive results</td>
</tr>
<tr>
<td>Somewhat positive</td>
<td>✔️ ✔️</td>
<td>Can produce positive results</td>
</tr>
<tr>
<td>Positive</td>
<td>✔️ ✔️ ✔️</td>
<td>Noticeable positive results can be achieved</td>
</tr>
<tr>
<td>Very positive</td>
<td>✔️ ✔️ ✔️ ✔️</td>
<td>Achieve highly noticeable positive results</td>
</tr>
<tr>
<td>Neutral</td>
<td>❌</td>
<td>No observable change</td>
</tr>
<tr>
<td>Slightly negative</td>
<td>❌</td>
<td>May produce negative results</td>
</tr>
<tr>
<td>Somewhat negative</td>
<td>❌ ❌</td>
<td>Can produce negative results</td>
</tr>
<tr>
<td>Negative</td>
<td>❌ ❌ ❌</td>
<td>Noticeable negative results can be achieved</td>
</tr>
<tr>
<td>Very negative</td>
<td>❌ ❌ ❌ ❌</td>
<td>Achieve highly noticeable negative results</td>
</tr>
</tbody>
</table>

Assessment of the consequence of the sub-areas against the above scale provided a simple method of determining the type of risk associated with each policy area. It also helped to formulate the type of issues that may arise as a result of adopting each policy area and where adjustments may be required to deliver the overall objective of the speed zone review.

The assessment was considered to be a high level assessment only and was based on the review of relevant literature, the experience and the expertise of the project team. The rationale behind the assessment was discussed with the RTA to ensure that the correct and appropriate interpretation of the policy options and impact areas and sub-areas was made. The impact assessment was presented at the workshops with the intention of providing a starting point for discussion only. Stakeholders were invited to comment on the impact areas and the assessment and to make their own assessment of the impact of the policy options.
3 POLICY OPTIONS LITERATURE REVIEW

3.1 Overview

This section summarises the findings of a review of international and national published literature that is relevant to the four policy options and the areas of impact being reviewed. The initial discussion outlines Australian speed management guidelines. Literature that provides some evidentiary support to issues and impacts related to the policy areas is discussed for each policy area later in this section.

In order to identify the relevant research pertaining to the project, a literature review was conducted using the resources of ARRB Group's M.G. Lay Library, the leading land transport library in Australia. The purpose of this literature review was to cross-reference published research or similar practices in other jurisdictions with the objectives of the four policy options under investigation, to identify evidence of the potential impacts that may arise from implementing the policy options.

The M.G. Lay Library resources included the library's own comprehensive collection of technical land transportation literature and information retrieval specialists with extensive experience in the transport field, as well as access to the collections and expertise of other transport-related libraries throughout Australia and internationally.

Used specifically in this literature search were the Australian Transport Index (ATRI), TRANSPORT and Transportation Research Information Services (TRIS) databases, whose content is coordinated by ARRB, the OECD / ECMT and the U.S. Transportation Research Board respectively. Use of these databases ensured wide coverage of quality research material within the subject area from national and international resources.

The keywords that were used to examine the extensive literature included speed zone review, length of speed zones, 70 km/h speed limit, 90 km/h speed limit, urban speed limit, safe speed limits, speed zone policy, speed zones New Zealand, impact speed limits, setting speed limits, or zones.

3.2 Speed limit management in Australia

The purpose of speed limits is to indicate the maximum safe and legal speed that vehicles should travel on the roads. Both the Australian Road Rules 2008 and the NSW Road Rules 2008 state in Rule 20 that 'A driver must not drive at a speed over the speed limit applying to the driver for the length of road where the driver is driving'.

The NSW Road Rules also state in Rule 21 (1) that:

The speed-limit applying to a driver for a length of road to which a speed-limit sign applies is the number of kilometers per hour indicated by the number on the sign.

The Australian Standard AS 1742 – 2008 Part 4: Speed Controls outlines the standards for regulatory speed control as used in Australia. In addition, the Austroads Guide to Traffic Management Part 5: Road Management (Austroads 2008b) and the Austroads Guide to Road Safety Part 3: Speed Limits and Speed Management (Austroads 2008a) provide guidelines on the different types of speed limits and their application to the road environment.

A speed zone may be defined as that length of road or a network of roads (i.e. area) within which a single sign-posted speed limit applies (RTA 2009). The objective of setting safe speed limits is to
ensure the safety and to improve mobility and amenity for all road users. The setting of speed limits should be compatible with the general road environment as this increases the awareness by drivers of the appropriate driving speed and assists with self-regulating compliance. Examples of various sign posted speed limits in Australia are presented in Table 3.1.

Table 3.1: Application of speed limits in Australia

<table>
<thead>
<tr>
<th>Speed limits (km/h)</th>
<th>Road function</th>
<th>Typical Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 and 20</td>
<td>Shared zone</td>
<td>Pedestrian malls</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Car parks</td>
</tr>
<tr>
<td>30</td>
<td>Local recreational areas</td>
<td>Car parks</td>
</tr>
<tr>
<td>40</td>
<td>Local</td>
<td>Residential streets</td>
</tr>
<tr>
<td></td>
<td>Local</td>
<td>Residential areas</td>
</tr>
<tr>
<td></td>
<td>Local</td>
<td>Commercial areas</td>
</tr>
<tr>
<td></td>
<td>Traffic</td>
<td>Strip shopping centre</td>
</tr>
<tr>
<td></td>
<td>Local</td>
<td>Urban roads outside of schools</td>
</tr>
<tr>
<td></td>
<td>Traffic (part-time)</td>
<td>Urban roads outside of schools</td>
</tr>
<tr>
<td>50</td>
<td>Local</td>
<td>Residential streets and collector roads</td>
</tr>
<tr>
<td>60</td>
<td>Traffic</td>
<td>Urban arterial roads</td>
</tr>
<tr>
<td></td>
<td>Traffic (part-time)</td>
<td>Rural roads outside of schools</td>
</tr>
<tr>
<td>70</td>
<td>Traffic</td>
<td>Urban arterial roads</td>
</tr>
<tr>
<td>80</td>
<td>Traffic</td>
<td>Urban arterial roads</td>
</tr>
<tr>
<td>90</td>
<td>Traffic</td>
<td>Rural roads</td>
</tr>
<tr>
<td>100</td>
<td>Traffic</td>
<td>Urban freeways/motorways</td>
</tr>
<tr>
<td>110</td>
<td>Traffic</td>
<td>Rural freeways/motorways</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Major roads in rural and remote areas</td>
</tr>
</tbody>
</table>

Source: Austroads (2008a).

The length of a proposed speed zone is an important consideration when assessing a road for a speed limit change. The minimum length of a speed zone is important since it can affect a range of issues, including traffic flow, compliance, enforceability, community acceptance etc. The minimum length for the range of speed limits used in Australia and New Zealand, by jurisdiction, is summarised in Table 3.2.
## 3.3 Speed limit application in NSW

In NSW, the RTA has responsibility for setting speed limits across the entire road network which includes more than 180,000 km of roads. Speed is considered to be the largest contributor to road deaths, accounting for approximately 40% of road fatalities in the state (RTA 2011).

Speed related crashes on NSW roads are managed, in part, through the effective application of speed limits. The RTA seeks to set speed limits that are based on achieving a balance between mobility and safety (RTA 2011). The NSW Speed Zoning Guidelines have been developed to make the roads and roadside environment safer for all road users. This guideline describes the principles and procedures that should be applied when determining appropriate speed limits on the NSW road network.

The NSW Speed Zoning Guidelines document was initially developed in 1995 and revised in 2004 and again in 2009. The guidelines are based on the philosophy of applying two approaches to setting of speed limits:

- ensuring a balance between safety and travel speed
- providing a balance between accurately reflecting changes in crash risk along a road and the number of changes of speed limits.

Speed zoning in NSW is based on a system of default speed limits and speed zoning. The default urban speed limit is 50 km/h and the default rural speed limit is 100 km/h. These two speed limits are defined by statute and apply unless an approved speed limit sign indicates otherwise. The current NSW Speed Zoning Guidelines outline the different speed limits that are used in NSW. Their application to different road environments and is summarised in Table 3.3.
### Table 3.3: Typical speed limits application in NSW

<table>
<thead>
<tr>
<th>Speed km/h</th>
<th>Key road environment features</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>Default urban speed limit</td>
</tr>
<tr>
<td>60</td>
<td>Significant urban undivided arterial access (with direct driveway access)</td>
</tr>
<tr>
<td>70</td>
<td>Significant urban divided arterial roads (with limited driveway access)</td>
</tr>
<tr>
<td></td>
<td>Urban fringe undivided road</td>
</tr>
<tr>
<td>80</td>
<td>Urban high standard divided roads (without driveway access)</td>
</tr>
<tr>
<td></td>
<td>Undivided arterial and sub-arterial roads on the fringes of urban areas</td>
</tr>
<tr>
<td></td>
<td>Lower quality rural roads</td>
</tr>
<tr>
<td></td>
<td>Undivided rural roads with less than 5.6 m wide sealed pavement or no marked dividing line</td>
</tr>
<tr>
<td>90</td>
<td>High volume urban motorways</td>
</tr>
<tr>
<td></td>
<td>Lower quality rural roads</td>
</tr>
<tr>
<td>100</td>
<td>Default rural speed limit</td>
</tr>
<tr>
<td></td>
<td>Urban motorways</td>
</tr>
<tr>
<td></td>
<td>Rural undivided road with sealed pavement greater than 5.6 m</td>
</tr>
<tr>
<td></td>
<td>Rural divided roads</td>
</tr>
<tr>
<td>110</td>
<td>Maximum allowable speed limit in NSW</td>
</tr>
<tr>
<td></td>
<td>Motorways (freeways,tollways) in non-built-up areas</td>
</tr>
<tr>
<td></td>
<td>High quality rural divided roads</td>
</tr>
<tr>
<td></td>
<td>Undivided rural roads with low traffic volume in western part of NSW</td>
</tr>
</tbody>
</table>

Source: RTA (2009)

In addition to the speed limits described in Table 3.3, other speed limits such as 10 km/h and 40 km/h may also be used on NSW roads. For example, 10 km/h speed limits may be used in shared zones and car parks. Along high pedestrian activity areas, school zones and in local traffic areas, 40 km/h speed limits may be used.

Temporary speed limits are also used on the NSW road network, particularly to manage temporary situations such as incident management or in association with road works. Variable speed limits (VSL) can be used in permanent situations such as along urban motorways and are typically used to ease traffic congestion and improve road safety particularly during periods of heavy congestion.

The RTA has recorded the location of speed zones across the NSW road network. Analysis of the speed zone data indicates the length of all speed zones measured in excess of 225,000 km. The breakdown of the length and proportion of each speed limit is summarised in Table 3.4.
The NSW Speed Zoning Guidelines is a comprehensive technical document that aims to provide practitioners with the criteria to evaluate a road environment and to determine the most appropriate speed limit that can be applied to a particular length of road. The guidelines take into account the nationally adopted Safe System approach that has been embraced by all state and territory road authorities in Australia.

### 3.4 Impacts of speed management

Establishing the appropriate speed limits across the road network is important to allow road users to arrive at their destinations efficiently and safely. Speed limit policies across Australia and internationally have been developed and implemented based on crash and casualty reduction as core objectives. However, those speed policies can impact on other network performance measures such as mobility and environmental indicators. It is important that policy makers take into account the range of impacts when developing and implementing new speed policies.

There are a number of positive impacts of faster travel speeds. Improved mobility as a result of reduced journey times is seen as a key benefit of higher speed limits. Advances in technology have led to the development of safer vehicles, a more efficient road transport system and improved design of roads. These advancements have allowed the implementation of higher travel speeds on the road network (OECD/ECMT 2006), which has significant positive impacts by improving the quality of life for individuals and economic performance for business.

Appropriate speed limits that are compatible with the road environment improve road safety for all road users especially vulnerable road users such as pedestrians and cyclists. In addition, suitable speed limits can have environmental benefits through reduced emissions and improved amenity for the local street environment that allows a safe and comfortable living environment for all road users and residents.

Excessive speed can also have a number of negative impacts, the consequence of which has a far greater impact on the quality of life than the positive impacts identified above.

**Impact on road safety**

Excessive or inappropriate speed is seen as the most negative aspect of speed management on the road network. It has contributed to one third of fatal crashes internationally and is an aggravating factor in the severity of all accidents (OECD/ECMT 2006). Vulnerable road users such
as pedestrians and cyclists face the greatest risk from high travel speeds since they are exposed to impacts that are well beyond the limits of human tolerance, making serious injury and death significantly more likely to occur.

OECD/ECMT (2006) has concluded that 50% of drivers on the roads are travelling above the signposted speed limit of the road, making roads users very exposed to speed related impacts. A plethora of research has conclusively stated that high travel speeds have a detrimental impact on road safety. Key research by Nilsson (2004) developed the 'Power Model', which defines the relationship between travel speed and the occurrence of crashes and severity outcomes. Figure 3.1 illustrates this relationship.

Figure 3.1: Nilsson's 'Power Model'

The 'Power Model' states that a 5% increase in mean vehicle speeds leads to a 10% increase in all injury crashes and a 20% increase in fatal crashes. The model also illustrates that a 5% decrease in vehicle speeds will lead to a 10% decrease in all injury crashes and a 20% decrease in fatal crashes. ETSC (1995) based on Finch et al (1994), as cited by OECD/ECMT (2006) has stated that for each 1 km/h reduction in mean vehicle speeds, injury crashes are reduced by 2% - 3%. Based on Nilsson's 'Power Model', Aarts and van Schagen (2006), as cited by OECD/ECMT (2006), determined the impact of a 1 km/h change in mean vehicle speeds on the severity of crashes for roads with different reference speeds, shown in Table 3.5.
Table 3.5: Percentage change in crashes for 1 km/h change in average speeds

<table>
<thead>
<tr>
<th>Accident severity</th>
<th>Reference speed in km/h</th>
<th>50</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injury accidents (%)</td>
<td>4.0</td>
<td>2.9</td>
<td>2.5</td>
<td>2.2</td>
<td>2.0</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Injury and fatal accidents (%)</td>
<td>6.1</td>
<td>4.3</td>
<td>3.8</td>
<td>3.4</td>
<td>3.0</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Fatal accidents (%)</td>
<td>8.2</td>
<td>5.9</td>
<td>5.1</td>
<td>4.5</td>
<td>4.1</td>
<td>3.3</td>
<td></td>
</tr>
</tbody>
</table>

Source: Aarts and van Schagen (2006).

It can be seen from the results in Table 3.5 that changes in mean speeds have a proportionally larger impact on crash severity outcomes at lower speed ranges.

Elvik and Vaa (2004), as cited by Archer et al. (2007) reviewed the current literature on the relationship between speed and crash risk and concluded that across all studies an average 11 km/h reduction in speed can reduce crash frequencies by up to 13%, and larger reductions for fatality crashes as compared to injury crashes. The impact of speed and crash risk is a well-researched area and there are clear positive benefits of introducing lower speed zones with the aim of reducing crash frequency.

**Safe Systems approach**

The current road safety management philosophy in Australia is the Safe System approach, which the Austroads Glossary defines as follows:

The Safe System approach emphasises the way different elements of the road transport system combine and interact with human behaviour to produce an overall effect on road trauma. The key components of the system are safer roads and roadsides (infrastructure), safer speeds and safer vehicles. The Safe System approach is the current philosophy behind the approach to road safety in Australia. The approach accepts that humans will make errors and so crashes are likely to occur. What is required is a road system that takes account of these errors and of the physical tolerances of humans in such circumstances, allowing road users to survive and avoid serious injury in the event of a crash (Austroads 2010a).

One of the key aims of the Safe System approach is to achieve harm minimisation. This involves the avoidance of death or serious injury for those using the road system (Austroads 2010b) and may be achieved through a combination of road infrastructure design, vehicle safety features and importantly the setting safe speed limits to manage human errors and impact tolerance in the event of a crash.

The harm minimisation approach involves setting safe speed limits over a road network so that crash forces are below the biomechanical tolerance of a road user, which is defined by Austroads (2010b) for the five most common crash types. This is shown in Table 3.6.
Table 3.6: Harm minimisation impact speeds

<table>
<thead>
<tr>
<th>Crash type</th>
<th>Impact speed</th>
<th>Harm minimisation impact speed</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car/pedestrian</td>
<td>20 km/h - 30 km/h</td>
<td>30 km/h</td>
<td>Where there is a mix of vulnerable road users and motor vehicle traffic</td>
</tr>
<tr>
<td>Car/motorcyclist</td>
<td>20 km/h - 30 km/h</td>
<td>30 km/h</td>
<td>Where there is a mix of vulnerable road users and motor vehicle traffic</td>
</tr>
<tr>
<td>Car/tree or pole</td>
<td>30 km/h - 40 km/h</td>
<td>40 km/h</td>
<td>Where unprotected road hazards exist within defined clear zone</td>
</tr>
<tr>
<td>Car/car (side impact)</td>
<td>50 km/h</td>
<td>50 km/h</td>
<td>It is advisable to limit approach speeds to less than 50 km/h where there is a likelihood of side impact crashes (intersections or access points)</td>
</tr>
<tr>
<td>Car/car (head on)</td>
<td>70 km/h</td>
<td>70 km/h</td>
<td>Where there is no separation between opposing traffic streams, median barriers should be used or speed limits should be kept below 70 km/h</td>
</tr>
</tbody>
</table>

*Source: Fildes et al (2005), as cited in Ausroads (2010)*

The harm minimisation approach to setting of speed limits has been adopted by road authorities in Australia, including the RTA. It has been a key influence on the approach used in the current NSW Speed Zoning Guidelines. Similarly, in Victoria, the VicRoads Speed Zoning Guidelines (VicRoads 2010) begin with an outline of how important speed management is to achieving the objective of a Safe System approach, while recognising the importance of speed limits to mobility on the road network.

Jurewicz and Hall (2009) discuss the principles of speed limit setting in a Safe System harm minimisation context and identify the effect of certain road characteristics on speed and casualty outcomes, Table 3.7.

While Jurewicz and Hall acknowledge that harm minimisation is always achievable through the adjustment of speed limits to match road infrastructure, they acknowledge that this must be balanced with mobility in accordance with road function. They also recognise that fulfilling this principle may need to occur over the longer-term and suggest that an approach of harm reduction may be 'a short to medium-term option'. This approach is described as follows:

It involves a speed limit 10 km/h to 30 km/h higher than the harm minimisation speed limit, closer to that suggested by the road function. A harm reduction approach would provide a reduced speed limit and driver warning/information telling motorists why the speed limit has been reduced. The harm reduction approach could be used on road links where:

- only some of the supporting road features exist
- application of primary road features would be not practical
- the relevant harm minimisation speed limit would have a low chance of compliance or regular enforcement (e.g. 40 km/h speed limit due to roadside hazards on low volume rural roads).

The RTA NSW Speed Zoning Guidelines outlines a ten step procedure that aims to incorporate the road function, road use, roadside development, road characteristics, and traffic mix into the setting of appropriate and safe speed limits.
Table 3.7: Relationships between road infrastructure, speed limits, speeds and casualty crashes

<table>
<thead>
<tr>
<th>Road characteristics and features</th>
<th>Effects on casualty crashes and speeds</th>
</tr>
</thead>
</table>
| **Existing speed limit**         | • Casualty crash rates (crashes per 100 million vehicle-kilometres) fall with increasing speed limit. This was observed for urban and rural roads, divided and undivided.  
• Crash severity increases with speed limit, especially for rural roads. Urban freeways did not follow this trend and had a relatively low crash severity indicator.  
• These results reflect the traditional approach to speed limit setting which requires various road features to be present for application of higher speed limits – these road features are proxies for reduced crash likelihood not severity. Specific safety requirements on speed zoning of urban freeways are reflected in the reduced crash severity. |
| **Traffic flow**                 | • Casualty crash rates fall with increasing speed limit.  
• Low volume roads tend to have very high casualty crash rates and low casualty crash frequency per kilometre. |
| **Direct access**                | • Casualty crash rates increase sharply with direct access frequency for undivided roads; the increase is relatively small for divided roads.  
• Similar trends were observed for urban and rural roads.  
• Measured speeds were found to decrease with increasing access frequency.  
• Lower speed limits could be considered for road sections with a high frequency of direct access to address the likelihood of casualty crashes. |
| **Lane width**                   | • Casualty crash rates were found not to be correlated with lane width for two-lane undivided urban roads with a 60 km/h speed limit.  
• On high speed roads, wider traffic lanes were found to be correlated with lower casualty crash rates.  
• Narrow traffic lanes on roads with a speed limit of 80 km/h or higher could be considered as a trigger for adopting a lower speed limit. |
| **Sealed shoulder width**        | • For undivided rural highways, greater sealed shoulder width was strongly correlated with lower casualty crash rates.  
• Lack of sealed shoulders, or very narrow sealed shoulders, on undivided rural highways could be a trigger for consideration of a speed limit below 100 km/h, if shoulder sealing cannot be carried out in a reasonable timeframe. |
| **Horizontal alignment**         | • Casualty crash rates were observed to increase strongly with the frequency of curves per kilometre. The mean casualty crash rate for rural undivided roads is exceeded for road sections with > 2 curves per km.  
• Lower speed limits may be considered for roads with frequency of curves higher than 2 per km. |
| **Median width**                 | • Casualty crash rates and mean speeds on urban divided arterials (not freeways) increased in the presence of a wider median (low statistical significance). |
| **Setback**                      | • Casualty crash rates and mean speeds increased in the presence of a greater setback to the property line (low statistical significance). |
| **Other road user factors**      | • In the urban road environment, an increased casualty crash rate was associated with other factors including presence of at least one of the following: preschools, kindergartens, day care centres, school crossings, frequent parking manoeuvres, recreational or tourist traffic, a significant proportion of heavy vehicles. |

Jurewicz and Hall 2009

Effect on journey times

It is a common perception that higher travel speeds lead to reduced travel time. Higher speeds can have the potential for journey time savings but as often occurs in an urban environment the journey time savings can be negligible due to delays from stop and start movements associated with traffic signals, intersections and congestion (OECD/ECMT 2006). A study by TRB (1998), as cited by Archer et al. (2008) revealed that travel time is more dependent on congestion, roadway design and geometry factors than the signposted speed limit.

A study conducted by NSC (France), cited by OECD/ECMT (2006), examined the relationship between traffic flows and speed along an urban motorway. This relationship is shown in Figure 3.2.
From Figure 3.2 it can be determined that maximum traffic flows along an urban motorway occur at speeds between 60 km/h - 70 km/h, often far lower than the speed limits that are set for such roads.

In a built-up environment, Taylor (2000), as cited by Archer et al. (2007) has shown that a speed limit of 60 km/h produces the optimum traffic flow over the road network.

Another study by Sehier, as cited but not referenced by OECD/ECMT (2006), has revealed that 'in built-up areas, reducing the average speed from 50 km/h to 30 km/h does not cause a very significant decrease in traffic flow capacity.' This is illustrated in Figure 3.3.
Archer et al. (2008) state that lower speeds can create reduced travel times over road networks that have a low to medium traffic density, where the traffic is able to travel close to the sign-posted speed limit. This results from traffic being able to travel at a smoother and more harmonic traffic rhythm. In addition, lower speeds can improve traffic flows over the road network through less lane changing, less speed dispersion, and greater headways. This can lead to fewer crashes and improve road safety for all road users.

The perception may be that higher speeds improve journey times, although research indicates this is marginal, but the synergy between the impacts on safety also needs to be evaluated. Rather than increased speeds, a more homogenous distribution of speeds as an objective can lead to improved traffic flows and journey times.

**Effect on the environment**

It is commonly understood that emissions from road vehicles that contain several different types of pollutants can have an adverse impact on the environment. In addition, the noise from road vehicles can also affect the environment and certainly impact on those living and working near busy roads. The UK Department for Transport has reported that at speeds between 40 km/h - 90 km/h, the emissions from vehicles are minimised. This is shown in Figure 3.4.

In a Japanese study it was concluded that the optimum speed for vehicles to minimise emissions was 50 km/h to 70 km/h. It should also be noted that at low travel speeds, below 15 km/h, the emissions from vehicles are at their highest (OECD/ECMT 2006).

![Figure 3.4: Gaseous emissions as a function of speed](image)


**Effect on fuel consumption and operating costs**

Fuel consumption in vehicles increases with speed resulting in increased vehicle operating costs. Reducing speeds from 100 km/h to 90 km/h can lead to approximately 23% in fuel cost savings.

Fuel consumption can increase at speeds less than 20 km/h (OECD/ECMT 2006).
In the Netherlands, there was a saving of 40 million litres of fuel when the mean speed on the motorways was reduced from 111 km/h to 104 km/h (Archer et al. 2008). Similarly, in New Zealand in 1996 there was an increase in fuel consumption by 10% when the speed limit was increased from 100 km/h to 110 km/h on motorways (Warning 1996, as cited by Archer et al. 2008).

In addition to fuel costs, the overall vehicle operating costs will also increase due to increased maintenance resulting from general wear and tear of the various vehicle components such as tyres and brake pads. Increased fuel costs and maintenance costs resulting from higher speed limits may not have a detrimental impact on private vehicle owners but it can have a significant impact on commercial vehicle fleet operators (Archer et al. 2008).

Sections 3.5 to 3.8 discuss the findings of the literature review as related to the specific policy options under examination.

### 3.5 Policy option 1: Increase the length of speed zones

Australian Standard AS 1742 – 2008 Part 4 Speed Controls states that speed limits should be set to encourage a uniform speed of travel and to reduce the potential for conflicts due to speed differentials between vehicles. It further identifies that excessive variation in vehicle speeds may suggest either an inappropriately set speed limit or non-compliance with the signposted speed limit due to driver confusion about the speed environment.

Speed zones in Australia are typically used where the general default speed limit is not appropriate for the existing road and traffic conditions. The speed zones may have a speed limit that is either lower or higher than the general speed limit associated with that particular type of road and traffic conditions.

The Australian Standard indicates minimum speed zone lengths for use by the state road authorities in Australia, Table 3.2. The state road authorities have generally adopted the minimum speed zone lengths with some modifications to suit local policy and application, also shown in Table 3.2.

It can be deduced from Table 3.2 that for speed limits greater than 60 km/h, NSW has minimum speed zone lengths significantly longer than all other Australian and New Zealand jurisdictions. The Australian Standard states that it is preferable to maintain consistent speed zone lengths to avoid confusion among drivers. The NSW Speed Zoning Guidelines advises that in order to avoid excessive variations in speed limits a balance needs to be achieved between:

- roadside development
- road environment
- number of changes of speed limit.

VicRoads (2010) has stated that the minimum speed limit lengths are used to limit the frequency of changing speed limits along a route.

Based on the literature reviewed, there appears to be a lack of research evidence that explicitly defines optimum minimum lengths of speed zones. Koravos and Styles (2008) completed a literature review on the minimum length of speed zones, which provided the following conclusions:

- The current minimum lengths of speed zones used by the various state authorities in Australia have not been derived from empirical evidence.
Minimum speed zone lengths for different contexts such as school zones, shopping strips etc. have been established across the various jurisdictions leading to inconsistencies in the speed zones.

Current minimum lengths of speed zones allow for adequate enforcement and there is no requirement to increase the minimum lengths in order to ensure satisfactory enforcement of the speed limits.

In addition to the above conclusions, Koravos and Styles (2008) also highlighted the following observations:

- In Tasmania, the minimum length of speed zones is equivalent to 0.6 minutes of travel time and is used to avoid constantly changing speed limits along a section of road (Department of Roads and Transport 1993).

- Circular 1/93 Setting local speed limits, the UK Department for Transport has recommended a minimum length of 600 m for speed zones. The minimum length can be reduced to 300 m – 400 m on roads with local access functions. These lengths are reduced from the minimum length of 800 m specified in a guide published in 1993 by the UK Department for Transport.

- Varying lengths of speed zones can lead to adverse safety implications due to driver confusion, especially if a higher speed zone is located between two lower speed zones.

The literature review for this policy option did not indicate any clear evidence for the best method to determine the minimum length of speed zones.

3.6 Policy option 2: Use of shorter speed zones at isolated locations

An isolated at-risk point can be defined as a point or short length hazard on a road that may pose a crash risk to drivers and other road users if they were to negotiate the hazard at the prevailing speed. Examples of at-risk points include:

- isolated intersections along a rural road network
- sections of road with several consecutive substandard curvilinear sections
- rural hamlets and villages on a through road
- narrow bridges on an otherwise wide cross-section
- intersections on stretches of road with no or limited access and other side road junctions (they may be signalised or unsignalised intersections)
- areas of pedestrian activity where such activity is generally unexpected.

For reasons of safety, these locations may require drivers to approach the at-risk location or hazard at a speed that is lower than the general speed suited for that particular road environment. The impact on mobility of using shorter speed zones that are less than the minimum length, as stated in the NSW Speed Zoning Guidelines, is of interest.

Australian Standard AS1742 Part 4 Speed controls stipulates, in section 2.1.2 General principles:

(b) The speed limit shall not be so low that a significant number of drivers will not be able to understand the reason for it and hence tend not to observe it.
(c) Where the speed limit exceeds the maximum safe speed of travel due to an isolated geometric deficiency or hazard, advisory speed signs displayed in conjunction with the relevant warning signs shall be used to advise drivers of the need to reduce speed. Speed limits shall not be applied specifically for this purpose.

Department for Transport (2006) similarly states, at clause 41, that:

speed limits should not be used to attempt to solve the problem of isolated hazards, for example a single road junction or reduced forward visibility such as a bend, since speed limits are difficult to enforce over such a short length.

The current NSW Speed Zoning Guidelines similarly makes comment about the use of shorter lengths of lower speed limits. It reinforces current recommended practice to utilise appropriate advisory warning signs to inform drivers about an approaching hazard and the need to adjust their driving speed accordingly. In the case of isolated curves or a series of curves for example, common standard practice is to erect curve advisory speed signs rather than impose a lower regulatory speed limit.

The literature review did not indicate any published literature that investigated the use of shorter speed zones at-risk locations. Lower speed zones have been used in areas such as school zones, shopping precincts and approaches to rural villages. In NSW, 40 km/h speed zones are used in school zones and areas of high pedestrian activity such as shopping strips or precincts. In the UK, the Department for Transport has used 20 mph (32 km/h) speed zones along a road network that passes through a village, home zones and high pedestrian activity areas (Department for Transport 1999).

There may be scope to use shorter speed zones at at-risk locations to improve road safety at these locations. Section 3.4 indicates reducing speeds say from 50 km/h to 30 km/h over short distances has very little impact on mobility objectives.

Compliance may be an issue with drivers failing to heed reduced speed limits on a short section of road. Regulatory speed limits should be able to be enforced, if required, to ensure that road safety objectives are met. The concern with shorter speed zones is the difficulty of enforcement due to their location and restricted roadside environment combined with their short length.

### 3.7 Policy option 3: Remove 70 km/h and 90 km/h speed limits

The 70 km/h and 90 km/h speed limits are speed zones currently in use in NSW. The typical application of these speed limits in NSW defined in the *NSW Speed Zoning Guidelines* and summarised in Table 3.3.

The literature review did not identify any published material that discussed or examined the justification for 70 km/h and 90 km/h speed limits, or indicated what effects might arise from their removal as options.

Long et al. (2006) examined the impact of reducing speed limits from 110 km/h to 100 km/h along a number of roads in South Australia. The study revealed a decrease in mean speed of 2 km/h with casualty crashes reduced by 32%. A similar study, Long and Hutchinson (2008) investigated the reduction of 100 km/h speed limit to 80 km/h at Adelaide Hills in South Australia and concluded that casualty crashes were reduced by 8%.

In both studies, journey time analysis was not completed.
3.8 Policy option 4: Strict speed limit regime in urban areas

The default urban speed in NSW is 50 km/h in built-up areas. The NSW Speed Zoning Guidelines has defines the default urban speed limit as the statutory speed limit that applies in the absence of speed limit signage.

The guidelines further define a built-up area as an area of at least 500 m in length that includes the following:

- buildings not over 100 m apart on land next to the road
- street lights not over 100 m apart.

The general urban speed limit in Australian jurisdictions was 60 km/h. This was changed to 50 km/h after a study concluded that the 60 km/h speed limit was too high for urban areas from a road safety perspective (Austroads 1996). State road authorities changed the urban speed limit in their jurisdictions progressively from 2001 onwards with NSW having completed its change to the 50 km/h default urban speed limit in November 2003.

The benefits of reducing the urban speed limit to 50 km/h in terms of reducing the crash rates have been well documented in the literature, for instance Langford & Fildes 2007. The speed limit of 50 km/h has been widely accepted as suitable for urban areas as it has been proven to achieve success in improving the overall road safety in the urban environment. Elvik (1998) found that the optimum speed limit in urban areas that can reduce speed related impacts was 50 km/h.

Tziotis et al. (2001) completed a study into the impacts of the 50 km/h urban speed limit in NSW. They revealed that the 50 km/h speed limit resulted in a:

- 21% reduction in all crashes
- 20% reduction in all casualties with substantially higher reductions for special road user groups such as young children and older drivers
- reduction of 22% in drivers travelling at speeds in excess of 60 km/h.

There does not appear to be consistency in the application of the 50 km/h default urban speed limit in NSW. There are a significant number of urban roads in NSW that have been speed zoned 60 km/h. Both speed limits have been implemented along roads with a similar type of road environment. As a result, frustration and confusion may arise among drivers due to the different speed limits in similar road environments.

Introducing a 60 km/h speed limit instead of a 50 km/h speed limit may not necessarily reduce travel time. Austroads (1996), as cited in Archer et al. (2007) have stated that reducing the speed limit from 60 km/h to 50 km/h will have negligible impacts on journey times due to the nature of the urban road network that comprises intersections, traffic signals and congestion.