Newell Highway Route Performance Review

October, 2008

Prepared for
NRMA Motoring & Services

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NCSI Certified Quality System ISO 9001

2112664A PR_2071 RevB

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Date:	27 October 2008..
Distribution:	PDF ....

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Executive summary

The Newell Highway is the longest highway in NSW, spanning 1060km from the Victorian border, near Tocumwal, to the Queensland border, near Goondiwindi. As an inland highway, it is a lifeline for the regional centres and towns along its route. It is also a crucial road link for commuter, freight and tourist traffic to destinations along and beyond the Highway. The Newell Highway is critical to Australia's economy as part of the Auslink national freight corridor between Melbourne and Brisbane. Due to the lack of a continuous inland rail network linking these two capital cities, they are heavily dependent on road haulage to perform and prosper.

This NRMA Motoring & Services (NRMA) *2008 Route Performance Review of the Newell Highway* follows on from NRMA's most recent review in 2002. The review provides an opportunity to highlight the changes and trends that have occurred along the Highway since 2002 and to track how the Highway is performing in terms of key performance criteria, such as the increase in traffic volumes including trucks and numbers of crashes. The 2008 Route Performance Review follows the approach of the previous reviews and enables a comparison of the highway's current and historic performance. As the road network and the surrounding land use changes over time, the regular review is critical in checking the health and contribution of the highway. This review identified sections of road that still require attention and some sections that have improved since 2002.

The 2008 Route Performance Review consisted of:

- an analysis of traffic volumes changes along the Newell Highway including numbers of cars and trucks
- a Route Condition Survey of key attributes such as number of lanes, speed limit changes, overtaking opportunities, pedestrian crossings and potential hazards located in the clear zone along the side of the road
- an analysis of road safety history of the Highway and an investigation of specific crash locations.

Traffic volumes and vehicle types

The traffic analysis showed that the traffic volumes in the urban centres along the Highway greatly exceeded those in its rural sections showing the route is a critical part of the local town accessibility. Dubbo recorded the highest levels of use, with approximately 5,000 vehicles carried per day in 2006[1]. The northern section of the highway between Gilgandra and the Queensland border carried higher traffic volumes compared with the southern section of the Highway, between Jerilderie and West Wyalong. This is most likely the result of the larger populations centres in the northern section including Parkes (11,700) Dubbo (30,500), Moree (9,200) and Narrabri (6,100).

The percentage of trucks using the highway is significant with trucks representing one in every two vehicles in certain sections (e.g. between West Wyalong and Parkes, and Narrabri and the Queensland border) and 35% of all vehicles on average. This compares with a figure of 10-20% for the Pacific Highway (PB, 2006).

[1] The latest available traffic volume data is from 2006.

Route condition survey

A route condition survey was carried out while driving the route and documenting road attributes such as speed zones, overtaking restrictions, speed reductions for curves, number of lanes, lane widths, pavement condition, the width of the sealed shoulder and its condition, provision of edge lines, rest areas, railway level crossings, and narrow sections and squeeze points.

A summary of the conditions found along the route follows.

Summary of the route condition survey

Route condition attribute	Summary of survey results
Speed limits	84% of the 1060km of the highway is zoned as a 110km/h speed zone. Approximately 5% of the highway is zoned for speeds of 70km/h or less. These are mainly within the towns along the Highway. The conversion of more of the Newell Highway to 50km/h speed zones has reduced the overall length of 60km/h zones rather than eroding the 110km/h zones.
Overtaking restrictions	Overtaking demands are more significant within the rural sections of the highway. Of the 1060km route, approximately 928km of cumulative length is of rural character. Overtaking is restricted (ie. it is prohibited for at least one direction) on about 21% of the total length of highway within these rural sections. The sections between Parkes and Narrabri contain the greatest lengths of overtaking restrictions, as a percentage of overall length. In particular, 45% of the 93km section between Gilgandra and Coonabarabran is subject to overtaking restrictions, increasing the risk of delays due to the number of heavy vehicles. Overtaking lanes are provided for only 9% (86km) of the total rural length of highway. It is not balanced by directions as 60km is in the northbound direction and 26km is in the southbound direction.
Horizontal alignment	There are 24 horizontal curves along the Highway that have been signposted with curve warning signs. This is four less than in the 2002 Route Condition Survey. 12 of these also have advisory speed signs, three of which are signposted as 85km/h curves and nine at 95km/h curves. The highest frequency of signposted curves were identified in the sections from Jerilderie to Narranderra, West Wyalong to Forbes, Parkes to Dubbo, Gilgandra to Coonabarabran, and Narrabri to Moree.
Number of lanes	91% of the rural sections of the highway provide one lane in each direction. As stated above, approximately 9% (86km) of the rural sections have a third lane for overtaking. These are provided between Forbes and Coonabarabran.
Lane widths	The lane widths were generally adequate along the entire Highway.
Pavement condition	The majority of the pavement appeared to be in fair or good condition.
Sealed shoulder widths	35% of the rural road sections contained narrow sealed shoulders, while 25% had acceptable shoulder widths and 40% provided wide sealed shoulders. Narrow sealed shoulders reduce the recovery area available for errant vehicles. These were most common in the rural sections between Coonabarabran and Narrabri, and from the Victorian border to Jerilderie.
Rural sealed shoulder condition	Approximately 35% of the rural sealed shoulders were in poor condition. Poor shoulder condition includes pavement failures such as corrugations, shoving, deteriorating sealed edge condition and edge drop off. These pavement failures compromise recoverability for errant vehicles.

Route condition attribute	Summary of survey results
Clearance from the road	In general, the clear zones along for the Newell Highway were reasonable. However, the sections between Jerilderie and West Wyalong, Parkes and Dubbo, and Gilgandra and Narrabri contained a number of substandard clear zones due to trees, rock cuttings or other hazards.
Provision of edge lines	All rural sections of the Highway had delineated edge lines.
Rest areas	In general there were sufficient rest opportunities provided with 59 rest areas spaced an average of 17.3km apart. These rest areas all allowed for heavy vehicle parking[2].
Railway level crossings	There are 11 railway level crossings of the Newell Highway, four of which are in high-speed rural areas. All level crossings are controlled by flashing lights.
Narrow sections	109 bridges and narrow squeeze points were recorded. These included 98 bridges and 11 other squeeze points.

Road Safety Performance

The safety performance assessment for the Newell Highway involved analysis of crash data for the five-year period between 2002 and 2006. During this period, there were 1011 reported crashes including 43 (4.3%) fatal crashes, 467 (46.2%) injury crashes and 501 (49.6%) tow-away crashes. The combined 510 casualty crashes resulted in 60 deaths and 694 injured persons.

The overall trend in the frequency of all crashes was a steady decline over the 10-year period from 1997 to 2006. In 2006, the total number of crashes, at a 171, was approximately two-thirds of the number reported in 1997. Even better news, the rate of 95 casualty crashes was approximately 70% of the casualty crashes reported in 1997.

Since 2002, when the previous Newell Highway Route Performance Review was completed, there has been a decline in both the numbers of crashes and casualty crashes. The number of crashes has reduced from 232 to 171 from the year 2002 to 2006. The number of casualty crashes has reduced from 113 to 95 throughout the same period.

The breakdown into crash type was similar profile to that reported in the 2002. 47% of all crashes were single vehicle crashes and a further 6% were crashes involving animals, which are common in rural areas. While 47% of crashes were multiple vehicle crashes which were the dominant crash types in urban areas.

During the five year period, approximately 31% of all crashes involved a heavy vehicle as a key vehicle involved. This was consistent with the proportion of heavy vehicles using the highway. 62% of crashes involved cars as the key vehicle. This breakdown by vehicle type was similar to that reported in 2002.

The analysis of crash frequency by speed zone revealed that the most significant changes were the proportion of crashes occurring in 50km/h and 60km/h zones, as well as 100km/h and 110km/h zones. Due to the increased number of 50km/h zones, the relative crash frequency between 50km/h and 60km/h zones changed from a ratio of 15:85 in the 1998-2001 period to a ratio of 43:57 in the 2002-2008 period. The proportion of all crashes that occurred in 110km/h zones decreased from 68% in the 1998-2001 period, to 53% in the 2002-2006 period.

[2] Note: There were also a smaller number of light vehicle only rest areas, but these are not included in the surveyed number of 59 rest areas.

The 2002 Route Performance Review reported 19% of all crashes occurred on a wet road surface. In the 2002-2006 period, this fell to 15%, which is probably attributable to reduced rainfall and drought conditions during this period.

An analysis of crash rates for urban and rural sections revealed that crash rates (per 100MVKT[3]) for rural areas were higher than those reported in 2002. Upon closer examination, this appeared to be primarily due to the reduced traffic volumes reported now compared with the 2002 report.

The crash rates analysis showed that the highest rates were experienced in the sections between Jerilderie and Forbes, and between Coonabarabran and Narrabri. These sections experienced more than 20 crashes per 100MVKT. The section between Jerilderie and Forbes also experienced more than 15 casualties per 100MVKT. This was relatively consistent with the distributed crash rates reported in the 2002 report.

The corresponding analysis for urban sections revealed that Dubbo experienced the highest crash rate, with approximately 500 crashes and 267 casualties per 100MVKT. Narranderra, West Wyalong, Parkes and Moree all experienced similar rates, with approximately 150-200 crashes and 100-150 casualties per 100MVKT.

Investigation of crash locations

Using similar criteria to the 2002 Route Performance Review, PB identified six crash locations for further investigation. These included:

- intersection of the Newell Highway, Alice Street and the Gwydir Highway, Moree
- Newell Highway, from Darling Street to Macquarie Street, Dubbo
- intersection of the Newell Highway and Thompson Street, Dubbo
- Newell Highway from Victoria Street (Mitchell Highway) to Baird Street, Dubbo
- Newell Highway from Church Street to Dalton Street, Parkes
- Newell Highway (Hartigan Avenue) between Forbes Street and Bogan Street, Parkes.

The roundabouts at Newell Highway/ Alice Street/ Gwydir Highway (Moree), Newell Highway/ Darling Street (Dubbo) and Newell Highway/ Victoria Street (Mitchell Highway) appear to contain similar line-marking deficiencies in the approach, as well as within the circulating path, of the roundabout. In each case, there are two lane approaches to the roundabout but only one marked lane within the circulating path of the roundabout. This would increase the risk of side-swipe and rear-end crashes, as drivers would not be given sufficient guidance to maintain lane discipline and lateral clearance to other traffic.

Speed was identified as another common cause of crashes, particularly at the Newell Highway/ Alice Street/ Gwydir Highway roundabout (Moree), and the Newell Highway/ Thompson Street intersection. These intersections are in road environments where drivers

- may not be aware of the changes in road condition, intersection control and presence of conflicting traffic streams in the road ahead; and/or

[3] MVKT is million-vehicle-kilometres-travelled and is a measure of crash *exposure*. The greater the length of road, and the greater the volume of traffic on that road, the higher the MVKT will be. The higher the MVKT, the greater the crash exposure.

- may get a false impression of the safe speed at which to negotiate the road. This would increase the risk of several crash types, including single vehicle loss-of-control crashes or multiple vehicle crashes due to a failure to stop or sudden braking behaviour.

The lack of visibility and restricted sight distance to traffic control devices, such as traffic signs and traffic signals as well as to other traffic streams was identified as possible crash causation factors for the Newell Highway intersections with Macquarie Street and Thompson Street, in Dubbo. In the southbound approach to Macquarie Street, a crest vertical curve restricts the stopping sight distance of the traffic signals, as well as to the back of the traffic queue which is variable in location. At the Thompson Street intersection, a combination of the road's alignment and a railway bridge support column restrict a number of critical sight lines required for turning safely at Thompson Street.

High traffic volumes along the Newell Highway at priority controlled intersections were identified as a possible crash causation factors at the Newell Highway/Thompson Street intersection (Dubbo), as well as the section of the Newell Highway between Church Street and Dalton Street, Parkes. The high traffic volumes and lack of gaps in the traffic stream would reduce opportunities for side road traffic to enter the Newell Highway. The lack of safe opportunities may result in greater risk taking by the waiting traffic, which could increase the risk of multiple vehicle crashes.

The Newell Highway intersections with Forbes Street and Bogan Street, in Parkes, present a number of challenges to road users. Firstly, as the Highway makes two 90° turns in this section, the priority rules for these intersections is unconventional, with certain turn movements having right-of-way over all other traffic. As the priority rules are unconventional, many drivers may be confused on appropriate, safe behaviour. This site is further complicated by a railway level crossing which reduces the safe queuing space between the two intersections.

The way forward

NRMA's Route Performance Review suggests a number of strategies that could improve road, transportation and travel conditions along the Newell Highway.

- *Continue road upgrades to enable a consistent rural speed limit of 110km/h throughout the length of the highway*. The route condition survey revealed that approximately 6% of the highway is signposted with a 100km/h speed limit. These zones tend to be in the more undulating country, with relatively poorer road geometry.

- *Strategic provision of overtaking lanes in undulating sections*: The overall length of overtaking lanes has increased between 2002 and 2008. However, there are many sections, particularly in the more undulating sections between Gilgandra and Coonabarabran, which lack overtaking provisions. Their provision would achieve better management of conflicting traffic and road functions, such as between caravans and faster moving freight trucks.

- *Increased widths of sealed shoulders*: Although lane widths were adequate throughout the entire route, approximately 35% of the route contained narrow sealed shoulders. Standard shoulder widths should prevail along the whole highway. This would reduce the single vehicle crash risk.

- *Strategic management of clear zones*: In general, the clear zones along the highway were in good condition. However, there are still a large number of clear zones that contain unyielding crash hazards such as trees, cuttings and steep embankments. These could be identified and priority treated. This would reduce single vehicle crash risk.

- *Strategic management of squeeze points*: It is acknowledged that many squeeze points cannot be addressed without substantial expenditure. However, a strategy could be developed for a consistent management scheme that included advanced warning signs, safety barrier upgrades and approach delineation.

- *Development of improvement options for the six crash locations* identified including (i) improvements to lane delineation at roundabouts, (ii) improvements to visibility and sight distances, (iii) management of speeds through speed zoning, enforcement and via the design and character of the road, and (iv) clear priority rules for complicated intersections.

1. Introduction

The Newell Highway is an Auslink route and a former National Highway which provides a critical inland road transportation link between Melbourne and Brisbane. As an Auslink route with no supporting continuous inland rail network between the two state capitals, there is a heavy dependence on this route as a road freight transportation route.

Goods manufactured in or imported into ports at Brisbane and Melbourne are distributed via the Newell Highway to the numerous regional centres along this route as well as those accessed by this route. This includes machinery and equipment required by the various industries in inland NSW.

The Newell Highway also provides a link to major primary industry regions in northern Victoria, central New South Wales and southern Queensland. These range from agricultural production in the Riverina region, including fruits, rice, grain, to cotton production in northern NSW, and wool production in the Central West.

The Newell Highway is also a popular route for tourism traffic as it provides the most direct land transportation route between Melbourne and Brisbane as well as to a large number of inland destinations. Along the route itself, there are numerous tourism attractions such as the Western Plains Zoo at Dubbo, the Siding Springs Observatory in Dubbo and the CSIRO Radio Telescope Observatory in Parkes. The Warrumbungles National Park, near Coonabarabran also attracts more than 70,000 visitors per annum.

The portion of the Newell Highway within NSW is approximately 1060km. It commences in the south at the NSW/Victoria border just south of Tocumwal and crosses the NSW/Queensland border just south of Goondiwindi.

In 1974, 1978, 1994 and 2002, the NRMA conducted Route Performance Reviews of the Newell Highway which included a review and investigation of traffic and safety issues along the route. In 2008, the NRMA commissioned another Route Performance Review for the purpose of providing an up to date “health check” of the highway and to assess the condition of the highway with respect to the previous Reviews.

PB has been engaged to undertake the 2008 Route Performance Review which included an analysis of traffic and road safety data for the route, a route condition survey and an investigation of crash locations along the highway. PB has used a similar approach and methodology as the 2002 Review to allow for a comparison of the route’s condition and performance. As such, the results of the 2002 Review have been heavily referenced for the purpose of comparison with the current performance of the highway.

This Route Performance Review was undertaken between July and September 2008.

2. Survey route and traffic volumes

2.1 Survey route

The route surveyed as part of the 2008 Route Performance Review for the Newell Highway is shown in Figure 2-1 and in more detail in Figure 2-2. Although the Newell Highway forms part of the national route between Melbourne and Brisbane, only the portion of the route in NSW was reviewed as part of this study. The study section is between the NSW/Victoria border near Tocumwal, and the NSW/Queensland border, just south of Goondiwindi. The total length of this study section is approximately 1,060km.

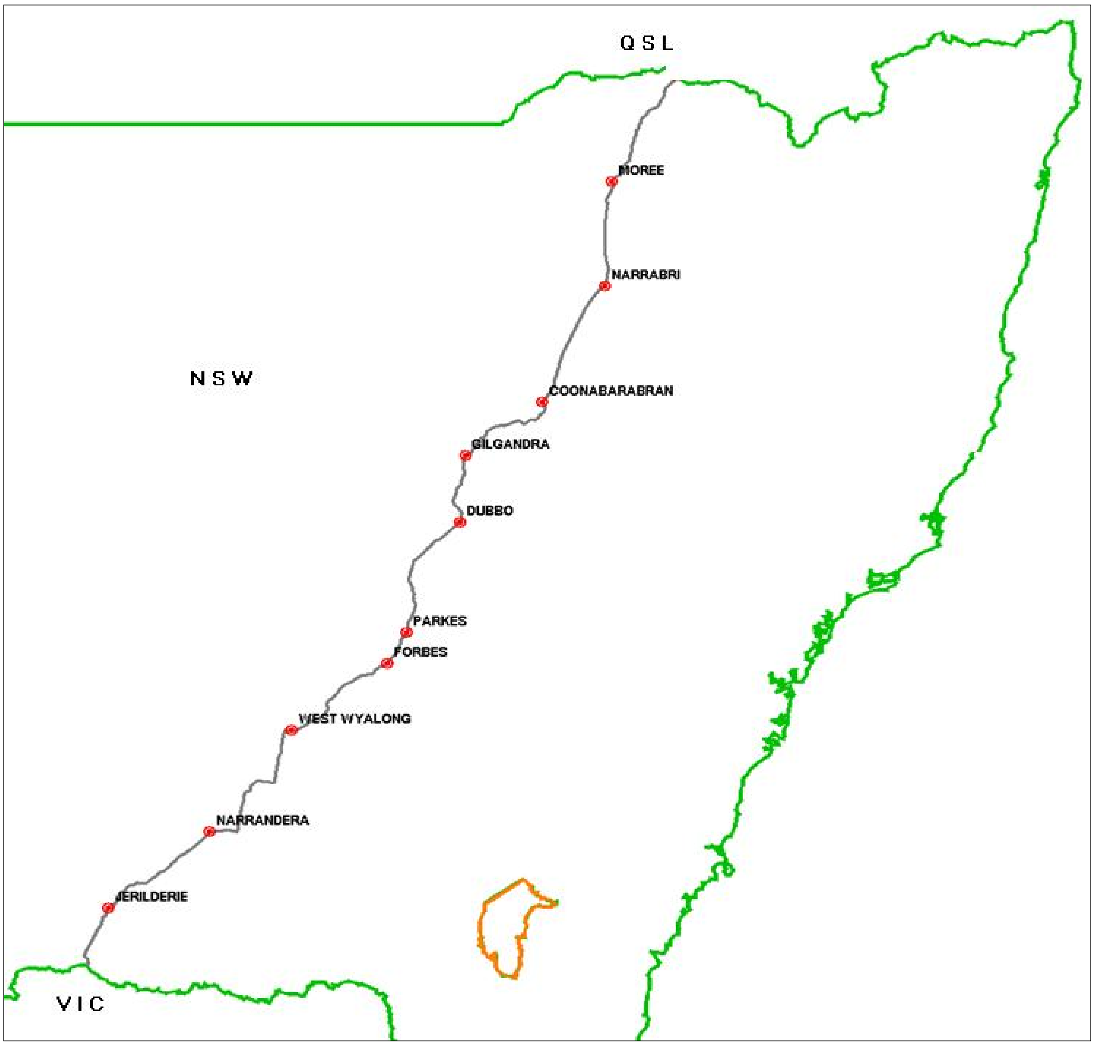

Figure 2-1 The Newell Highway route within NSW.

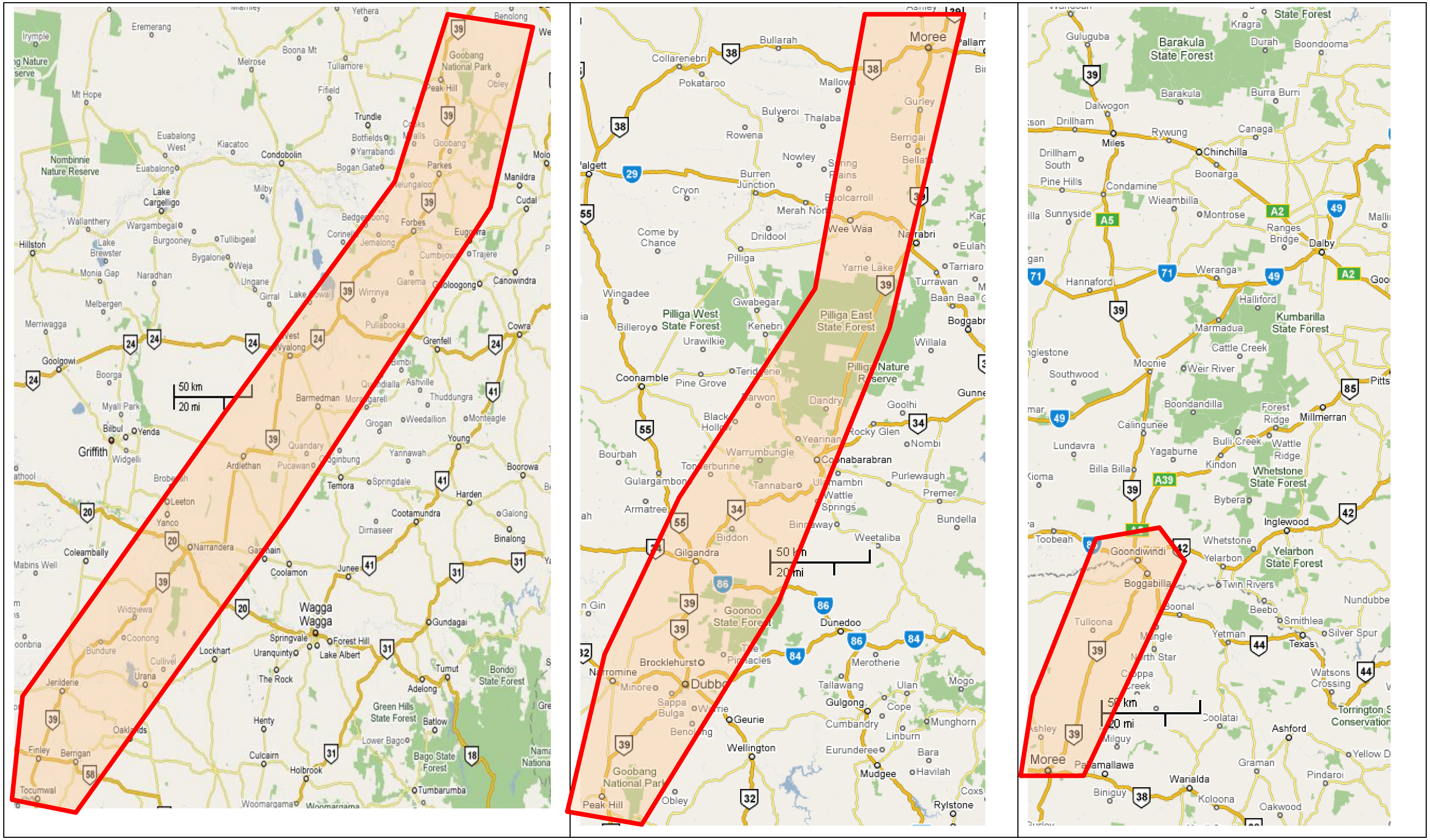

Figure 2-2 The Newell Highway showing the relevant towns and cross roads along the route.

For the purpose of analysis, the survey route was divided into a series of 11 rural links (segments) between 10 urban major population centres. This segmentation was also used in the crash analysis component of this Review to provide separate crash rates for each of the urban and rural sections. Each section has been further divided into an urban and rural section so that the frequency of road crashes within the urban centres can be compared separately with the frequency of road crashes within the rural sections The urban and rural sections within each link are shown in Table 2-1.

Table 2-1 The urban and rural segments.

Section Code	Rural Links / Urban Areas	Urban / Rural	Length of Section (km)
R1	VIC Border to Jerilderie	Rural	56.2
U1	Jerilderie	Urban	2.6
R2	Jerilderie to Narrandera	Rural	105.9
U2	Narrandera	Urban	3.0
R3	Narrandera to West Wyalong	Rural	133.8
U3	West Wyalong	Urban	5.0
R4	West Wyalong to Forbes	Rural	98.5
U4	Forbes	Urban	2.6
R5	Forbes to Parkes	Rural	29.8
U5	Parkes	Urban	4.1
R6	Parkes to Dubbo	Rural	115.2
U6	Dubbo	Urban	4.0
R7	Dubbo to Gilgandra	Rural	61.6
U7	Gilgandra	Urban	1.5
R8	Gilgandra to Coonabarabran	Rural	93.1
U8	Coonabarabran	Urban	3.2
R9	Coonabarabran to Narrabri	Rural	114.0
U9	Narrabri	Urban	4.5
R10	Narrabri to Moree	Rural	96.6
U10	Moree	Urban	3.8
R11	Moree to QLD Border	Rural	121.2
Grand Total	VIC Border to QLD Border		***1060.1***

2.2 Route description

The length of the Newell Highway within NSW is approximately 1,060km. From the southern end to the northern end, it passes through the towns of Finley, Jerilderie, Narrandera, West Wyalong, Forbes, Parkes, Dubbo, Gilgandra, Coonabarabran, Narrabri and Moree as shown in Figure 2-2.

Sections of the Newell highway within these towns are generally of urban character within a built-up area with:

- lower speed limits of 50 or 60km/h
- characterised by other road amenities typical of urban roads such as road lighting and formal road side drainage via kerb and gutter.
- passing through the town centre forming part of the main street of the town centre
- passing around the main commercial/retail area via a number of alternate roads. In the case of the latter, these are not formal town bypasses but rather bypasses using the outer roads of the town's grid network that have evolved over time through use by heavy vehicles. They are still low speed roads that also have an urban/residential character although they do not have the same pedestrian or local access function as the main streets.

Many approaches to the town centres are characterised by a buffer speed zone of 70 or 80km/h, a short speed zone between the high speed rural sections and the lower speed limits in the urban centres.

The rural sections are generally;

- all zoned as 110km/h zones
- are typically a two-lane-two-way undivided road formation
- in most cases, the alignment of the route is good with few curves requiring advisory speed advice
- some overtaking lanes are provided in the more undulating sections
- many rural intersections are treated with safe turning facilities such as indented turning lanes allowing decelerating vehicles to be laterally separate from the faster moving through traffic.

Within the rural sections, there are also a number of small villages, which have lower speed zones. However, these tend to be short sections of the highway where the village consists of a few basic amenities and retail properties surrounding the Newell Highway, mostly associated with a local industry such as a rail loading grain silo.

There are frequent rest opportunities with road side rest areas for both light and heavy vehicles. The majority of rest areas are located within the rural sections however some rest areas are also located within the towns themselves.

A brief description of each section of the highway is provided in Sections 2.2.1 to 2.2.11.

2.2.1 Tocumwal to Jerilderie (56km)

Characteristics of this section of the Newell Highway are;

- mostly flat country and as such the road provides a good alignment and very few clear zone problems
- a few stock crossings between the grazing pastures on either side of the road

- reasonable standard sealed shoulders, wide clear zones and reasonable pavement condition both in the traffic lane and shoulders
- north of Jerilderie, a railway line on the eastern side of the route
- Intersection with the Riverina Highway at Finley which provides an east–west link between Albury and Deniliquin.

2.2.2 Jerilderie to Narrandera (106km)

The northern part of this section has distinctly poorer characteristics compared to the southern part. Characteristics of the northern section are:

- dense vegetation within close proximity to the road provides a poorer clear zone standard compared to other parts of the route
- there are some crest/sag combinations resulting in poorer vertical alignment
- lower standard safety conditions along the number of floodways and causeways just south of Narrandera. Apart from this section, the rest of the section generally provides better safety conditions and also provides a number of rest areas.

Other features of this section are:

- the rail line follows part of this route and as a result a number of towns provide rail loading grain silos
- a grade-separated road/rail bridge is located south of Morundah
- intersection with the Kidman Way north of Jerilderie which provides a link to Griffith
- intersection with Jerilderie Road which provides a connection to Wagga Wagga via Urana
- within Narrandera, the highway makes two 90° turns and also has a number of river crossings.

2.2.3 Narrandera to West Wyalong (134km)

Characteristics of this section are:

- mostly a two-lane-two-way road surrounded by flat country and grassy plains offering wide clear zones and as such the road generally provides a good alignment and driving conditions
- the shoulders and pavement are mostly of good quality and condition
- an overtaking lane is provided along a short section of the highway near Grong Grong
- there are isolated sections with poorer clear zones and trees within close proximity to the road
- the highway makes a 90° turn at Grong Grong and again to the south of Mirrool.

2.2.4 West Wyalong to Forbes (99km)

Characteristics of this section are:

- similar to the sections to the south in that this section of the highway passes through very flat country with grasslands and grazing pastures either side of the road which generally provides good road geometry and road alignment for drivers
- the land, and road, appears to be prone to flooding. This is also exacerbated by the relatively low elevation of the land and the lack of low points and creeks for run-off drainage
- the shoulders and clear zones are generally of high standard
- the straight alignment has few visibility restrictions which allows for safer overtaking via use of the opposing lane.

2.2.5 Forbes to Parkes (30km)

Characteristics of this section are;

- this section is distinctly characterised by a higher frequency of three lane sections where the provision of the third lane alternates for overtaking in either direction
- the overtaking lanes indicate that this section carries a higher volume of traffic probably due to the short distance (30km) between the two towns (Forbes and Parkes) where employment opportunities from one town could generate traffic movements from the other.

2.2.6 Parkes to Dubbo (115km)

Characteristics of this section are:

- from Parkes to Peak Hill, the highway provides undulating conditions with crest/sag vertical curve combinations as well as horizontal curves
- the surrounding land is more undulating compared with other sections, although the ground cover is still mostly grassland rather than heavily vegetated land
- there are some sections with denser vegetation within the road corridor reducing the available clear zone
- north of Peak Hill, the land is much flatter and prone to flooding as evident from a floodplain and a number of causeways
- further north between Tomingley and Dubbo, the highway passes through hilly country again and provides overtaking lanes for section of roadway with steeper grades.

2.2.7 Dubbo to Gilgandra (62km)

Characteristics of this section are:

- this section generally provides a good alignment and driving conditions with very few crests and curves

- wide clear zones are provided and the sealed shoulder is in good condition
- however, there are some isolated sections with narrower shoulder provision
- a number of three-lane sections are provided with the overtaking lane alternating by direction
- at Gilgandra, the Newell Highway makes a 90° turn and bypasses most of the town.

2.2.8 Gilgandra to Coonabarabran (93km)

Characteristics of this section are;

- at the southern end, this section starts off quite flat and has good vertical and horizontal geometry resulting in very few crests and curves
- compared to the section between Dubbo and Gilgandra, there are more lengths of narrow sealed shoulder as well as shoulders in poor condition
- south of Toowareenah, there is a long length of highway without any overtaking lanes, although the terrain is very flat with little or no grades
- north of Toowareenah, the highway meanders around the foot of the Warrumbumbles and as such, traverses a series of hills and has a number of crest/sag combinations as well as more horizontal curves, many which are signposted with advisory speed signs
- due to the surrounding topography north of Toowareenah, the highway has been constructed through a series of cut and fill sections. This presents more challenging clear zone issues such as steep embankments (mostly guardrail protected) and vertical rock faces in the cut sections
- the more hilly terrain has resulted in more overtaking demands which is reflected in the higher number of overtaking lanes. This section also appears to have more rest areas compared with the others
- at Gilgandra the Newell Highway crosses the Oxley Highway (SH34) and the north and south sections of Castlereagh Highway (SH55 & SH86). The western section of the Oxley Highway, from Gilgandra to Warren and Nevertire provides a link to the Mitchell and Barrier Highways. The eastern section of the Castlereagh Highway provides a connection to Dunedoo and then via the Golden Highway to Singleton and eventually to Newcastle.

2.2.9 Coonabarabran to Narrabri (114km)

Characteristics of this section are:

- the most distinct characteristic about the Newell Highway in this section is the surrounding landscape, which is densely vegetated with rocky outcrops. The surrounding land which is mostly the Pilliga State Forest
- the vertical alignment is characterised by a series of alternating cut and fill sections, with the cut sections resulting in vertical rock faces adjacent to the road. While this has attenuated the effects on longitudinal grade to some extent there are still a number of crests and sags

- due to the extensive cut and fill sections there are few horizontal curves
- the fill sections have resulted in steeper embankment slopes which typically have guardrail protection
- the low point of each of the sag curve tends to coincide with low points in the water catchment as indicated by river or creek beds
- Most of this section contains narrow sealed shoulders with deteriorating edge condition and edge drop-off
- the clear zones are generally wide and quite traversable being void of trees and as such also offers a good sight bench
- towards the northern end of the section, the road tends to have more moderately undulating country before levelling out into flatter country
- within Narrabri, the highway makes a 90° turn and bypasses the main street and commercial area of the town. At the northern end of the town, the highway makes another two 90° turns and then extends to the north-west.

2.2.10 Narrabri to Moree (97km)

Characteristics of this section are:

- by contrast to the Coonabarabran to Narrabri section, this section of the Newell Highway passes through flat country with very few water crossings, and as such there are very few bridge and culvert structures. The flat terrain has also allowed for a very straight horizontal alignment throughout most of the section. The surrounding land is dominated by agricultural fields and grazing land
- the flat terrain provides for other rail facilities and throughout this section, a railway line is provided adjacent to the highway. From Narrabri to Bellata, the railway is on the western side of the highway. A road over rail bridge crossing north of Bellata then places the railway line to the east of the highway for the remaining section up to Moree
- the road and railway lines service a number of villages along the highway including Edgeroi, Bellata, Gurley and Tycannah. Grain and rail loading facilities are provided in each of these villages
- disadvantages with these characteristics from a road user perspective include (i) the relatively higher number of 60km/h speed zones along the highway at each of the villages as well as (ii) the higher risk associated with short stacking lengths in side roads (due to the close proximity of the rail lines)
- the highway passes through the Moree town centre where the Newell Highway intersects the eastern and western sections of the Gwydir Highway (SH38). The eastern section of the Gwydir Highway intersects with the Newell Highway at the southern end of the town. This section of the Gwydir provides a link to Grafton via Inverell and Glen Innes.

2.2.11 Moree to Goondiwindi (121km)

Characteristics of this section are:

- Similar to the Narrabri to Moree section, this section of the highway passes through flat country which has resulted in good horizontal and vertical alignment. By contrast, this section does not contain a parallel railway line, as separate rail lines branch east and west to the north of Moree.
- Whilst the flat country presents good alignment and driving conditions, the lack of significant elevation changes provide very few natural drainage channels as indicated by the lack of bridges and culvert structures. This has resulted in a number of signposted floodways. In the event of flooding, a major risk is the lack of alternative routes with the closest parallel north-south routes being the New England Highway and the Castlreagh Highways, approximately 200km east and west of the Newell Highway respectively.
- The highway makes a 90° turn at Boggabilla, at the junction with the Bruxner Highway and then extends north-west towards Goondiwindi. The Bruxner Highway provides an eastbound link to Ballina via Tenterfield and Lismore.

2.3 Traffic volumes

Figure 2-3 shows the 2006 Annual Average Daily Traffic (AADT) volumes as sourced from the RTA website. The traffic volume data for the section of the Newell Highway from Marsden to the Queensland border was collected in 2005 and the data south of Marsden was collected in 2006. For the purposes of this study, PB has regarded these traffic volumes as 2006 figures assuming minimal traffic growth between 2005 and 2006. The traffic volume data in Figure 2-3 is shown in geographical sequence from south to north. The 0km chainage is at the Victorian border.

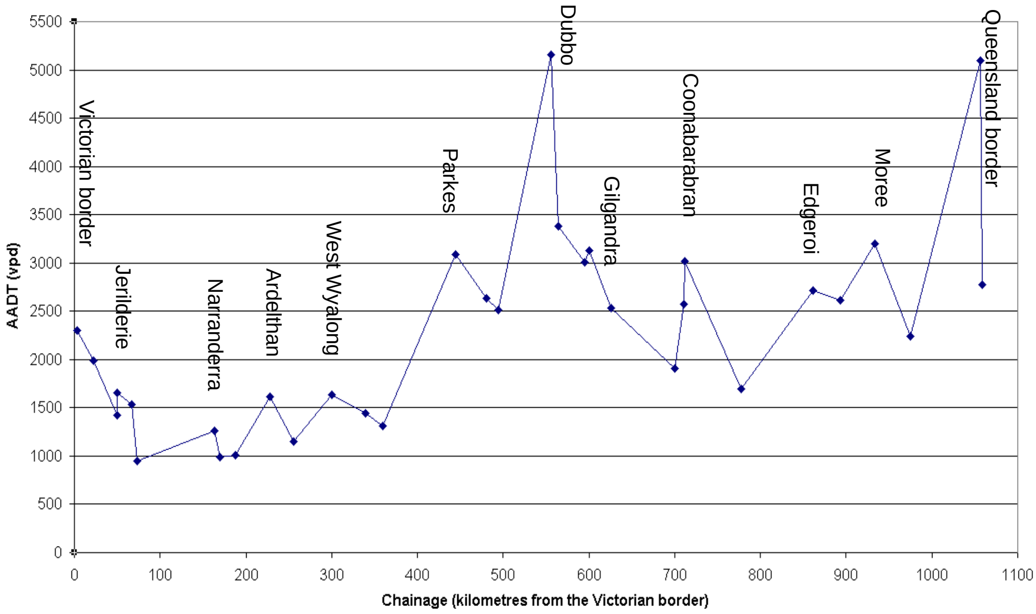

Figure 2-3 traffic volumes (AADT) from the RTA traffic counting stations (vehicles/day)

Figure 2-3 shows a number of peaks which are associated with the higher traffic volumes in the town centres. The troughs tend to be representative of the rural sections of the route which carry considerably less traffic.

The graph shows that the rural traffic volumes in the southern sections of the route are noticeably less than those in the northern section of the route. This is consistent with the trends observed in the 2002 Newell Highway Route Performance Report. Overall there has been an average increase in daily traffic volumes by approximately 1-3% per annum (which varies by location).

2.4 Vehicle types

The importance of this highway as a national freight route is clearly demonstrated in Figure 2-4 which show the distribution of vehicle types at a number of permanent counting stations. The data shown was obtained from vehicle classification counts provided by the Roads and Traffic Authority for portion of the Newell Highway in NSW.

These figures generally show that the proportion of heavy vehicles (i.e. those defined as Austroads classes 3-12) along the route is between 20-50%, with an average of approximately 35%. Light vehicles were those that corresponded to Austroads class 1 and made up between 50-80% of all traffic. Caravans were those that corresponded to Austroads class 2 and made up approximately 4-12% of all traffic. The proportion of caravans on the route is indicative of the traffic generated by travellers. The Newell Highway is a popular road transport route for retired travellers. Although this is still a small proportion compared with all traffic, it does highlight the contrasting (and possibly conflicting) functions of the highway and the resulting diversity in vehicle types.

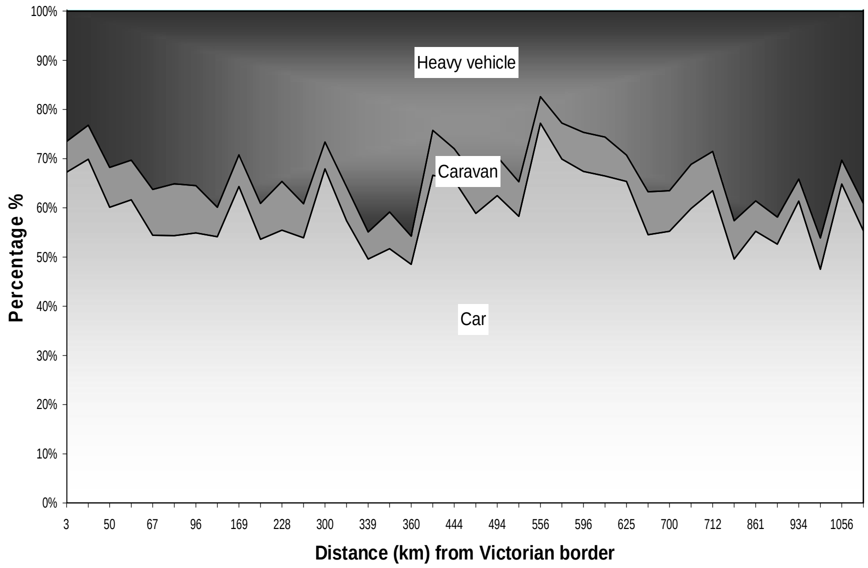

Figure 2-4 The proportion of vehicle types along the Newell Highway.

3. Route condition survey

PB conducted a drive through survey of the Newell Highway from the NSW/Victorian border near Tocumwal to the NSW/Queensland border south of Goondiwindi. The survey utilised state-of-the-art GIS and GPS methods to enable the survey team to log road condition during the survey. The use of GPS equipment ensured that the collected data was geo-referenced and hence able to be spatially viewed and presented in a GIS application. The survey was undertaken in July and August of 2008.

The road condition attributes selected for analysis were those that are the most significant to road users with respect to safety, travel time, travel comfort and amenity. They included:

1. Speed zones
2. Overtaking restrictions
3. Horizontal alignment (curves)
4. Number of lanes
5. Lane widths
6. Pavement condition
7. Rural sealed shoulder width
8. Rural sealed shoulder condition
9. Rural clear zone condition
10. Provision of edge lines
11. Rest areas
12. Railway level crossings
13. Narrow sections and squeeze points

These are further described in Sections 3.1 to 3.13.

3.1 Speed zones

3.1.1 Definition and purpose

Speed zoning involves the setting of speed limits to balance the safety and mobility functions of a road and its surrounding land use. The typical range of speed limits now available to authorities in NSW ranges from 40 to 110 km/h, in 10 km/h increments. All of these speed limits were observed on the surveyed section of the Newell Highway. As part of the route condition survey, the start and end points for all speed zones was documented which enabled the lengths of each zone to be determined.

In general, within the rural section, the higher the speed zone, the better the driving amenity as this would allow for faster travel and hence reduced travel times, presuming that the speed zones were correctly applied in the first place and that the road geometry, function and frequency of accesses were all appropriate for those speed limits.

3.1.2 Survey results

Table 3-1 shows the cumulative lengths for each of the speed zones along the surveyed portion of the Newell Highway. It also shows the proportion of the overall highway length for each speed zone.

Table 3-1 The cumulative lengths and proportion of each speed zone

Speed zone (km/h)	2008 Cumulative length (km)	2008 proportion of length	2002 Cumulative length (km)	2002 proportion of length
50	37.8	3.6%	25.6	2.4%
60	12.4	1.2%	25.5	2.4%
70	6.5	0.6%	3.1	0.3%
80	26.7	2.5%	51.5	4.9%
90	6.6	0.6%	3.5	0.3%
100	61.9	5.8%	61.6	5.9%
110	908.1	85.7%	881.0	83.8%
Total	**1060**	**100%**	**1051.8**	**100%**

The typical functions of each speed zone are summarised below:

- 50km/h: Urban with high pedestrian and local access function
- 60km/h: Urban with relatively less pedestrian and local access function
- 70km/h: Urban fringe or buffer zone
- 80km/h: Urban fringe or buffer zone
- 90km/h: Urban fringe, inter-urban arterial road or buffer zone
- 100km/h: Rural section with poorer geometric standard or level of safety
- 110km/h: Rural section with relatively better geometric standard and level of safety.

Table 3-1 also compares the corresponding results from the previous 2002 route survey. Notwithstanding the slight discrepancy between the total lengths of the highways in both surveys, a comparison between the two survey results indicates the following:

- It appears more urban areas have been converted to 50km/h. This is probably due to the new urban default speed limit which would have resulted in an increased number of roads being converted from 60km/h to 50km/h. It may have also been the result of speed limit conversions from other speed zones. The results indicate that approximately 131km of the highway passes through urban areas and that the ratio of 50km/h to 60km/h zones changed from approximately 50% / 50% in 2002 to 75% / 25% in 2008.
- The cumulative length of 110km/h speed zones increased from 881km to 908km, an increased of approximately 27km (or about 3.1%). However, the overall length of 100km/h zone remained at 61km which indicates that the additional 27km of 110km/h would have been the result of an upgrade to other parts of the highway such as a reduction in 80km/h zones.

- The cumulative length of 80km/h zones reduced from 51km to 26km, an approximate 50% reduction probably indicating a combination of (i) some 80km/h sections being upgraded to higher speed zones, and (ii) an adjustment to the speed zone boundaries to reduce the lengths of buffer speed zones.

These changes would have both positive and negative impacts for road users. Whilst the lowering of more urban speed limits to 50km/h provides improved pedestrian safety and amenity, it also increases journey times for heavy vehicles and freight movement. This would increase the need for alternate routes for heavy vehicles and a greater need to separate the local access and pedestrian amenity of the local town from the through movements.

The provision of more length of 110km/h zones would improve travel times in the rural sections.

The 61km of 100km/h zone that has remained unchanged is between Gilgandra and Coonabarabran. This is due to the more mountainous topography in this section. All other rural sections are 110km/h speed zones.

A total of six school zones were recorded for the highway during the survey. These are zoned as variable speed zones where the 40km/h school zone speed limit applies to the weekday periods of 8:00-9:30am and 2:30-4:00pm on school days. Outside these times, the permanent speed limit of the road for those locations would apply.

Table 3-2 shows the distribution of speed zoning on the National Highway for each of the surveyed links.

Table 3-2 A breakdown of the speed zones by urban and rural link.

Length of Signposted Speed Limit (km)							
Speed zone	**50**	**60**	**70**	**80**	**90**	**100**	**110**
VIC border to Jerilderie	3.9	0.0	1.3	1.7	0.0	0.0	49.0
Jerilderie	2.5	0.0	0.0	0.1	0.0	0.0	0.0
Jerilderie to Narrandera	0.0	0.0	2.1	0.5	0.0	0.0	103.3
Narrandera	2.7	0.0	0.2	0.0	0.0	0.0	0.0
Narrandera to West Wyalong	0.4	1.2	0.0	0.0	2.1	0.0	130.0
West Wyalong	4.0	0.0	0.0	1.0	0.0	0.0	0.0
West Wyalong to Forbes	0.2	0.0	0.0	1.5	0.0	0.0	96.8
Forbes	2.2	0.0	0.0	0.4	0.0	0.0	0.0
Forbes to Parkes	0.5	0.0	0.0	2.5	0.0	0.0	26.7
Parkes	3.8	0.0	0.0	0.3	0.0	0.0	0.0
Parkes to Dubbo	3.8	1.0	0.0	5.1	0.0	0.0	105.3
Dubbo	0.0	4.0	0.0	0.0	0.0	0.0	0.0
Dubbo to Gilgandra	0.0	1.6	0.0	3.0	4.5	0.0	52.5
Gilgandra	0.0	1.5	0.0	0.0	0.0	0.0	0.0
Gilgandra to Coonabarabran	0.1	0.5	1.1	2.7	0.0	51.9	36.7
Coonabarabran	2.6	0.0	0.6	0.0	0.0	0.0	0.0

Length of Signposted Speed Limit (km)							
Speed zone	**50**	**60**	**70**	**80**	**90**	**100**	**110**
Coonabarabran to Narrabri	0.3	0.0	0.9	0.6	0.0	4.3	107.9
Narrabri	4.4	0.0	0.0	0.0	0.0	0.0	0.0
Narrabri to Moree	1.3	2.5	0.0	3.2	0.0	0.0	89.5
Moree	3.8	0.0	0.0	0.0	0.0	0.0	0.0
Moree to QLD border	1.2	0.0	0.0	4.0	0.0	5.7	110.3
Total 2008	**37.8**	**12.4**	**6.5**	**26.7**	**6.6**	**61.9**	**908.1**
Total 2002	**25.6**	**25.5**	**3.1**	**51.5**	**3.5**	**61.6**	**881.0**

3.2 Overtaking restrictions

3.2.1 Definition and purpose

Overtaking opportunity is a type of driver amenity in that it makes provision for vehicles to pass around slower moving vehicles. A restriction or prohibition in overtaking would reduce driver amenity as it could lead to increased delays, longer travel times and increased driver frustration and risk taking behaviour.

Overtaking is normally in higher demand on rural sections where only one lane in each direction is provided. Occasionally more than one lane in each direction is provided in urban areas. As such, the route condition survey only reviewed the overtaking opportunity on rural sections.

The route condition survey involved logging the following attributes:

- The number of lanes provided in each direction: The provision of more than one lane per direction was rare for the rural sections. However, there were a number of sections that provided an additional lane for overtaking, particularly in the mountainous sections or on uphill grades.
- The type of centreline provided: Generally centrelines can be of three types:
  - Separator (S) lines consisting of a broken centreline: These allow both directions to cross the centreline in order to pass around a slower moving vehicle.
  - Separator – Barrier (SB) lines consisting of a broken separator line adjacent to an unbroken line: This allows the traffic immediately adjacent to the separator line to cross the centreline in order to overtake. The opposing direction would not be permitted to overtake.
  - Barrier – Separator (BS) lines which are the reverse of SB lines.
  - Barrier – Barrier lines (BB) lines which consist of two unbroken parallel lines: This would prohibit crossing of the centreline for both directions and hence no overtaking would be possible if only one lane was provided per direction.

In the case of the centreline type and number of lanes the survey involved logging the start and end points at each change in the road attribute. This enabled PB to determine the location and the length of each road attribute. To enable effective capture of this road inventory data, PB made the following exclusions in the survey. A justification for each has been provided.

- PB did not record short sections of barrier centreline associated with intersections. In most cases, these sections were only in the order of 100m long and would result in a large number of short sections where overtaking was not permitted. In the "bigger picture", these short lengths were not significant compared to the long lengths of overtaking opportunity both upstream and downstream of the intersection.
- In some cases, there were short sections of separator (S) centreline between two longer sections of barrier centreline. PB disregarded these short sections as it would be difficult to safely complete an overtaking movement within the short distance.

3.2.2 Results

Table 3-3 shows the lengths of the two-lane sections of the highway in rural areas which have a barrier centreline types (i.e. SB, BS or BB). In the case of SB and BS lines, the traffic immediately adjacent to the broken line (S line) is allowed to cross the centreline to overtake. However, for the purposes of simplifying the analysis and also accounting for the road (both directions) as a whole, PB grouped all barrier lines together.

Table 3-3 Centreline type and overtaking restrictions on the two-lane rural sections (figures in km unless stated)

Rural Link	2 lanes overtaking restricted	2 lanes overtaking unrestricted	2 lanes total	Total section length	% of section with overtaking restriction
VIC border to Jerilderie	0.0	52.7	52.7	52.7	0%
Jerilderie to Narrandera	9.8	96.1	105.9	105.9	9%
Narrandera to West Wyalong	43.1	85.7	128.8	133.8	32%
West Wyalong to Forbe	9.0	89.5	98.5	98.5	9%
Forbes to Parkes	3.5	15.1	18.6	29.8	12%
Parkes to Dubbo	25.9	44.1	70.0	115.2	23%
Dubbo to Gilgandra	15.1	39.4	54.5	61.6	24%
Gilgandra to Coonabarabran	41.6	39.0	80.6	93.1	45%
Coonabarabran to Narrabri	34.2	75.7	109.9	114.0	30%
Narrabri to Moree	13.4	83.2	96.6	96.6	14%
Moree to QLD border	21.4	92.3	113.7	120.5	18%
Total	**216.8**	**712.8**	**929.8**	**1021.57**	**21%**

Table 3-3 indicates that the sections between Narrandera and West Wyalong, and Parkes to Narrabri have the greatest proportions of overtaking restrictions as a result of a barrier centreline being placed adjacent to a single lane of traffic. These are due to the greater number of sight distance constraints due to crest vertical curves as well as horizontal curves with inadequate sight benching.

Table 3-4 shows the cumulative lengths of three-lane sections (i.e. sections with an additional lane for overtaking) for each of the rural links. This table also indicates which direction the overtaking lane is provided for.

Table 3-4 Cumulative length and overtaking lane provision for three-lane sections in the rural links.

Rural Link	1 lane NB, 2 lanes SB		2 lanes NB, 1 lane SB		3 lanes total length
	Length (km)	% of all 3 lane sections	Length (km)	% of all 3 lane sections	
VIC border to Jerilderie	0.0	0%	0.0	0%	0.0
Jerilderie to Narrandera	0.0	0%	0.0	0%	0.0
Narrandera to West Wyalong	2.5	50%	2.5	50%	5.0
West Wyalong to Forbes	0.0	0%	0.0	0%	0.0
Forbes to Parkes	5.3	48%	5.8	52%	11.1
Parkes to Dubbo	5.7	13%	39.5	87%	45.2
Dubbo to Gilgandra	3.1	43%	4.1	57%	7.2
Gilgandra to Coonabarabran	7.3	59%	5.1	41%	12.4
Coonabarabran to Narrabri	1.5	36%	2.6	64%	4.1
Narrabri to Moree	0.0	0%	0.0	0%	0.0
Moree to QLD border	0.6	100%	0.0	0%	0.6
Total	**25.9**	**30%**	**59.7**	**70%**	**85.7**

Dedicated overtaking lanes provide a number of safety benefits including:

- a safer overtaking facility that does not put road users at risk of head-on collisions with opposing traffic
- less decision making requirements regarding overtaking gap acceptance, merge lengths and speeds
- they allow for overtaking even if overtaking sight distances are not available
- overtaking lanes provide a three (or more) lane carriageway which means that most traffic (except those using the overtaking lanes) would be laterally separated by the central lane(s), thereby further reducing head-on crash risk.

3.2.3 Overtaking Restrictions on Previous 5km

Figure 3-1 shows the percentage of length over which overtaking is effectively restricted in the preceding 5 kilometres. This is shown as a continuous record along the entire survey route. This data is used as an indication of the level of driver frustration caused by long sections of limited overtaking opportunities. This data shows that although overtaking opportunities on the Newell Highway are generally good there are a number of locations were frustration may occur due to limited opportunities over previous 5km lengths. This may encourage motorists to take unnecessary risks in order to overtake slower moving vehicles.

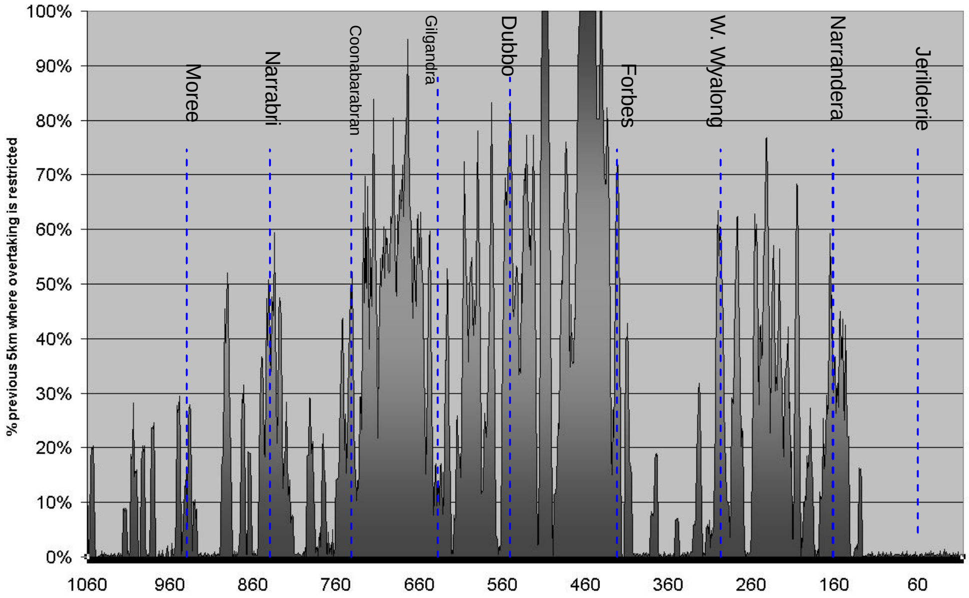

Figure 3-1 Percentage of the last 5km with overtaking restrictions for southbound (chainage is measured as north from the Victorian Border)

The graph shows that there are many sections along the highway for which there are significant lengths of overtaking restrictions (for southbound traffic). In particular, throughout most of the section between Forbes and Dubbo, more than 60% of the previous 5 kilometres contains overtaking restrictions (for southbound traffic). This could lead to increased levels of frustration and traffic delay for motorists in this section. Similarly, throughout most of the section between Gilgandra and Coonabarabran, more than 50% of the previous 5km contains overtaking restrictions (for southbound traffic).

3.3 Horizontal alignment

3.3.1 Definition and purpose

The methodology used in the survey of horizontal alignment was similar to the 2002 survey, which involved recording the number of horizontal curves for which curve warning signs were installed. These curve warning signs are often accompanied by advisory speed base plates.

Advisory speed signs used to supplement curve warning signs indicate the comfortable speed of travel for vehicle occupants, under reasonable weather and road conditions. Where the advisory speed is greater than the speed limit, it is not signposted, although a curve warning sign may still be used. Where the advisory speed is less than the legal speed limit, it is rounded down to the nearest speed limit ending in "5", i.e. 85km/h, 95km/h. The presence of a large number of advisory speed signs is generally considered an indication of poor horizontal alignment. Furthermore, the greater the difference between the speed limit and the advisory speed sign, the poorer the alignment of the curve. This presumes that the curve warning and advisory speed signs were installed correctly in the first place.

3.3.2 Results

Table 3-5 shows the number of curve warning and speed advisory signs on each rural link of the surveyed route.

Table 3-5 The number of curve warning and advisory speed signs for each rural section.

Survey link	Number of signposted curves			2008 Total	2002 Total
	With 85 km/h advisory speed	With 95 km/h advisory speed	No advisory speed		
VIC Border to Jerilderie	0	0	0	0	0
Jerilderie to Narrandera	1	0	5	6	3
Narrandera to West Wyalong	0	0	1	1	1
West Wyalong to Forbes	0	0	3	3	1
Forbes to Parkes	0	0	0	0	2
Parkes to Dubbo	1	1	2	4	5
Dubbo to Gilgandra	1	0	0	1	1
Gilgandra to Coonabarabran	0	4	0	4	11
Coonabarabran to Narrabri	0	0	0	0	1
Narrabri to Moree	0	4	1	5	3
Moree to Queensland Border	0	0	0	0	0
Total	**3**	**9**	**12**	**24**	**28**

In comparison with the 2002 survey, the following changes were noted:

- the section between Forbes and Parkes previously had two 85km/h curves whereas the 2008 survey did not note any curves with advisory speed limits
- the section between Parkes and Dubbo previously had two 85km/h curves and three 95km/h curves. In the 2008 survey these have been reduced to one of each
- the section between Gilgandra and Coonabarabran previously had 10 curves with a 95km/h advisory speed sign. The 2008 survey indicated that there were only four such curves

- the section from Narrabri to Moree previously had three 95km/h curves whereas the 2008 survey noted that this had increased to four.

There are several factors that may affect the comparability of the two surveys such as the record of the signs per travel direction. It should be acknowledged that curve warning and advisory speed advice is not always symmetrical per direction. However, the large contrast between the surveyed results for the sections between Forbes and Parkes, between Parkes and Dubbo, and between Gilgandra and Coonabarabran suggest that there have been some improvements to the route to enable the reduction of advisory speed advice.

The 2002 survey also provided results on the ratio between the number of kilometres to the number of curves. This ratio provides an indication of the frequency of curves per kilometre. The higher the ratio, the better the alignment as this indicates fewer curves per kilometre. A comparison between the kilometre to curve ratio from the 2008 survey to the 2002 survey has been provided in Table 3-6. ‘Infinity’ in Table 3-6 indicates that there were no signposted curves in that section.

Table 3-6 The kilometre (length) to number of curves ratio for each rural link.

Survey link	2002 km/curve	2008 km/curve
VIC Border to Jerilderie	Infinity	Infinity
Jerilderie to Narrandera	36	18
Narrandera to West Wyalong	136	134
West Wyalong to Forbes	106	33
Forbes to Parkes	16	Infinity
Parkes to Dubbo	24	29
Dubbo to Gilgandra	63	62
Gilgandra to Coonabarabran	9	23
Coonabarabran to Narrabri	119	Infinity
Narrabri to Moree	33	19
Moree to Queensland Border	Infinity	Infinity
Average	**36.5**	**42.5**

As seen from Table 3-6, there appears to be an increase in the number of signposted curves in the following sections:

- Jerilderie to Narrandera
- West Wyalong to Forbes
- Narrabri to Moree.

It is uncertain whether these are the result of improved signposting of curves or the increase in speed limits which would have resulted in more substandard curves.

There appears to have been an improvement in the frequency of curves in the following sections:

- Forbes to Parkes
- Gilgandra to Coonabarabran
- Coonabarabran to Narrabri.

The severity of a horizontal curve is also indicated by the difference between the curve advisory speed and the prevailing speed limit. Australian Standard AS 1742.2 defines a substandard curve as being one in which the recommended advisory speed is greater than or equal to 15 km/h below the prevailing limit. Table 3-7 shows the distribution of horizontal curve advisory speeds on each section tabulated against the required reduction from the prevailing speed limit.

Table 3-7 Difference between curve advisory speed and signposted speed limit

Difference between curve advisory speed and signposted speed limit (km/h)					
Rural link	**25**	**15**	**5**	**No advisory speed**	**Total**
VIC Border to Jerilderie	0	0	0	0	0
Jerilderie to Narrandera	1	0	0	5	6
Narrandera to West Wyalong	0	0	0	1	1
West Wyalong to Forbes	0	0	0	3	3
Forbes to Parkes	0	0	0	0	0
Parkes to Dubbo	1	1	0	2	4
Dubbo to Gilgandra	1	0	3	0	4
Gilgandra to Coonabarabran	0	1	0	0	1
Coonabarabran to Narrabri	0	0	0	0	0
Narrabri to Moree	0	4	0	1	5
Moree to QLD Border	0	0	0	0	0
Total	**3**	**6**	**3**	**12**	**24**

3.4 Number of lanes

The fundamental measure of the capacity of a roadway is the number of trafficable lanes it provides. For example in urban areas, traffic capacity is increased by providing more than one lane per direction or by providing exclusive turning lanes at intersections.

For the rural sections, Table 3-8 shows the number of lanes as a proportion of the section length.

Table 3-8 Number of lanes on each rural link (2008)

Rural link	Lengths of rural		
	2 lanes (km)	3 lanes (km)	4 lanes (km)
VIC Border to Jerilderie	52.7	0.0	0.0
Jerilderie to Narrandera	105.9	0.0	0.0
Narrandera to West Wyalong	128.8	5.0	0.0
West Wyalong to Forbes	98.5	0.0	0.0
Forbes to Parkes	18.6	11.2	0.0
Parkes to Dubbo	70.0	45.2	0.0
Dubbo to Gilgandra	54.5	7.2	0.0
Gilgandra to Coonabarabran	80.6	12.5	0.0
Coonabarabran to Narrabri	109.9	4.1	0.0
Narrabri to Moree	96.6	0.0	0.0
Moree to QLD Border	113.7	0.6	6.2
Total	**929.8**	**85.7**	**6.2**
% of total rural length	**91%**	**8%**	**1%**

As seen in Table 3-8, 91% of the total rural length of the Newell Highway is a two-lane road with approximately 85km of three-lane sections between Forbes and Coonabarabran. As mentioned in Section 2.2, the increased overtaking demands in the section of highway between Forbes and Parkes would probably be due to the increased traffic volumes compared to other rural links and the relatively short distance between the towns and the traffic generation impacts of employment and social opportunities in each town.

Section 2.2 describes the topography of the route between Parkes and Coonabarabran which has resulted in more overtaking requirements.

Of interest is the short (6km) section between Moree and Boggabilla where four lanes are provided.

A comparison with the 2002 survey revealed the following upgrades from two lanes to three lanes (i.e. the provision of an overtaking lane):

- Narrandera to West Wyalong: An additional 5km of road was upgraded to three lanes
- Forbes to Parkes: An additional 2km of road was upgraded to three lanes
- Parkes to Dubbo: An additional 37km of road was upgraded to three lanes
- Dubbo to Gilgandra: An additional 5km of road was upgraded to three lanes
- Gilgandra to Coonabarabran: An additional 6km of road was upgraded to three lanes.

The additional overtaking lanes appear to have been provided in the more undulating sections of the Newell Highway.

3.5 Lane widths

3.5.1 Definition and purpose

Lane widths are measured as the trafficable portion of road seal either (i) between lane lines in the case of a multi-lane section of road, (ii) between edgeline and centreline in the case of a two lane undivided rural road and (iii) between the vertical face of the gutter to the nearest lane or centreline for urban roads. It is a measure of driver amenity in that the wider the lane (up to a certain point), the safer the road conditions.

Wider lanes provide more margins for error due to the poor tracking or wind-loading on the trailers of articulated vehicles. They increase the lateral separation between vehicles in adjacent lanes as well as opposing vehicles on undivided sections.

For the purpose of reporting NRMA Highway surveys, lane widths were divided into three categories:

- good, which generally referred to lanes of 3.5m wide or greater
- medium, which generally referred to lanes greater than 3.0m width but less than 3.5m.
- poor, which generally referred to lanes with width less than 3.0m.

Although, lane widths were not measured manually, the widths were estimated by observing preceding vehicles and their offsets to the lane and centrelines.

3.5.2 Results

The survey indicated that all sections of the Newell Highway had *good* lane widths, mostly meeting the 3.5m width requirement. This is a contrast to the 2002 survey results where a substantial length of the highway was noted as having narrow or poor lane widths. These included the sections between:

- Narrandera to West Wyalong
- West Wyalong to Forbes
- Coonabarabran to Narrabri
- Narrabri to Moree.

PB is of the understanding that the dramatic improvements in lane widths since 2002, are only partly due to targeted widening of the highway. It appears that substantial lane widening has been achieved by reducing the widths of sealed shoulders whereby the additional seal recovered from the shoulder reduction has been re-allocated as lane width. This is further supported by the results of the sealed shoulder survey in Section 3.7.

3.6 Pavement condition

3.6.1 Definition and purpose

Pavement condition is a measure of driver amenity and comfort and is governed by the extent of cracking, rutting, roughness and skid resistance. These are described briefly below:

- road cracking: Cracks in the road affect the skid resistance and allow water ingress to the sub base which can lead to further pavement damage
- rutting: Ruts are longitudinal depressions in the pavement caused by loading from the vehicle wheel paths. Excessive rutting increases water ponding, and compromises vehicle stability
- roughness: This is a measure of the ride quality and comfort. The rougher a road is, the less smooth the ride quality
- polishing: This a result of wearing of the pavement such that the aggregates protruding above the binder matrix become rounded and less angular. This results in less skid resistance and friction, particularly in wet weather.

PB's survey involved a visual inspection of the pavement quality during the drive through inspection as well as observations with regard to in-cabin vibration and noise. Generally this method enabled PB to comment on pavement condition with respect to cracking (including potholes), rutting and roughness. It was difficult to provide an account for skid resistance as a result of polishing.

The pavement was then categorised into one of the following three categories:

- good surface: Few deformed areas and few or no potholes
- fair surface: Occasional pavement deformation with potholes
- poor surface: Frequently deformed pavement with cracks, potholes and/or depressed asphalt patches.

3.6.2 Results

PB's survey concluded that the pavement condition for most of the highway is of fair or good quality.

3.7 Rural sealed shoulder widths

3.7.1 Definition and purpose

The sealed shoulder width is the distance measured from the outer edge of the traffic lane to the edge of sealed carriageway and excludes any unsealed shoulder, verge or embankment rounding. The advantages of wide shoulders include the following:

- they provide additional pavement width for errant vehicles to recover and hence minimise the probability of loss-of-control crashes
- they provide additional pavement width for broken down vehicles to stand clear of moving traffic in through lanes

- they provide additional sealed width and hence provide for better lateral separation between opposing vehicles thereby reducing head-on crash risk
- they provide better sight benching requirements for sight distances around horizontal curves and to road side vegetation
- they provide safer facilities for cyclists.

The minimum acceptable sealed shoulder width, stated in the RTA Road Design Guide is 0.5m where the daily traffic volume in the lane immediately adjacent to the shoulder is 2,000 vehicles/day or less. A 1.0m sealed shoulder should be provided where this daily traffic volume is greater than 2,000 vehicles/day.

However, the Road Design Guide also states that the sealed shoulder should be increased to 2.0-3.0m (depending on the traffic volumes in the adjacent lanes) where the road is adjacent to (i) a lined table drain, kerb or dyke and (ii) on the outer shoulder of a superelevated curve.

The rating of shoulder width and condition during this survey was rather subjective as all observations were made from a moving vehicle. However, the following guide and rating was used:

- *narrow* sealed shoulders: Less than 0.5m wide
- *standard* sealed shoulders: Between 0.5 – 1.0m wide
- *wide* sealed shoulders: More than 1.0m wide.

The survey of shoulder conditions was only conducted for the rural links as the urban sections tended to be lined with kerb and gutters or very wide shoulders for parking provisions.

3.7.2 Results

Figure 3-2 shows the breakdown of the route with regard to the proportion of the route matching each sealed shoulder width category.

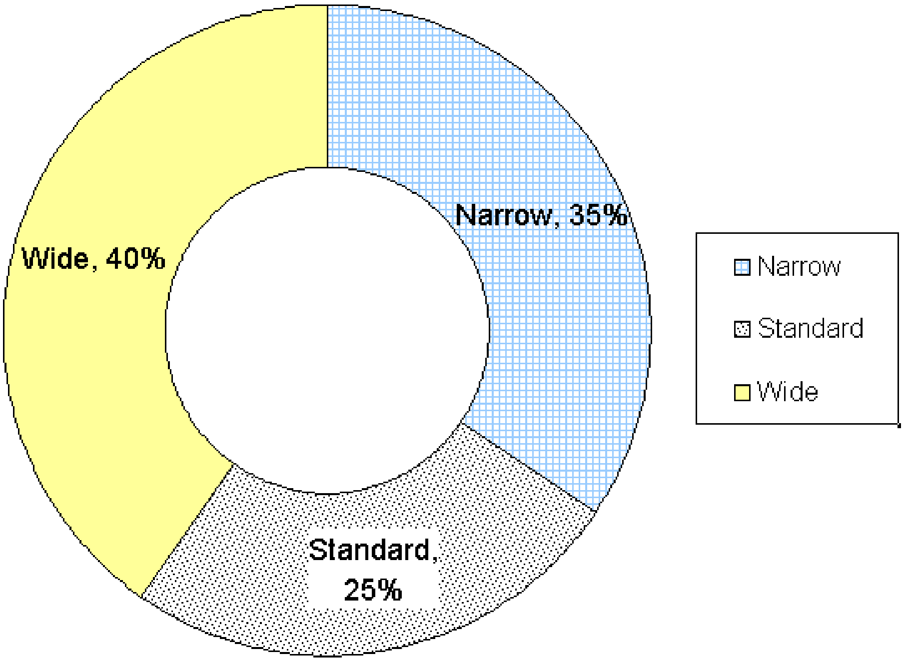

Figure 3-2 The breakdown of the route by sealed shoulder width

Unlike the pavement condition survey, Figure 3-2 shows that more than one-third of the total length of the highway has narrow sealed shoulders. Following PB's analysis of shoulder and lane widths, it appears that in any given section of road, the priority has been to provide lanes of sufficient width. As a result (as evident from the survey results reported in Section 3.5) a fairly consistent lane width of approximately 3.5m has been provided for the whole route. The extent of sealed shoulder provided appears to have been the result of the residual sealed width after the provision of the 3.5m lanes. As a result (and as evident in Figure 3-2) there is much more variability in sealed shoulder width compared with lane widths.

On a positive note, PB's survey did note that in most cases where a substandard sealed shoulder was provided, the unsealed portion of the shoulder was usually in good condition (i.e. compacted earth or traversable verge). Furthermore, the clear zones adjacent to these shoulders were generally free of hazards.

The distribution of shoulder width categories on each link is shown in Table 3-9.

Table 3-9 Sealed shoulder category by percentage of rural link length.

Rural Link	Narrow	Standard	Wide	Total
VIC border to Jerilderie	47.2%	30.7%	22.2%	100%
Jerilderie to Narrandera	36.6%	16.2%	47.2%	100%
Narrandera to West Wyalong	34.6%	8.9%	56.5%	100%
West Wyalong to Forbes	23.7%	40.3%	35.9%	100%
Forbes to Parkes	32.7%	50.7%	16.6%	100%
Parkes to Dubbo	18.7%	19.3%	62.0%	100%
Dubbo to Gilgandra	21.9%	66.7%	11.4v	100%
Gilgandra to Coonabarabran	28.1%	28.5%	43.5%	100%
Coonabarabran to Narrabri	74.8%	16.4%	8.8%	100%
Narrabri to Moree	21.0%	27.1%	51.8%	100%
Moree to QLD border	35.5%	18.4%	45.2%	100%
Total	**34.5%**	**25.1%**	**40.3**%	**100**%
2008 % of total rural survey length	**35%**	**25%**	**40**%	**100**%
2002 % of total rural survey length	**0%**	**60%**	**40**%	**100-**%

Table 3-9 provides the cumulative lengths of the highway (as a percentage of the overall length) meeting the narrow, standard, wide ratings. For the purpose of comparison, the corresponding figures from the 2002 survey have been provided as well.

As seen, the proportion of narrow sealed shoulders appears to have increased from 0% in 2002 to approximately one-third in 2008. Similarly, the percentage of the route in the standard shoulder width category appears to have decreased from 60% in 2002 to 25% in 2008. Accepting that there would be some discrepancies due to the subjective assessments applied in both the 2002 and 2008 surveys, these results do present some findings of interest.

The percentage of the route assessed as having wide shoulders appears to have remained relatively unchanged between 2002 and 2008. This indicates that the main change has been the conversion of standard width shoulders to narrow sealed shoulders. This further supports the above finding that of the available sealed carriageway widths, the fist priority appears to have been to provide lane widths of 3.5m. The residual sealed width has been allocated as a sealed shoulder and hence is much more variable in width.

From the survey results, the sections between Coonabarabran and Narrabri and between the Victorian border and Jerilderie have the highest proportion of narrow shoulder widths with 75% and 47% of the link providing narrow sealed shoulders.

Given that this is a national freight route and an Auslink route between Melbourne and Brisbane, the minimum shoulder widths as described above should be provided throughout the entire length.

3.8 Rural sealed shoulder condition

3.8.1 Definition and purpose

The sealed shoulder condition refers to a number of condition attributes:

- Rutting: Rutting and shoving of the pavement results in corrugations in the pavement which affect vehicle stability.
- Width: The width of the sealed shoulder is described above in Section 3.7.
- Edge condition: A variable edge of seal line can affect vehicle stability and also lead to wheel trap on the soft side of the shoulder. The extent of edge drop off also affects vehicle stability. A significant elevation change from the sealed shoulder to the unsealed shoulder, coupled with a lack of transition between the levels would increase the probability of wheel trap.

As the outside edge of the carriageway seal for most of the rural sections was bounded by earth (and not more rigid structures like kerb and gutters), the extent of rutting and shoving were not as prominent as the other condition attributes.

In many ways, the condition of the sealed shoulder is closely related to its width. A narrow sealed shoulder allows for more wear and tear of the edge of seal as more vehicles would track over the edge. The gradual “erosion” of the sealed edge reduces the width of the shoulder which in turn leads to more vehicles tracking over it. As such, the damage is somewhat cyclical and ongoing.

The following definitions were used as a Guide for assessing the condition of the sealed shoulder:

- **Poor:** Generally rutted along the edges of pavement, eroded edge and/or covered by long grass, with little opportunity for use in an emergency
- **Fair:** Usually in need of maintenance attention and/or grassed, generally an uneven surface but broadly providing suitable friction characteristics for use in an emergency
- **Good:** Well constructed and of adequate width, providing good drainage conditions, giving driver's adequate room and friction characteristics for use in emergencies.

3.8.2 Results

PB observed a close correlation between the *narrow* width sealed shoulders described in Section 3.7 and the poor shoulder conditions. As such, approximately 35% of the route provided poor sealed shoulder condition.

3.9 Rural clear zone condition

3.9.1 Definition and purpose

The clear zone is the portion of the road reserve outside the trafficable lanes which is not normally intended for moving traffic. It is measured from the outside edge of the traffic lane (edge line or kerb line) and hence includes the width of the sealed and unsealed portions of shoulder. The design function of a clear zone is to provide an area for errant vehicles to recover or decelerate to rest. As such, the design objectives of a clear zone are to provide a forgiving, traversable, and hazard-free area which will allow for vehicle recovery rather than a collision with a road side object.

Generally the clear zone requirement is more critical for high speed roads such as those along the rural sections of the Newell Highway. Whilst urban areas also have recommended clear zones, these are generally more difficult to achieved, as the urban road side environment contains more mixed use such as on-street parking, pedestrian walkways, properties and other amenity structures.

The RTA Road Design Guide provides guidance on the recommended clear zone widths for roads of differing design speed, traffic volume and where the road side varies with respects to embankment/cutting slope. However, generally for roads with flat embankment slopes, the clear zones as listed in Table 3-10 are recommended by the Guide:

Table 3-10 Recommended clear zone widths (RTA)

Design speed (km/h)	Traffic volume (vehicles/day)	Recommended clear zone (m)
90	<1,000	5.0
	1,000 - 3,000	5.5
	>3,000	7.0
100	<1,000	6.0
	1,000 - 3,000	7.0
	>3,000	9.0
110	<1,000	7.0
	1,000 - 3,000	8.5
	>3,000	11.0

The recent survey used the figures in Table 3-10 as a guide in categorising clear zones as “acceptable” or “unacceptable”. This was largely a subjective assessment via observations on the drive-through inspection due to the impracticality of taking actual field measurements. However, whilst the above figures were used as a guide, PB cannot guarantee that in all instances an “acceptable” clear zone meets these requirements. The converse is also similar.

PB also considered the quality of the ground material with regard to its impacts on the stability of the vehicle once it becomes errant. The provision of safety barriers was also considered in the assessment of clear zones. Generally, the provision of barriers meant that the road side environment, despite containing hazards, also provided some hazard risk mitigation and presented a more acceptable level of safety than the absence of a barrier.

PB's clear zone assessment involved counting the number of poor clear zones along each rural link. These mainly concentrated on larger scale hazards such as clusters of large trees, steep embankments and rock cuttings. Isolated hazards, such as a one-off tree were not included.

3.9.2 Results

In general, most sections along the highway provided acceptable clear zones. These included flat road sides which were also void of unforgiving objects such as trees and other structures.

The survey noted a number of poor clear zones which are summarised below:

- between Jerilderie and Narrandera, there were several sections with large trees
- between Narrandera and West Wyalong, several sections contained trees and others contained steep embankments
- between West Wyalong and Forbes, there was one section with large trees
- between Parkes and Dubbo, there were several sections with trees and several with rock cuttings
- between Gilgandra and Coonabarabran, there were poor clear zones observed due to steep embankments, trees and cuttings
- between Coonabarabran and Narrabri, there were several sections noted as having poor clear zones due to cut and fill sections.

3.10 Provision of Edges Lines

3.10.1 Definition and purpose

Edge lines are longitudinal lines which delineate the edge of the trafficable lane. It is also the demarcation between the lane and the shoulder area. Edgeline delineation consists of both a white longitudinal line (which can also be profiled in the case of audio tactile edge lines) as well as raised retroflective pavement markers (RRPMs).

Edge lines are a critical component of road delineation and work in combination with other delineation devices such as guideposts (edge of unsealed shoulder delineation) and lane lines (lane delineation).

Edge lines and the accompanying RRPMs also provide night time delineation on unlit rural roads by retro-reflecting the head light beams back to the driver.

3.10.2 Results

The entire route contained edge line markings. This was the same in the 2002 survey.

3.11 Rest Areas

3.11.1 Definition and purpose

The RTA (2004) defines rest areas as:

> *Off-road designated locations provided for drivers and passengers to take rest breaks and overcome fatigue. Rest areas enable drivers to increase the frequency, duration and quality of rest breaks. They provide roadside amenities which improve the driving experience on NSW roads and support tourism. Rest areas also provide places for heavy vehicle drivers to stop so that they may observe statutory regulations for driving, take rest breaks to counter the effects of fatigue, as well as to check their loads and fill in log books. (RTA, 2004).*

RTA (2004) also states that rest areas should ideally be spaced at 100km intervals or at intervals equivalent to 60 minutes of travel time.

The National Guidelines for the Provision of Rest Area Facilities (NTC, 2006) states as a general rule:

- major rest areas should be spaced at maximum intervals of 100km
- minor rest areas should be spaced at maximum intervals of 50km
- truck parking bays should be spaced at maximum intervals of 30km.

It also states that although toilets are not required for truck parking areas, they are desirable facilities at rest areas.

PB completed a number of investigations with regard to rest area provision. These are summarised below:

- an up to date list of rest areas was provided by the RTA. This included details of the amenities provided at each of the rest area as well as the type of rest area.
- truck rest area lists and rest area maps were also sourced from the RTA's website.
- the Route Condition Survey completed by PB also included a log of the rest areas, and their spatial location
- the results of the above sources were correlated and compared with available aerial and network photography available on Google Maps
- the calculated spacing between the rest areas was compared with the Guidelines specified by the RTA and NTC as detailed above.

3.11.2 Results

Light vehicle rest opportunities

Light vehicle rest opportunities are provided in the form of light vehicle only rest areas, combined light and heavy vehicle rest areas as well as the general amenities in each of the towns along the route. Table 3-11 provides a summary of the number of light vehicle rest areas along the route as well as the overall frequency of these rest areas. Although the towns themselves would also be an attractive rest opportunity, these have not been included this table.

Table 3-11 Summary of light vehicle rest areas along the route

Rural link	No. of light vehicle only rest areas	No. of combined light and heavy vehicle rest areas	Total number of light vehicle rest areas	Length of Sections (km)	Average km/ rest area
VIC Border to Jerilderie	2	2	4	52	13
Jerilderie to Narrandera	2	5	7	106	27
Narrandera to West Wyalong	2	5	7	134	19
West Wyalong to Forbes	1	6	7	98	14
Forbes to Parkes	2	4	6	30	5
Parkes to Dubbo	6	9	15	115	8
Dubbo to Gilgandra	2	3	5	62	12
Gilgandra to Coonabarabran	3	6	9	93	10
Coonabarabran to Narrabri	1	8	9	114	13
Narrabri to Moree	3	4	7	97	14
Moree to QLD Border	1	9	10	120	12
Totals	**25**	**61**	**86**	**1060**	**12**

(Source: RTA, 2006.)

The following notes relate to the provision of light vehicle rest areas along the route:

- some light vehicle rest areas also operate as driver reviver sites
- some light vehicle only rest areas are within the towns
- the numbers of light vehicle rest areas in the above table does not include the towns as general rest opportunities
- the numbers of rest areas presented in Table 3-11 above is not mutually exclusive from those in Table 3-12 as there are combined light and heavy rest areas presented in both tables.

As evident in Table 3-11, the frequency of light vehicle rest areas is well in excess of the guidelines stated in the RTA (2004) and NTC (2006) references.

Heavy vehicle rest areas

Using the information from the references discussed above, PB have provided a summary of the number of rest areas in each of the rural links as well as details regarding the provision of amenities such as toilets, seating areas, rubbish bins and access from the highway. This summary has been provided in Table 3-12.

Table 3-12 Summary of heavy vehicle rest areas for each rural link.

Rural Link	Chainage (NB)	Side of the road	Toilet	Rubbish bins	Shelter	Seating facilities	Table facilities	Access direction	Heavy vehicle / Light vehicle	Total number of rest areas	Length of Sections (km)	Average km/ rest area
VIC Border to Jerilderie	8.0km north of Finley	R			Y			B	B	2	52	26
	8.0km north of Finley	L	Y	Y	Y	Y	Y	B	B			
	27.0km north of Finley	L		Y		Y	Y	B	B			
Jerilderie to Narrandera	9.0km north of Jerilderie	R		Y				B	B	5	106	21
	9.0km north of Jerilderie	L		Y	Y	Y	Y	B	B			
	39.0km north of Jerilderie	L	Y	Y	Y	Y	Y	B	B			
	58.0km north of Jerilderie	R	Y	Y	Y	Y	Y	B	B			
	96.0km north of Jerilderie	R	Y	Y	Y	Y	Y	B	B			
	100.0km north of Jerilderie	R	Y	Y	Y	Y	Y	B	B			
Narrandera to West Wyalong	55.0km north of Narrandera	R	Y	Y	Y	Y	Y	B	B	5	134	27
	55.0km north of Narrandera	L	Y	Y	Y	Y	Y	B	B			
	79.0km north of Narrandera	L	Y	Y	Y	Y	Y	B	B			
	103.0km north of Narrandera	L		Y				B	B			
	110.0km north of Narrandera	R		Y				B	B			
	127.0km north of Narrandera	L		Y				B	B			
West Wyalong to Forbes	7.0km north of West Wyalong	R		Y				B	B	6	98	16
	7.0km north of West Wyalong	L		Y				B	B			
	36.0km north of West Wyalong	L	Y	Y	Y	Y	Y	B	B			
	37.2km north of West Wyalong	R	Y	Y	Y	Y	Y	B	B			
	58.0km north of West Wyalong	R		Y				B	B			
	73.2km north of West Wyalong	L						B	B			
	82.1km north of West Wyalong	R						B	HV only			
	93.1km north of West Wyalong	L		Y				B	HV only			
Forbes to Parkes	3.0km north of Forbes	R		Y				B	HV only	4	30	7
	8.8km north of Forbes	R		Y				B	B			
	8.8km north of Forbes	L		Y				B	B			
	12.7km north of Forbes	R		Y				B	HV only			
	14.3km north of Forbes	L		Y				B	HV only			
Parkes to Dubbo	1.3km north of Parkes	L	Y	Y	Y	Y	Y	B	B	9	115	13
	51.0km north of Parkes	R		Y	Y	Y	Y	B	B			
	61.3km north of Parkes	R	Y	Y	Y	Y	Y	B	B			
	64.3km north of Parkes	R		Y	Y	Y	Y	B	HV only			
	73.3km north of Parkes	L		Y	Y	Y	Y	B	B			
	96.3km north of Parkes	L		Y				B	HV only			
	104.1km north of Parkes	L		Y	Y	Y	Y	B	B			
	110.0km north of Parkes	R		Y				B	HV only			
	113.4km north of Parkes	L		Y	Y	Y	Y	B	B			

Rural Link	Chainage (NB)	Side of the road	Toilet	Rubbish bins	Shelter	Seating facilities	Table facilities	Access direction	Heavy vehicle / Light vehicle	Total number of rest areas	Length of Sections (km)	Average km/ rest area
Dubbo to Gilgandra	2.7km north of Dubbo	L		Y				B	B	3	62	21
	9.3km north of Dubbo	L		Y				B	B			
	50.0km north of Dubbo	R		Y	Y	Y	Y	B	B			
Gilgandra to Coonabarabran	3.5km north of Gilgandra	L		Y				NB	HV only	6	93	16
	13.6km north of Gilgandra	L		Y				NB	B			
	21.9km north of Gilgandra	R		Y		Y	Y	B	B			
	21.9km north of Gilgandra	L		Y		Y	Y	B	B			
	27.8km north of Gilgandra	R		Y	Y	Y	Y	B	B			
	37.6km north of Gilgandra	L		Y				NB	B			
	55.4km north of Gilgandra	L		Y	Y	Y	Y	B	B			
	55.4km north of Gilgandra	R		Y	Y	Y	Y	B	B			
Coonabarabran to Narrabri	4.2km north of Coonabarabran	R		Y				B	HV only	8	114	14
	4.2km north of Coonabarabran	L		Y				B	HV only			
	6.8km north of Coonabarabran	R		Y	Y	Y	Y	B	HV only			
	6.8km north of Coonabarabran	L	Y	Y	Y	Y	Y	B	HV only			
	31.0km north of Coonabarabran	R	Y	Y				B	HV only			
	51.6km north of Coonabarabran	R	Y	Y	Y	Y	Y	B	B			
	67.4km north of Coonabarabran	R		Y	Y	Y	Y	B	B			
	95.1km north of Coonabarabran	R		Y	Y	Y	Y	B	B			
	103.0km north of Coonabarabran	L		Y				B	HV only			
	115.0km north of Coonabarabran	R		Y				B	HV only			
Narrabri to Moree	48.8km north of Narrabri	L		Y	Y	Y	Y	B	B	4	97	24
	52.2km north of Narrabri	R		Y	Y	Y	Y	B	B			
	54.0km north of Narrabri	L		Y	Y	Y	Y	B	HV only			
	83.5km north of Narrabri	R		Y	Y	Y	Y	B	B			
	83.5km north of Narrabri	L		Y	Y	Y	Y	B	B			
Moree to QLD Border	7.2km north of Moree	R		Y				B	HV only			
	7.2km north of Moree	L		Y				B	HV only			
	7.9km north of Moree	L		Y				B	B	9	120	13
	9.8km north of Moree	L		Y				B	HV only			
	38.4km north of Moree	R		Y	Y	Y	Y	B	B			
	38.4km north of Moree	L		Y	Y	Y	Y	B	B			
	54.5km north of Moree	L		Y	Y	Y	Y	B	B			
	55.5km north of Moree	R		Y	Y	Y	Y	B	B			
	68.0km north of Moree	L		Y				NB	HV only			
	84.0km north of Moree	R		Y	Y	Y	Y	B	B			
	97.0km north of Moree	L		Y				NB	HV only			
Total		**74**	**15**	**71**	**38**	**40**	**40**			**61**	**1021**	**17**

Overall, this highway provides a regular spacing of rest areas and many opportunities for drivers to stop and rest. The average spacing of 17km equates to approximately nine minutes of travel at 110km/h. Even in the sections with the lowest frequency of rest areas, i.e. Narrandera to West Wyalong, with only one rest area every 27km, this equates to approximately 15 minutes of travel time at 110km/h.

The frequency of rest areas is well in excess of the guidelines stated in the RTA (2004) and NTC (2006) documents. Neither of these documents contains a strict requirement for the provision of toilets at rest areas although both documents state that these are desirable facilities to have and should be provided where ever possible. PB's investigations revealed that toilets were only provided at 15 (20%) of all heavy vehicle rest areas along the route.

3.12 Railway level crossings

3.12.1 Definition and purpose

A railway level crossing is an at-grade road and railway crossing consisting of a right-of-way provisions either enforced passively or actively. Passive railway level crossings are ones where the responsibility for detecting the presence of an approaching train and judging whether it is safe to cross is left entirely to the road user. By contrast, active crossings are ones that contain traffic control devices such as boom gates, flashing lights and bells to warn road users of an approaching train and to reinforce the need to stop.

Although the numbers of people killed or injured are small in terms of road casualties, railway level crossings are one of the main sources of death and injury for the rail system.

3.12.2 Results

The route condition survey identified 11 railway level crossings as listed below:

- Mirrool (between Narrandera and West Wyalong)
- Alleena (between Narrandera and West Wyalong)
- West Wyalong
- Forbes
- Tichborne (Forbes to Parkes)
- Parkesborough (Forbes to Parkes)
- Parkes
- Dubbo
- Gilgandra
- Narrabri
- Moree North.

All railway level crossings are controlled by stop lights.

3.13 Narrow sections and squeeze points

3.13.1 Definition and purpose

The width of the road reserve is an important safety attribute in that it provides a more forgiving road for both run-off-road crashes as well as catering for the clearances between vehicles in adjacent lanes (including opposing vehicles). Understanding the *shy line effect* is particularly important in providing and assessing the width of the road reserve.

The *shy line* effect refers to the tendency of the driver to shy away from, slow down or both, a static or moving object if it is perceived to be a crash hazard. This effect is experienced when drivers approach a section of road lined with trees, safety barriers and other structures which are within close proximity to the road. This effect is also experienced when drivers approach moving objects such cyclists and large trucks.

To cater for the *shy line* effect and still maintain the desired operating speeds of 100-110km/h, it is necessary to provide enough width in the road reserve, and enough lateral clearance from objects so that drivers feel safe when travelling past these objects at high speed.

Narrow sections and squeeze points which may not cater for this *shy line* effect include the following:

- bridges lined with concrete parapets, bridge railings or other safety barriers
- culverts with safety barrier protection
- other sections such as fill sections where safety barriers may be used to provide protection from steep embankments.

It should be noted that this part of the route condition assessment is not related to the structure as a crash hazard, nor to the crashworthiness of the structure as they were already included as part of the assessment in Section 3.9 (clear zones). Contrastingly, this assessment is with regard to how that structure affects the freedom of movement at the desired travel speed. i.e. does the squeeze point make drivers veer away from the structure and potentially into the path of oncoming traffic? Or does it make drivers slow down and thereby risk the probability of a rear-end crash?

The safety implications of squeeze points is further summarised below:

- They may increase the probability of vehicle loss-of-control as they require drivers to negotiate a narrower section of road. The approach to the squeeze point is particularly hazardous as drivers may feel like they have less margin for error in “aiming their vehicle” towards the smaller opening.
- They may increase the probability of crashes with road side objects due to the closer proximity of those objects. This is despite the fact that the object itself may be a safety barrier.
- They may increase the tendency for drivers to veer away from the object and into other lanes, including an increase in head-on crash risk.

- They may increase rear-end crash risk if drivers slow down in approach to the squeeze point.
- They reduce the width available for broken down vehicles, bicycles and pedestrians as well as the lateral clearance of these from moving traffic.

PB’s assessment involved documenting the number of squeeze points along the highway. As this is a more prominent issue in the high-speed sections of the highway, the results discussed below only refer to the squeeze points in the rural sections of the highway.

3.13.2 Results

Table 3-13 provides a summary of the number of squeeze points within each of the rural links.

Table 3-13 Number of squeeze points

Rural link/Urban	Narrow Bridge	Narrow Road	Total
VIC border to Jerilderie	8	1	9
Jerilderie to Narrandera	5	0	5
Narrandera to West Wyalong	7	3	10
West Wyalong to Forbes	9	2	11
Forbes to Parkes	2	1	3
Parkes to Dubbo	15	2	17
Dubbo to Gilgandra	7	1	8
Gilgandra to Coonabarabran	17	0	17
Coonabarabran to Narrabri	8	0	8
Narrabri to Moree	13	0	13
Moree to QLD border	7	1	8
Total	**98**	**11**	**109**

4. Crash Analysis

As part of the 2008 Newell Highway Route Performance Review, PB analysed crash data for the five year period between 2002 and 2006. From the analysis of this five year crash data set, PB identified a number of trends with respect to

- crash types
- vehicles involved
- road surface condition
- light conditions.

PB also determined the crash rates for each of the urban and rural sections, as well as a spatial analysis to identify crash locations along the highway. These crash locations were also investigated to identify road environment, traffic condition and other factors that may have contributed to the crash problem.

Wherever possible PB has compared and correlated the findings of this crash analysis to the crash analysis results reported in the 2002 Route Performance Review. That Review used a four-year crash data set from 1998 to 2001.

PB also looked at a 10 year crash data set from 1997 to 2006 to identify long term trends in crashes along this highway.

4.1 Crash trends by severity

During the five-year period from 2002 to 2006, there have been a total of 1,011 reported crashes along the Newell Highway. This included 43 (4.3%) fatal crashes, 467 (46.2%) injury crashes and 501 (49.6%) towaway crashes. The combined 510 casualty crashes resulted in 60 deaths and 694 injured persons.

The distribution of fatal, injury and casualty crashes for the 2002 to 2006 period is shown in Table 4-1. This table shows that in a total of 1,011 crashes in the five year period, a total of 60 persons were killed in 43 fatal crashes and a further 694 were injured in 467 crashes.

Table 4-1 Crashes along the Newell Highway between 2002 and 2006.

	2002	2003	2004	2005	2006	Total
Fatal Crashes	13	5	7	6	12	43
Injury Crashes	100	100	85	99	83	467
Non-casualty	119	104	101	101	76	501
Fatalities	17	5	10	9	19	60
Injuries	159	148	120	153	114	694
Total Crashes	**232**	**209**	**193**	**206**	**171**	**1011**

4.2 Crash trends by year

The 10-year crash data set enabled PB to identify longer term crash trends along the highway as shown in Figure 4-1.

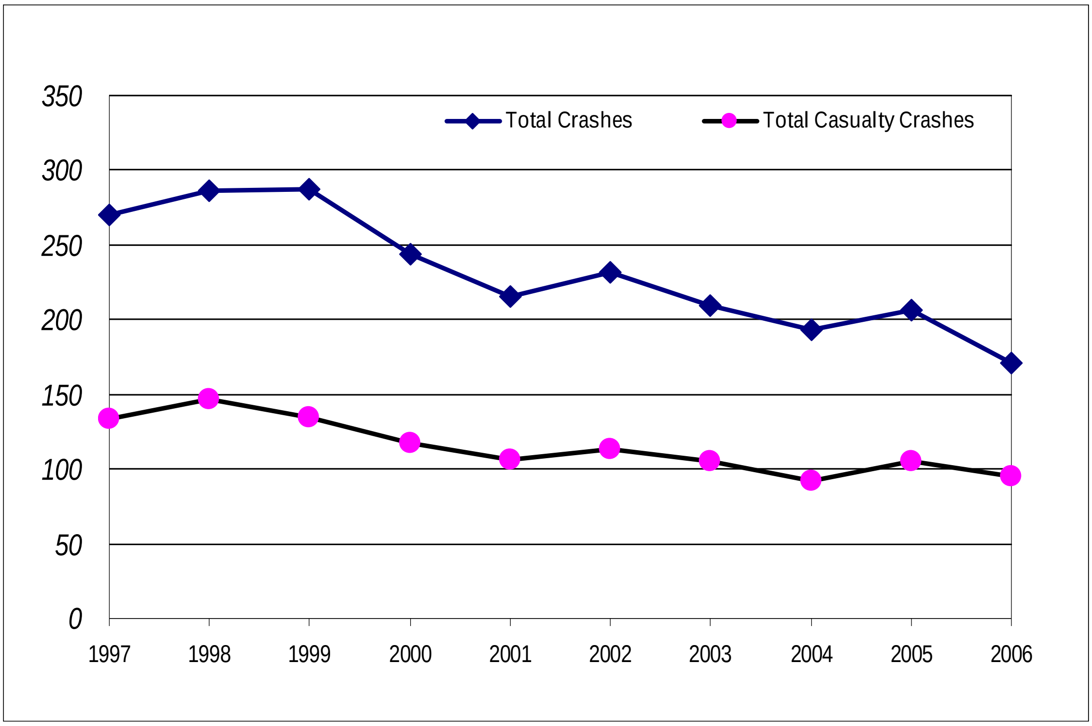

Figure 4-1 Longer term crash trends along the Newell Highway

As seen in Figure 4-1, both the total number of crashes as well as the casualty crashes have reduced over the 10-year period. Although there is some cyclical fluctuation in the number of crashes with relative peaks in 1998, 2002 and 2005, the overall trend has been a downward (positive) trend in the number of crashes. In 2006, the total number of crashes, at 171 crashes is approximately two-thirds of the number of crashes in 1997. Furthermore, the 95 casualty crashes is approximately 70% of the number of casualty crashes in 1997.

This downward (positive) trends in the number of crashes has followed from a similar downward trend as reported in the 2002 Route Performance Review. The 2002 Review reported approximately 470 crashes and more than 200 casualty crashes in 1979. That is, in 2006, the total number of crashes along the highway has been reduced to approximately one-third of the number of crashes reported in 1979. The number of casualty crashes in 2006 is approximately one-half of the number that occurred in 1979.

4.3 Crash types

Figure 4-2 shows the distribution of crash types along the NSW section of the Newell Highway for the five-year period from 2002-2006.

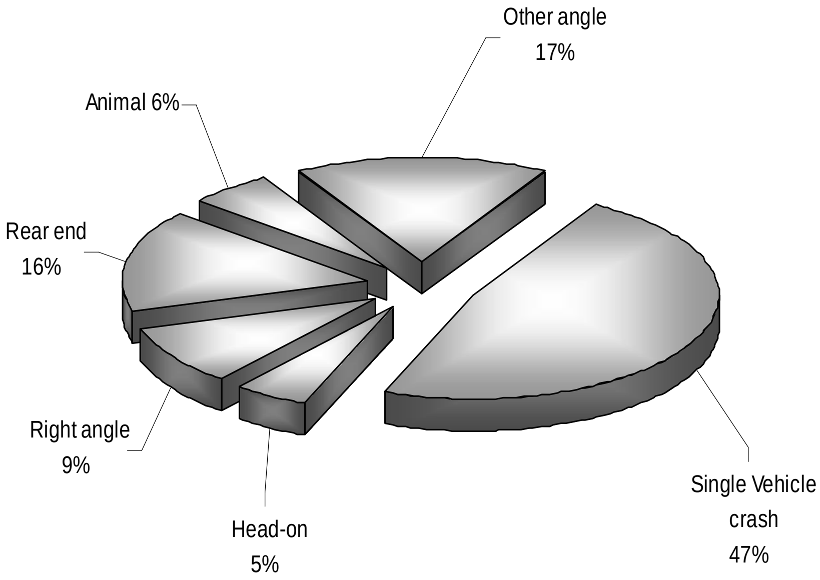

Figure 4-2 Breakdown of crash types along the Newell Highway

Figure 4-2 shows that the most dominant group was the single vehicle crashes which includes loss-of-control with or without a run-off-road result. A total of 47% of the total crash population was of this crash type.

A portion of the 5% head-on and 6% hit animal crashes would have similar crash factors to the single vehicle crashes either by cause, effect or both. For example, if a vehicle approaches an animal on the road at high speed, the driver, depending on his/her reaction and skill is faced with a range of crash outcomes including swerving to avoid the animal, in which case the outcome would be a single vehicle run-off-road crash. Alternatively, the driver could also impact the animal, in which case it becomes a “hit animal” crash type. Similarly, any crash mechanism leading to an initial loss-of-control can also result in a head-on crash if the out of control vehicle is met by an opposing vehicle. These crash types are typical of a rural crash profile and would have been predominately on the high speed rural sections.

The 9% right-angle, 17% other angle and 16% rear-end crashes refer to multiple (more than one) vehicle crashes which are more prominent in urban locations. It is acknowledged that some of the crash population would have occurred at rural junctions, but due to the much larger volumes of traffic on the urban network, and more critically, the larger volumes of *conflicting* traffic, these would have mostly occurred on urban sections of the route. The combined 42% for these crash types indicates that the number of crashes in these urban locations is disproportionately higher than the lengths of the route in these urban areas. This indicates that the somewhat large crash populations are a product of the high volumes of traffic. This is further supported by the crash rates analysis below.

Although the absolute number of crashes has reduced since the 2002 Route Performance Review, the above analysis shows no significant change in the distribution of crash types since the previous survey.

4.4 Vehicles involvement in crashes

Figure 4-3 shows a breakdown of vehicles involved in each of the recorded crashes during the five-year period. The outer ring shows the breakdown by the key vehicle (i.e. the vehicle at fault) and as such, the breakdown shown applies to the total crash data set. The inner circle refers to the “other” vehicle involved and only applies to the population of crashes for which there were two or more vehicles involved. Figure 4-2 suggests that the number of multiple vehicle crashes was 45% of all crashes that occurred on the Newell Highway.

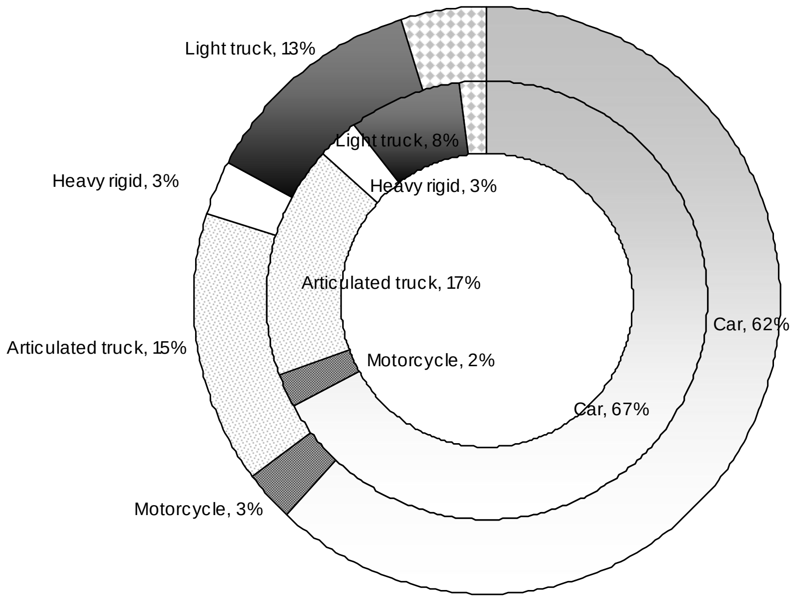

Figure 4-3 Types of vehicles involved (outer ring represents the key vehicle and inner ring represents the other vehicle involved)

Figure 4-3 shows that cars were the key vehicle in approximately two thirds of all crashes occurring on the Newell Highway with the next highest being articulated vehicles in approximately 15% of all crashes. Heavy vehicles, including articulated vehicles, and heavy and light trucks were the key vehicle in 31% of all crashes. Whilst, the majority of crashes are caused by light vehicle drivers, the relatively high proportion of heavy vehicles involved as a key vehicle is a concern. Heavy vehicles tend to have more momentum and energy compared with light vehicles and as such would result in more severe crashes, particularly if they impact lighter vehicles with less occupant protection.

The overall involvement of trucks (31% of all recorded crashes) is consistent with the proportion of these vehicles identified in the vehicle classification surveys reported in Section 2.4.

The overall breakdown of crashes by type of key vehicle is consistent with that reported in the 2002 Route Performance Review.

4.5 Crash breakdown by speed limit

The breakdown of crashes by speed zone is shown in Figure 4-4. As can be seen, approximately 64% of crashes occurred in 100 or 110km/h speed zones, along the rural sections of the Newell Highway. There is a reasonably good correlation between this 64% and the combined 58% crashes which are possibly a result of the single vehicle crash mechanism discussed in Section 4.3.

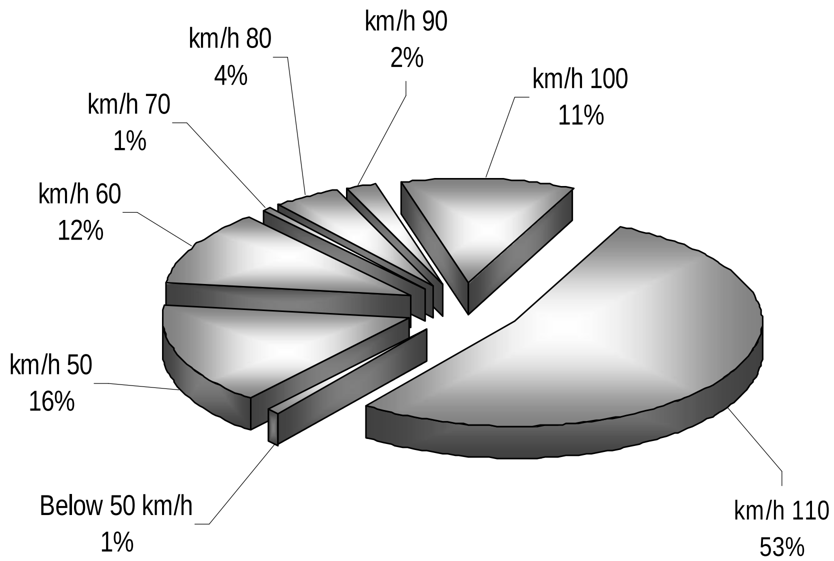

Figure 4-4 Breakdown of crashes by speed zone

The urban speed limits along the Newell Highway were zoned with speed limits of 70km/h or less (as the 80 and 90km/h speed zones tended to be short buffer speed zones between the urban and rural sections). A combined 30% of crashes occurred in these speed zones, with the most prominent speed zones being 50km/h and 60km/h. This also supports the above findings (from Section 4.3) that approximate 42% of crashes meet the urban crash profile characterised by multiple vehicle crashes.

Of interest is that the relative proportion of crashes in 50km/h and 60km/h zones appears to have changed substantially compared with the breakdown reported in the 2002 Route Performance Review. In that review, the ratio was 15%:85% (50km/h versus 60km/h). In the 2008 crash analysis, this ratio has increased to 43%:57%. This is most likely due to the increase in 50km/h zones in urban areas.

Also of note is the significant change in the proportion of crashes in 110km/h and 100km/h zones. The 2002 Route Performance Review reported an approximate 68% and 8% of crashes as having occurred in 110km/h and 100km/h zones respectively. However, in this Route Performance Review, the proportions have shifted to 53% and 11% respectively.

Table 3-1 shows that the overall length of the route signposted at 110km/h and at 100km/h has not changed significantly since the 2002 survey. This suggests the reduction in crashes in the 110km/h zones have been achieved without requiring a reduction in the speed limit.

4.6 Crash breakdown by surface conditions

The breakdown in crashes by road surface condition is shown in Figure 4-5. This shows that approximately 85% of crashes occurred when the road surface was dry and 15% occurred when the road surface was wet.

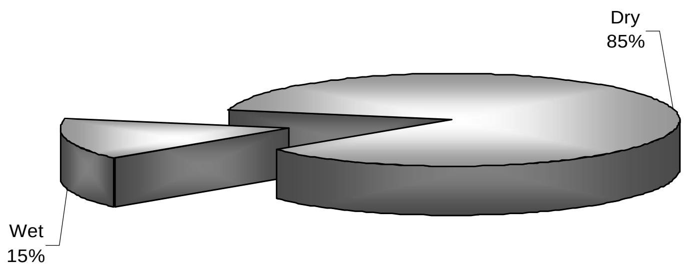

Figure 4-5 Breakdown of crashes by road surface condition.

The 2002 Route Performance Review reported approximate 19% of crashes as having occurred when the road surface was wet. The reduction to 15% is more likely a result of the reduction in “rain days” due to extensive drought conditions throughout the period from 2002 to 2006, compared with the period from 1998 to 2001.

4.7 Crash breakdown by light conditions

The breakdown in crashes by natural lighting conditions is shown in Figure 4-6.

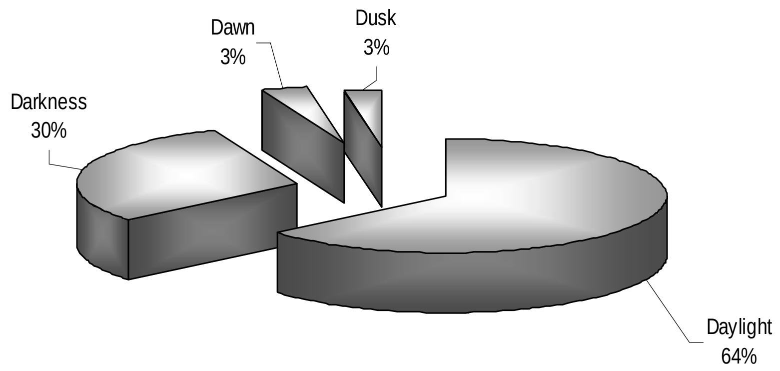

Figure 4-6 Breakdown of crashes by natural lighting condition

This figure shows that approximately 30% of crashes occurred during night time conditions. The breakdown by lighting condition is consistent with that reported in the 2002 Route Performance Review.

4.8 Crash rates

The crash rates calculated in this report are rates per million vehicle kilometres travelled (MVKT). These rates normalise the crash frequencies per unit of *crash exposure* as generally, the longer the section of road, and the more traffic that it carries, the higher the crash exposure. Contrastingly, short sections of road with lower traffic volumes tend to have less crash exposure.

However, whilst the crash exposure for roads of similar character (i.e. rural roads) allows for better comparability of crash risk per unit of exposure, it should be acknowledged that different road types may also differ in *crash type exposure*. This is particularly the case for urban roads versus rural roads. That is, urban roads will present more “opportunity” for different crash types ranging from multiple vehicle crashes, vehicle to pedestrian crashes as well as single vehicle crashes. Also the traffic conditions are much more variable and they themselves affect the extent of crash type exposure. By contrast, rural roads tend to have less variability in crash type exposure. The lower traffic volumes result in less opportunity for multiple vehicle crashes which is also the reason why single vehicle crashes are the dominant crash type in rural areas.

As such, PB has separated the crash rates analysis into urban crash rates and rural crash rates. Crash rates have been provided for all crashes as well as casualty crashes (i.e. fatal and injury crashes).

Figure 4-7 shows the crash rates per 100MVKT for each of the urban centres along the Newell Highway. It also shows the number of casualties (not casualty crashes) per 100MVKT, as well as the absolute number of crashes and absolute number of casualties. These performance data were selected as they were the ones used in the 2002 Route Performance Review.

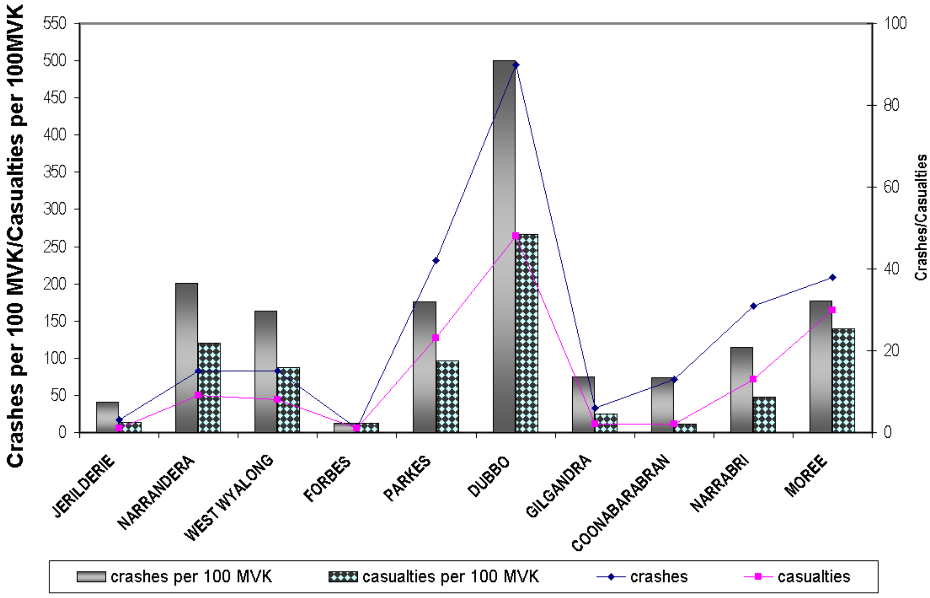

Figure 4-7 Crash rates for urban centres along the Newell Highway (2002-2006)

As seen, during the period from 2002 to 2006, Dubbo experienced the highest crash rate with approximately 500 crashes and 267 casualties per 100MVKT. Narrandera, West Wyalong, Parkes and Moree all experienced similar rates with approximately 150-200 crashes and 100-150 casualties per 100MVKT.

For comparison, Figure 4-8 shows the corresponding crash rates for the period from 1998 to 2001, as reported in the 2002 Newell Highway Route Performance Review. Notwithstanding the potential discrepancies with regard to the length of highway in each of the town centres and the criteria used to define this, there still appears to be significant changes. In most cases, the crash and casualty rates per 100MVKT have increased. In particular, Dubbo's crash rate increased significantly from 130 to 500 crashes per 100MVKT. Similarly, the crash rates for Narrandera, West Wyalong, Parkes and Moree all increased by between 90-160 crashes/100MVKT. Forbes experienced an improvement in safety performance with a reduction from approximately 35 to 13 crashes per 100MVKT.

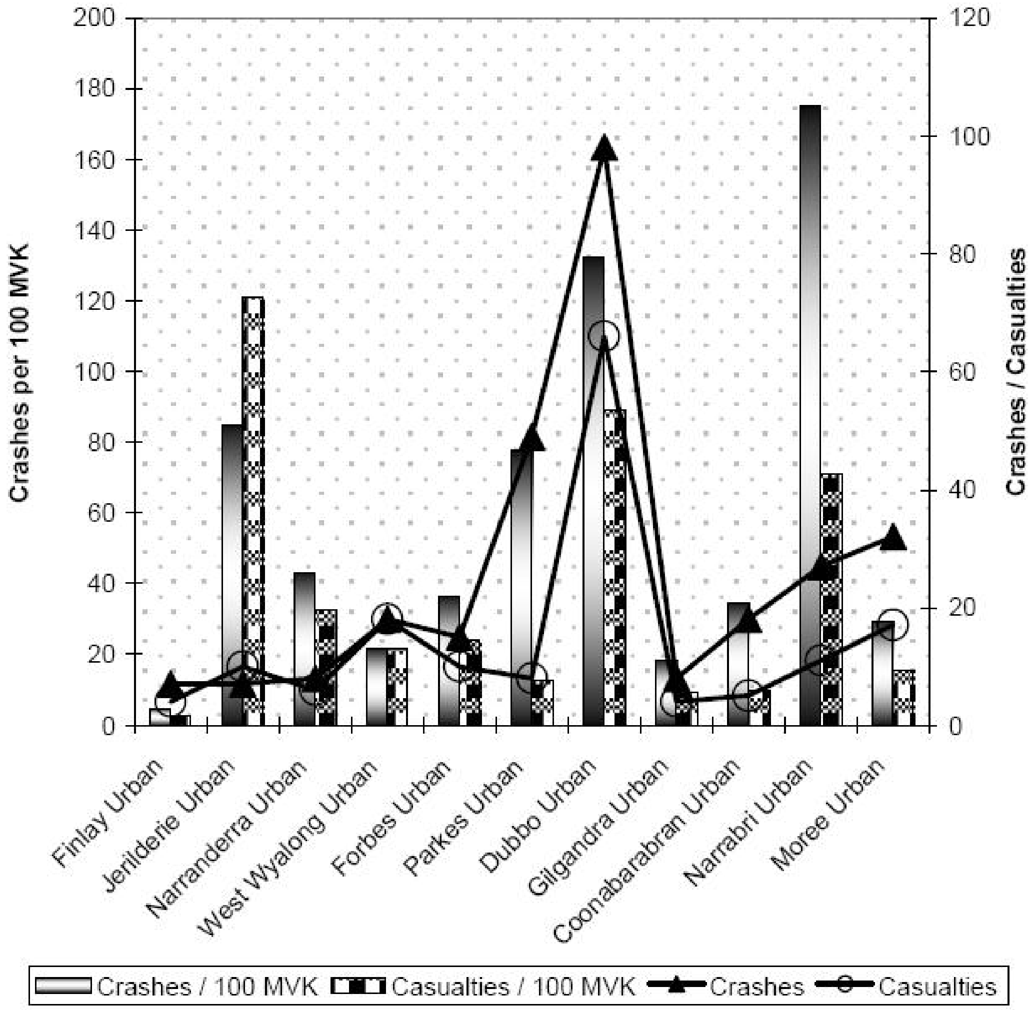

Figure 4-8 Crash rates for urban centres along the Newell Highway (1998-2001). (TRL, 2002)

Figure 4-9 shows the crash rates per 100MVKT for each of the rural sections along the Newell Highway. Similar to the urban crash rates, the casualty (not casualty crash) rates per 100MVKT, and the absolute numbers of crashes and casualties have been shown for each section.

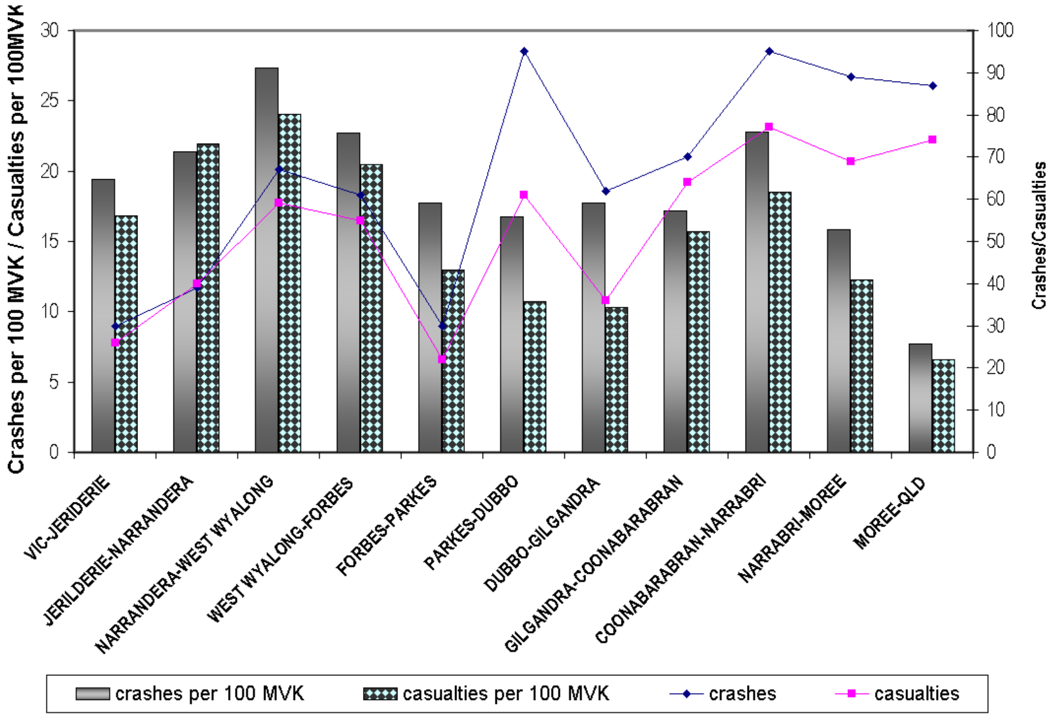

Figure 4-9 Crash rates for urban centres along the Newell Highway (2002-2006)

As seen in Figure 4-9, the highest crash rates were experienced in the sections between Jerilderie and Forbes, and between Coonabarabran and Narrabri. These sections experienced more than 20 crashes per 100MVKT. The section between Jerilderie and Forbes also experienced more than 15 casualties per 100MVKT.

Figure 4-10 shows the corresponding results for the period from 1998 to 2001 as reported in the 2002 Review. The comparison between the two Reviews indicates that crash rates have increased for most of the rural sections. In particularly, the greatest increases are in the southern portion of the route between the Victorian border and Forbes. The section between Moree and Queensland experienced a reduction in both crashes and casualties per 100MVKT.

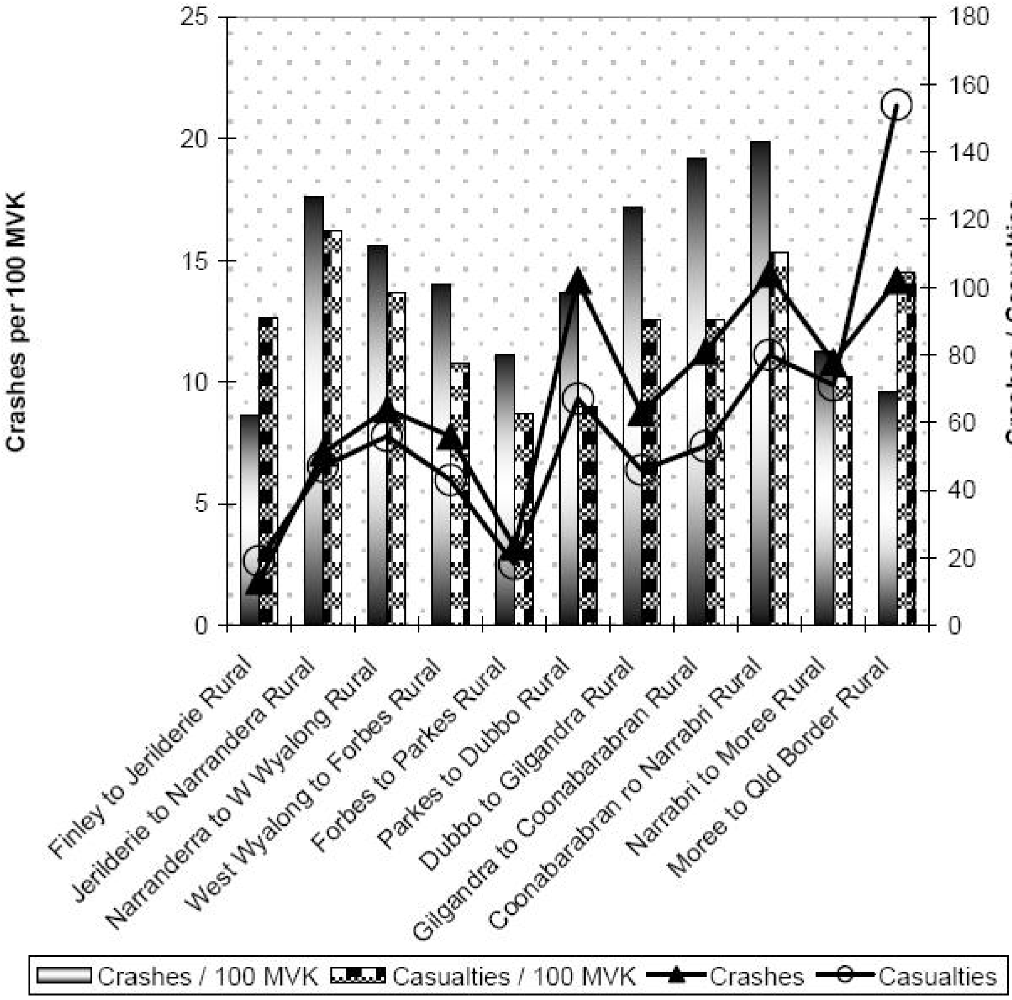

Figure 4-10 Crash rates for rural sections along the Newell Highway (1998-2001). (TRL, 2002)

Overall, the crash rate for the whole highway was 21 crashes per 100MVKT for the period from 2002 to 2006 (2008 Review) compared with the 17 crashes per 100MVKT reported in the 2002 Review and 19 crashes per 100MVKT as reported in the 1994 Review (TRL, 2002)

The casualty rate was 16 casualties per 100MVKT for the period from 2002 to 2006 (2008 Review) compared with the 15 casualties per 100MVKT reported in the 2002 Review and 17 casualties per 100MVKT as reported in the 1994 Review.

4.9 Crash locations

The 2002 Route Review referred to a number of crash locations as “blackspots” which were defined as “an identifiable location where six or more crashes were recorded during the period from 1998 to 2001”. In this Review, PB has used a similar approach. However, since PB used a five-year crash data set rather than a four-year data-set, the criteria was pro rated up to eight crashes per the five-year period. The 2002 Report did not give a length of road criteria over which these crashes occurred, and PB has used the following criteria to identify crash locations for investigation as part of this Route Performance Review.

Criteria: Any location at a point location or length of road not more than 150m which has experienced eight or more reported crashes within the five-year period from 2002 to 2006.

Using this criterion, the following six crash locations were identified:

- intersection of the Newell Highway, Alice Street and the Gwydir Highway, Moree
- Newell Highway, from Darling Street to Macquarie Street, Dubbo
- intersection of the Newell Highway and Thompson Street, Dubbo
- Newell Highway from Victoria Street (Mitchell Highway) to Baird Street, Dubbo
- Newell Highway from Church Street to Dalton Street, Parkes
- Newell Highway (Hartigan Avenue) between Forbes Street and Bogan Street, Parkes.

PB carried out an investigation of each of these sites with the purpose of identifying road and traffic conditions that may have contributed to the crash problem. These are further discussed in Sections 4.9.1 to 4.9.6.

4.9.1 Intersection of Newell Highway, Alice Street and the Gwydir Highway (south), Moree

This is a four-way intersection with roundabout/give way control. The northern and southern approaches are the Newell Highway, and the eastern and western approaches are Alice Street. Alice Street East is also the Gwydir Highway (southern occurrence) which provides a connection to Grafton via Inverell and Glen Innes. The Moree CBD is north of the intersection.

The northern approach to the roundabout is a concrete span bridge over the Mehi River. This is a two-lane-two-way approach which flares to provide two turning lanes for southbound traffic. The eastern and western approaches (Alice Street) also provide two approach lanes to the roundabout. The southern approach (Newell Highway south) only provides a single lane approach. The existing layout of the intersection is shown in Figure 4-11.

During the five-year period from 2002 to 2006, there were a total of 13 crashes reported at this intersection. Of these 13 crashes, five (38%) were coded as rear-end crashes with a further five crashes coded as right-angled crashes involving two vehicles from adjacent approaches.

Figure 4-11 Existing configuration of the intersection of the Newell Highway, Alice Street and the Gwydir Highway.

PB's site investigation revealed a number of factors that may be contributing to the crash problem at this site.

- The bridge across the Mehi River in the northern approach contains a crest vertical curve with restricted stopping sight distance to the roundabout.
- The southbound traffic approaching this roundabout, which also contained a significant proportion of heavy vehicles, appeared (during the site inspection) to be approaching at a speed well in excess of a safe approach speed to such a roundabout.
- The high speed of this approaching traffic could compromise the ability of the driver to stop in order to give way to other traffic using the roundabout. This could be a contributory factor in the rear-end and right-angle crashes at this site.
- Apart from an advanced direction sign on the northern side of the bridge, there appears to be a lack of advanced warning or visual cues on the presence of a roundabout in the road ahead. Drivers, especially unfamiliar drivers, may get the impression that the road is appropriate for travel at a higher speed.

- The downhill approach to the roundabout on the southern side of the crest further compromises the stopping distance and ability.
- Linemarking in the approach to and within the roundabout is also somewhat confusing for road users.
- The northern, eastern and western approaches to the roundabout all provide two lane approaches with the left-most lane being a dedicated left-turn lane, and the right-lane being a shared through and right turn lane (see Figure 4-12). As such, this allows two adjacent streams of traffic to enter the roundabout at the same time providing they adhere to the turn restrictions. However, the circulating width of the roundabout itself only provides one marked lane which presents a side swipe crash conflict between the two vehicles.

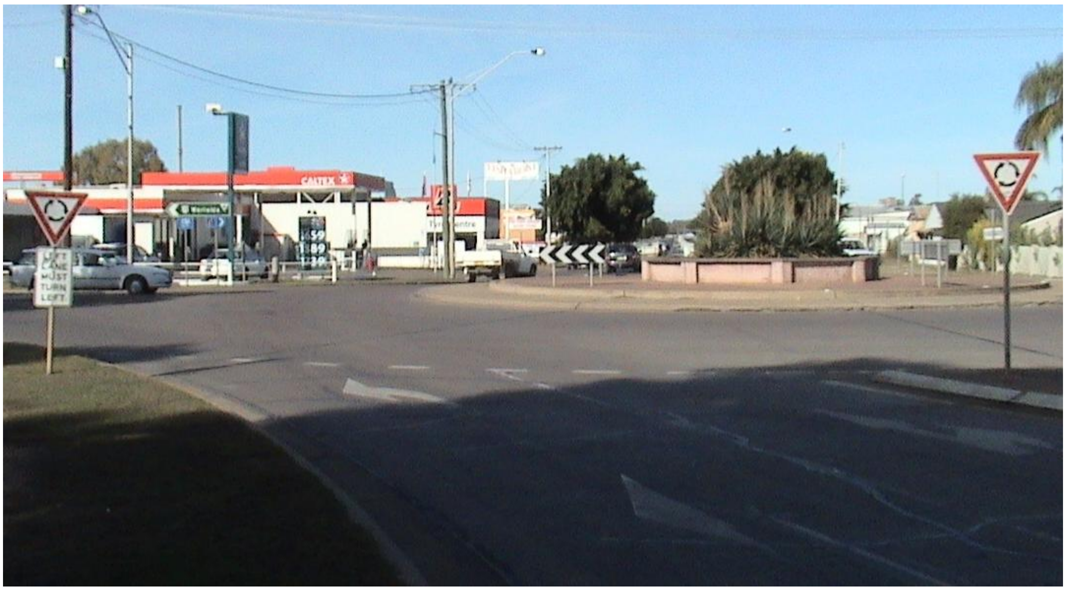

Figure 4-12 The northern approach to the roundabout providing two-lane entry into a one-lane roundabout.

- It is possible that the lack of lane delineation within the circulating path of the roundabout may have been a deliberate omission to allow for trucks to negotiate the roundabout without breaching the lane lines. However, new amendments to the NSW road rules now make special provisions for trucks at multi-lane roundabouts.
- A crash risk would arise from the following scenario. If a left-turning vehicle approaches the intersection, the driver in the next approach may recognise this movement and enter the roundabout (as the two vehicles would not be in conflict). However, if a vehicle in the right-lane also approached the upstream approach, this would present a crash conflict between this vehicle and the other vehicle entering the downstream approach.

4.9.2 Newell Highway from Darling Street to Macquarie Street, Dubbo

This site includes four intersections along the Newell Highway in Dubbo. The Newell Highway forms the east and western approaches to each intersection, The intersections in order from east to west are:

- Darling Street; a four-way roundabout with Darling Street as the northern and southern approaches. The southern approach has a railway level crossing and limited stacking distance
- Park Street; A Give-Way priority controlled intersection
- Brisbane Street; A Give-Way priority controlled intersection
- Macquarie Street; A traffic signal controlled intersection.

The speed limit along this section of the Newell Highway is 60km/h. These intersections are shown in Figure 4-13.

Figure 4-13 The Newell Highway between Macquarie Street and Darling Street, Dubbo.

A total of 27 crashes occurred in this section of the Newell Highway during the five year period from 2002 to 2006. These included five crashes at or near Darling Street, three at or near Park Street, seven at or near Brisbane Street and 12 crashes at or near Macquarie Street.

Of the five crashes at the Darling Street roundabout, two of them were right-angle crashes and two were rear-end crashes. The site investigation revealed that this intersection has similar lane configuration deficiencies as the Moree intersection. That is, the intersection provides two lane approaches into a roundabout with only one marked lane. Furthermore, unlike the Moree roundabout, the crash conflicts are more pronounced at this intersection because the conflicting traffic in adjacent traffic streams also have similar movements. That is, they do not diverge in the same way as the traffic at the Moree roundabout (see Figure 4-14). The crash conflicts are further exacerbated by the narrow widths in each departure which would result in side swipe and rear-end crash potential, especially if a truck is travelling in one of those traffic streams.

Figure 4-14 The eastern approach to the Newell Highway/Darling Street roundabout providing two-lane entry into a one-lane roundabout.

Between Brisbane Street and Macquarie Street, there is a crest vertical curve which limits the sight lines required for stopping and limits the sight lines for vehicles on the side road to select gaps and entering or crossing the Newell Highway.

Traffic entering from either of the Brisbane Street approaches have entering sight distance sight lines restricted towards traffic approaching from the west. As such, they may not be able to judge safe gaps which could lead to right-angle crashes as well as rear-end or loss-of-control crashes if drivers on the Newell Highway take evasive action. Of the seven crashes at this location, three were right-angle crashes. This intersection was also identified in the 2002 Route Performance Review as a crash location. However, the crash investigation from that study was inconclusive with regard to crash causation factors.

Macquarie Street is at the base of the crest curve and also within a sag vertical curve (see Figure 4-15). The combination of the crest and downhill grade limit the stopping sight distance to the traffic signals and to the linemarking at the intersection. The downhill approach may also compromise stopping ability, particularly for the observed traffic speed which appeared to be in excess of the 60km/h limit, particularly during wet conditions. Although the stopping sight distance measured from the actual traffic signals is adequate, the sight distance to vehicles at the back of the queue (the location of this would be quite variable) could be restricted. Of the 12 crashes at or near this intersection, eight of them resulted in a rear-end collision and four of them result in a right-angle collision. It appears as though more advanced warning of (i) the signalised intersection, (ii) the conflicting traffic streams entering from the side road as well as (iii) to the back of the queue are required to mitigate the crash risk at this intersection.

The Newell Highway/ Macquarie Street intersection was also identified in the 2002 Route Performance Review as a crash location meeting the defined criteria. However, at that time the intersection was not signalised. The intersection has since been upgraded with the installation of traffic signals which may have partially addressed this crash problem. This is evident with all seven of the crashes at this location occurring prior to 2006. There were no crashes reported at this location in 2006.

Figure 4-15 The crest curve on the Newell Highway in approach to the signals at Macquarie Street, Dubbo.

4.9.3 Intersection of Newell Highway and Thompson Street, Dubbo

The Newell Highway/ Thompson Street intersection is a priority controlled tee intersection with Thompson Street as the western and terminating leg. The Newell Highway forms the eastern and south-western approaches. The configuration of the intersection is shown in Figure 4-16.

In the eastern approach to the intersection (Newell Highway), the road ascends from a sag vertical curve to the west of Macquarie Street, curves to the south and then crosses a bridge over the Macquarie River. The combination of the curve and road side vegetation on the inside if the curve limits the sight distance available between westbound vehicles and vehicles waiting at the hold line of Thompson Street.

The south western approach to the intersection (Newell Highway) descends from Victoria Street (Mitchell Highway) at a higher elevation to the Thompson Street at a lower elevation. A railway overpass bridge (rail over road bridge) just south of Thompson Street is supported by a bridge column which is location in the raised median of the Newell Highway. The combination of the horizontal curve, the vertical grade and the width of the bridge column has resulted in a number a sight line restriction between southbound vehicles in the right-turn lane waiting to turn into Thompson Street, and opposing vehicles in the northbound direction.

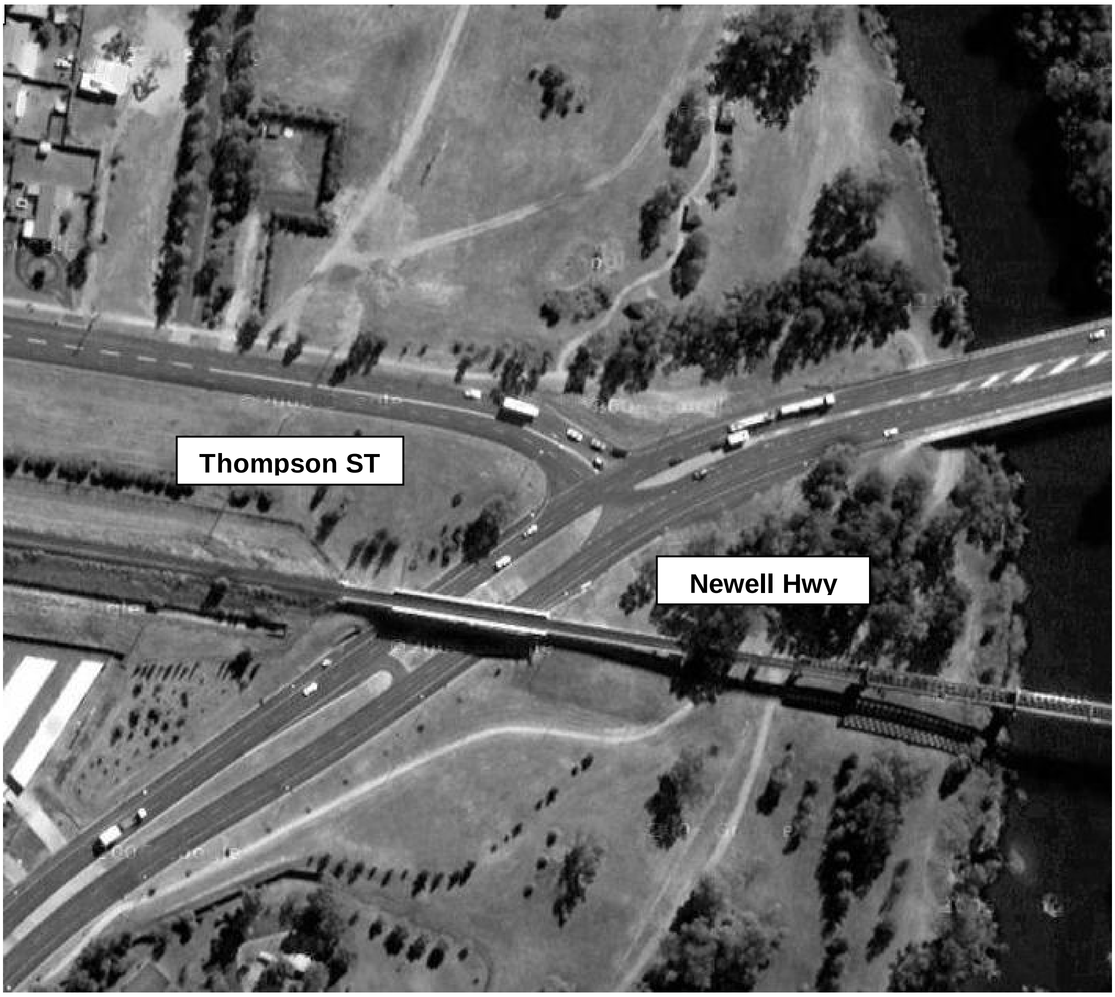

Figure 4-16 Existing configuration of the Newell Highway/ Thompson Street intersection, Dubbo.

Although the actual angle of intersection for the two roads is close to perpendicular, the two roads converge at an approximate 45° angle. As a Give Way controlled intersection, there may be a tendency for early gap checking by drivers approaching the intersection from Thompson Street. That is, they may tend to start checking for gaps in the Newell Highway traffic (particularly the northbound traffic stream) well before reaching the hold line. As the upstream section of Thompson Street is at a higher elevation, this would further tempt drivers to check gaps in this manner. The disadvantage of this is that since the angle of these approaching roads is quite acute, the driver would need to turn their head well away from the road ahead. This could lead to sudden braking and rear end crash risk.

The section of the Newell Highway between Victoria Street and Macquarie Street has a vastly different appearance and character as the sections to the east and west. As a four-lane semi-divided road with few accesses, it may give drivers the impression that it is suitable as a high-speed route despite the signposted speed limit of 60km/h. The combination of the number of approach lanes (two per direction) and the high operating speed of this section may also reduce entering opportunity for Thompson Street traffic due to the lack of sufficient gaps in the Newell Highway traffic. The lack of any protected acceleration lane for right-turning traffic from Thompson Street means that they are required to enter as a one-stage crossing rather than a more desirable two-stage crossing. This requires these drivers to check for gaps in two lanes of northbound traffic as well as (potentially) two lanes of southbound traffic. The on-site observations also confirmed that there were limited opportunities for these entering movements due to the high volumes of traffic on the Newell Highway.

During the five year period from 2002 to 2006, there were a total of 12 crashes at this intersection. Five of these (42%) occurred on Thompson Street with four of them being rear-end type crashes. These probably involved the following contributory factors:

- poor gap selection due to poor visibility to oncoming traffic approaching on the Newell Highway (due to the horizontal alignment in the northern approach and the road geometry and bridge support column in the southern approach)
- poor gap selection due to the lack of sufficient gaps and resulting frustration (including frustration and pressure from other drivers in the queue)
- early attempted gap selection and sudden braking leading to rear-end crashes.

Seven of the crashes occurred on the Newell Highway, with five of these coded as a single vehicle loss-of-control crash. The possible crash contributing factors include the following:

- high speed travel on a section of road with changing horizontal and vertical alignment
- sudden braking and evasive behaviour when this traffic (whether speeding or not) encountered conflicting traffic turning into or from Thompson Road.

In essence, PB believes that the single vehicle crash mechanisms and the multiple vehicle crash mechanisms are inter-related. That is, some single vehicle crashes are occurring due to single vehicle crash mechanisms and factors such as speeding, poor alignment and changes in the vehicle’s forward or centripetal acceleration. However, some single vehicle crashes may have also been due to multiple vehicle crash mechanisms. For example, drivers may take evasive action to avoid a crash with another (turning) vehicle which subsequently results in a single vehicle crash

4.9.4 Newell Highway from the Mitchell Highway to Baird Street, Dubbo

The intersection of the Newell Highway and the Mitchell Highway is a four way roundabout/give way controlled intersection. The Newell Highway forms the northern and southern approaches and the Mitchell Highway forms the eastern and western approaches. The eastern approach is locally known as Cobra Street and provides local access to the Dubbo CBD as well as a regional link to Wellington and Bathurst. The western approach is locally known as Victoria Street and provides a regional link to Bourke. A left-turn slip lane has been provided for westbound traffic on Cobra Street to bypass the roundabout.

The intersection of the Newell Highway and Elizabeth Street is a tee intersection with Elizabeth Street as the western and terminating leg. The intersection is priority (give way) controlled and allows right turns both into and out of the side road.

The intersection of the Newell Highway and Baird Street is a four way priority controlled intersection with the Newell Highway forming the northern and southern approaches, and Baird Street forming the eastern and western approaches. Both of the Baird Street approaches are controlled by Give Way signs. There are no turn restrictions in place for this intersection.

The Newell Highway is a four lane road. The section between the Mitchell Highway and Elizabeth Street being divided with a raised central median. The layout of each of these intersections is shown in Figure 4-17.

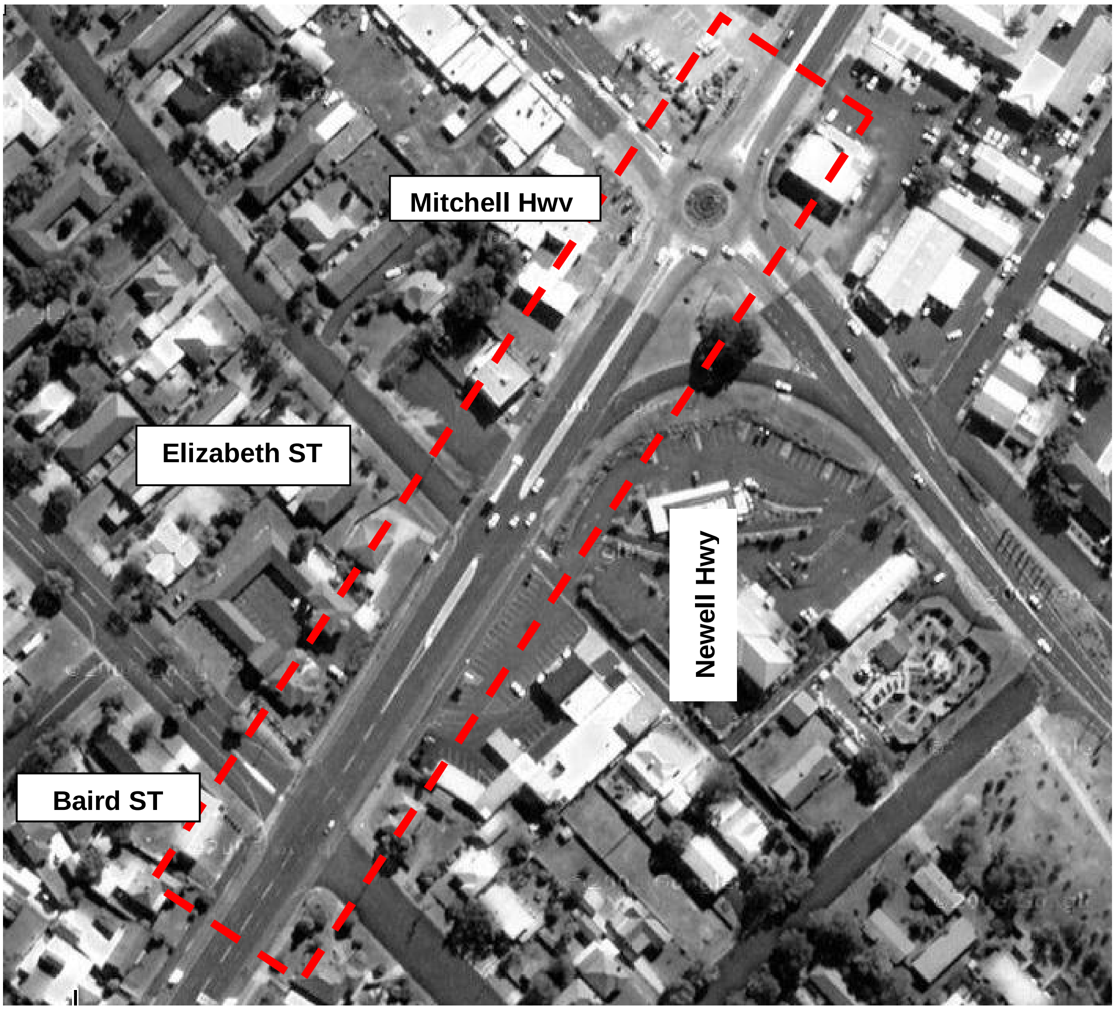

Figure 4-17 The Newell Highway between the Mitchell Highway and Baird Street

During the five-year period from 2002 to 2006, there were a total of 19 crashes within this section of the Newell Highway. Of these, six (31%) occurred at the Baird Street intersection caused by a vehicle attempting to turn right into Baird Street. The lack of formal right-turn bays at this location provides little protection to vehicles that have slowed or stopped in order to wait for a gap to turn. As a result, this would increase rear-end crash risk as demonstrated by the three rear-right crashes at this location.

During the five-year period from 2002 to 2006, there were also eight crashes that occurred in the southern approach to the Mitchell Highway intersection. Of these eight, seven of them were rear-end crashes. The site investigation indicated that these were most likely a result of queuing from the roundabout which would lead to more interrupted traffic flow conditions. This is a particularly prominent rear-end crash risk for northbound traffic as this roundabout is the first intersection in Dubbo for which traffic needs to observe a priority rule (give way).

The site inspection also confirmed that this roundabout is similar to the Newell Highway/Darling Street and the Newell Highway/Gwydir Highway roundabouts discussed previously in that there are two approach lanes but only one marked circulating lane within the roundabout.

4.9.5 Newell Highway from Church Street to Dalton Street, Parkes

Prior to 1999, the Newell Highway route through Parkes was via Hartigan Avenue, Welcome Street and Clarinda Street as outlined in blue in Figure 4-18.

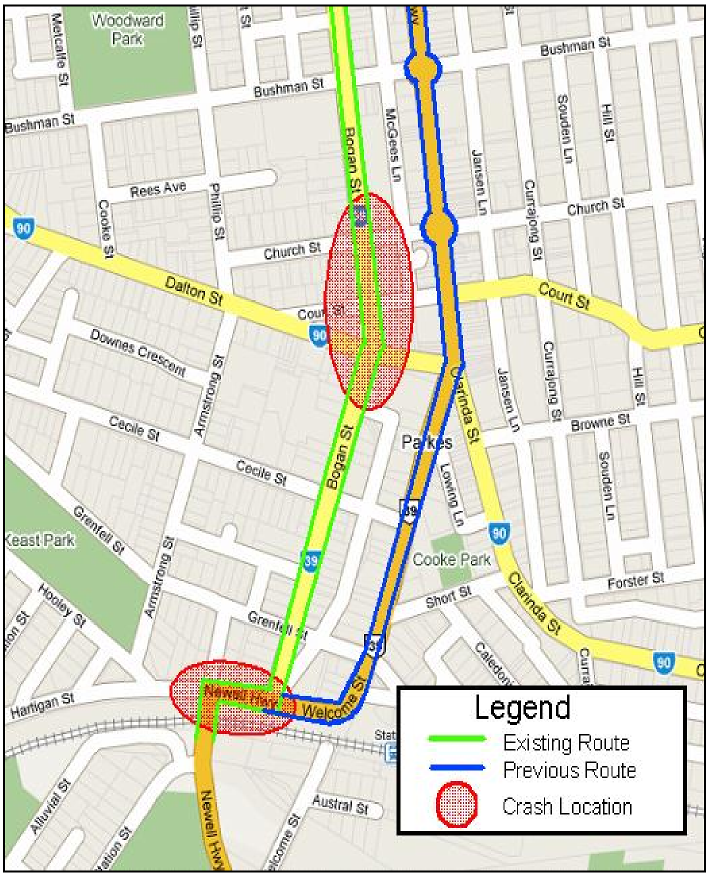

Figure 4-18 The Newell Highway route through Parkes and the two crash locations investigated.

Clarinda Street is also the main street of the town and includes the main retail and commercial centre and provides a high local access and pedestrian amenity function. As such, under the previous route classification, a heavy vehicle detour was provided via Bogan Street and Mitchell Street.

In 1999, the Newell Highway route was re-classified and re-routed via this heavy vehicle bypass, which is the current highway route. As a result, Welcome and Clarinda Streets were de-classified and converted to local roads.

In the section of the highway (Bogan Street) between Church Street and Dalton Street, the Newell Highway provides one lane per direction with indented turn lanes provided at key intersections. The intersection with Dalton Street is a four way priority controlled intersection. The western approach, Dalton Street West extends into Main Road 61 which is a regional route to Condobolin. This approach is controlled as a give-way seagull configured intersection. This seagull design allows for left and right-turn access onto the Newell Highway, and also allows for both left and right-turns from the Newell Highway. However, through movements from the eastern to the western sides of the Newell Highway, and vice versa are not permitted.

The eastern approach, Dalton Street East meets the Newell Highway as a left-in-left-out arrangement, which is reinforced by a triangular island. These approaches are shown in Figure 4-19. The combined effect of these turn restrictions and channelised turn facilities has reduced the total number of crash conflicts from 36 conflicts to 12 conflicts.

As seen in Figure 4-19, a pedestrian refuge with a staggered crossing arrangement, enforced by a pair of pedestrian fences) has been provided on the southern side of the intersection.

Figure 4-19 The Newell Highway at the Dalton Street intersection

The Court Street intersection was previously a four-way intersection with Court Street as the eastern and western approaches. Following a closure of the western approach and conversion of this approach to a cul-de-sac, the current configuration is a tee intersection with Court Street as the eastern and terminating leg. The intersection currently allows for left-in-left-out access to and from Court Street with right-turns prohibited. This is reinforced by a raised median along the Newell Highway. A pedestrian refuge has been provided on the northern side of this intersection.

The Church Street intersection is a four-way give way controlled intersection with Church Street as the eastern and western approaches. The western approach is a left-in-left-out access which is reinforced by a triangular island (see Figure 4-20). Both left and right-turns are allowed into and out of the Church Street East approach. This intersection was previously configured as a roundabout.

Figure 4-20 The Church Street West approach to the intersection with the Newell Highway.

During the five-year period from 2002 to 2006, there were a total of eight crashes that occurred along the Newell Highway between Dalton Street and Church Street. Of these, five (63%) occurred at the Dalton Street intersection and all involved two vehicles from adjacent approaches. This was an unexpected finding since, as mentioned above, there are many safety features in place such as the turn restrictions and channelised turning facilities. These features have reduced the number of crash conflicts from 36 conflicts to 12. PB concluded that some possible explanations for the crash problems may include:

- The high through traffic volumes along the Newell Highway resulting in a lack of gaps and entering opportunity: Although the re-routing of the Newell Highway via Bogan Street has reduced the conflict between the through traffic function and the local access and pedestrian functions, there is still a considerable amount of conflict as this route provides local access to eight side streets. As described above, there has been some attempt to reduce the amount of conflict using turn restrictions from some of these side roads, but whilst ever there is a demand for local access onto this route, the through traffic volumes and lack of gaps would lead to safety problems as a result of poor gap selection and frustration.
- A considerable frequency of illegal movements: This includes the through movements from the eastern to western approaches. There could be a tendency for eastbound traffic to attempt this illegal movement as Dalton Street forms part of the major regional link from Condobolin to the main street and commercial centre of Parkes. The alternative of turning left or right and circulating back to Clarinda Street would be circuitous. Although there was little evidence of this during the site inspection (i.e. no illegal movements observed and very few tyre marks indicating this manoeuvre), the fact that many crashes were coded as cross traffic crashes, despite the limited opportunities for these crash types suggests that there may be some offending vehicles involved.

4.9.6 Newell Highway from Forbes Street to Bogan Street, Parkes

The Newell Highway enters the southern side of Parkes via Forbes Street, then makes a 90° turn at Hartigan Avenue and then another 90° turn at Bogan Street (see Figure 4-18). At the Forbes Street/Hartigan Avenue intersection, the Newell Highway forms the southern and eastern approaches. As such, the dominant movements are the northbound right-turn and the westbound left-turn movements. There is also a railway level crossing in the southern approach (Forbes Street) approximately 20m south of the controlled area of the intersection.

To address short stacking issues with the nearby rail line and also to cater for the dominant movements described above, an unconventional priority rule has been put in place consisting of the following:

- northbound traffic approaching the intersection along Forbes Street (Newell Highway South) have right of way over all other traffic movements
- the eastern and western approaches are controlled by give way signs
- the northern approach is controlled by a stop sign.

The Hartigan Avenue/ Bogan Street intersection is a tee intersection with Bogan Street (Newell Highway North) as the northern and terminating leg. The western approach (Hartigan Avenue) is part of the Newell Highway. Hartigan Avenue East is signposted as an access route to Main Road 61 (East) which provides a regional link to Orange.

As the Newell Highway forms the western and Northern approaches to this intersection, the dominant movements are the southbound right-turn and the eastbound left-turn movements. As such, similar to the Forbes Street intersection, an unconventional priority rule has been put in place consisting of the following:

- the southbound traffic on Bogan Street have right of way over all other traffic movements
- the eastern and western approaches are controlled by give way signs.

During the five-year period from 2002 to 2006, there were a total of eight crashes along the Newell Highway between Forbes Street and Bogan Street. Most of these crashes occurred at the intersections with six of the eight crashes (75%) involving traffic from adjacent approaches.

PB's investigation of the site revealed the following possible factors that may have contributed to this crash pattern:

- The unconventional priority rules in place for both intersections could result be confusing as to which traffic units have right of way when approaching the intersection. This is particularly the case for the Forbes Street intersection where there are three levels of priority including (i) full right-of-way, (ii) give way signs and (iii) stop signs. Furthermore, as discussed below, the left turn movements into Forbes Street South and Bogan Street are both complementary to the opposing right-turn movements which have right of way over all other traffic. It is possible that many regular drivers are aware of this but will deliberately neglect to give way when turning left. The result may be that the adjacent traffic in the right-hand lanes, not aware that the other vehicles are not giving way when they should may follow which places them at risk of an impact from other traffic using the intersection.

- The eastbound traffic on Hartigan Avenue approaching Bogan Street, and the westbound traffic approaching Forbes Street are required to give way. PB noted that there is only approximately 65m of storage between these the Forbes Street and the Bogan Street intersection. The traffic flow breakdown caused by the give way signs would increase the risk of queuing which could result in queue spillback into the upstream intersection. This could increase the risk of multiple vehicle crashes since some vehicles entering the intersection may be impeded from clearing the intersection. A more likely scenario would be the vehicle being able to clear the intersection, but at a different speed to their entering speed which could in turn lead to a collision with another vehicle. Figure 4-21 shows this queue spillback risk with two B-doubles. Figure 4-22 presents a diagram showing the crash risks.

Figure 4-21 Two B-doubles approaching the hold line of the Hartigan Avenue/ Bogan Street intersection. Note the second vehicle is still within the control area of the Hartigan Avenue/ Forbes Street intersection.

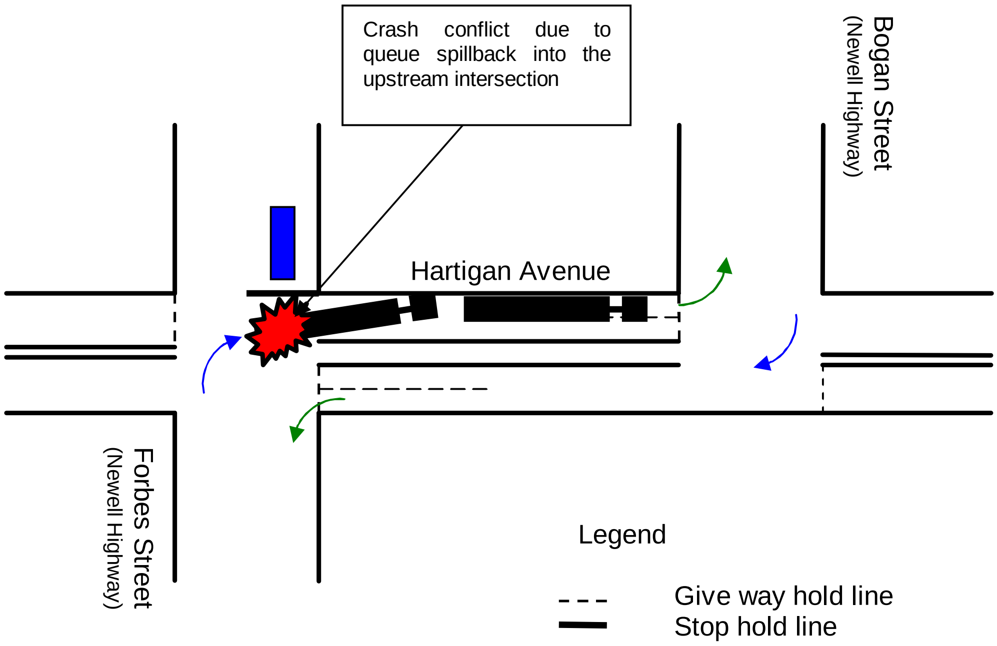

Figure 4-22 Crash risks due to the short storage length between Bogan Street and Forbes Street

The give way signs that are placed at the give way hold lines on Hartigan Avenue apply to all traffic on those approaches irrespective of whether this traffic intends to go straight or turn left or right. The left-turn movements as indicated by the green arrows in Figure 4-22 could be allowed to continue without giving way as these are complementary to the opposing right-turn movements shown by the blue arrows. PB did note that because of the swept paths of B-doubles and other articulated trucks, these vehicles are required to commence the left-turns from the right-hand (through) lanes. As such, under the existing road width it is difficult to provide separated approaches for left-turning traffic. However, there is potential to reconfigure these intersections to allow more free flowing left-turn movements and thereby reduce queuing and queue spillback potential.

5. Conclusions

Following the analysis and investigation activities involved in this Route Performance Review, PB has developed a number of strategies that could be further considered for improving road, transportation and travel conditions along the Newell Highway. These are summarised below:

- Continue road upgrades to enable a consistent rural speed limit of 110km/h throughout the whole highway length: The route condition survey revealed that approximately 6% of the highway is signposted with a 100km/h speed limit. These tend to be in the more undulating country with relatively poorer road geometry.
- Strategic provision of overtaking lanes in undulating sections: The overall lengths of overtaking lanes provided along the highway has increased between 2002 and 2008. However, there are many sections, particularly in the more undulating sections between Gilgandra and Coonabarabran which lack overtaking provisions. This would achieve better management of conflicting traffic and road function such as between caravans and faster moving freight trucks.
- Increased sealed shoulders: Although lane widths were adequate throughout the entire route, approximately 35% of the route contained narrow sealed shoulders. Standard shoulder widths should be applied to the whole highway. This would improve safety amenity with respect to single vehicle crash risk.
- Strategic management of clear zones: In general, the clear zones along the highway were in good condition. However, there are still a large number of clear zones that contain unyielding crash hazards such as trees, cuttings and steep embankments. These could be strategically identified and treated if appropriate. This would improve safety amenity with respect to single vehicle crash risk.
- Strategic management of squeeze points: It is acknowledged that many squeeze points cannot be addressed without substantial cost. However, a strategy could be developed involving consistent management of these including advanced warning signage schemes, safety barrier upgrade and approach delineation.
- Development of improvement options for the six crash locations identified including (i) improvements to lane delineation at roundabouts, (ii) improvements to visibility and sight distances, (iii) management of speeds through speed zoning, enforcement and via the design and character of the road, (iv) clear priority rules for complicated intersections.

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