GOLDEN HIGHWAY CORRIDOR STRATEGY

OCTOBER 2016

Transport MASTER PLAN

Golden Highway CORRIDOR STRATEGY

NSW GOVERNMENT

Recently upgraded section of the Golden Highway at Elong Elong

Cover image: Canola plantation on the Golden Highway east of Dunedoo

EXECUTIVE SUMMARY

The Golden Highway is 313 km in length and passes through five local government areas, connecting the Hunter region (Singleton, Muswellbrook and Upper Hunter) with the Central West region (Warrumbungle and Western Plains Regional Council). At the eastern end is the New England Highway, a national highway connecting the Golden Highway to Tamworth, Armidale and south-east Queensland in the north and Newcastle to the east. At the western end, another national highway, the Newell Highway connects the Golden Highway to south-west Queensland in the north and central north Victoria to the south. West of Dubbo the Mitchell and Barrier highways connect Dubbo with western NSW and South Australia.

This Golden Highway Corridor Strategy has been prepared by a multidisciplinary project team from Transport for NSW and Roads and Maritime Services with expertise in road safety, traffic, asset management, land use, environment, planning and development. The strategy sets out the NSW Government's 20 year plan to manage and guide the development of the road corridor to improve safety, traffic efficiency and sustainability.

The purpose of this strategy is to identify:

- Objectives specific to the Golden Highway that support the *NSW Long Term Transport Master Plan,* and the Regional Transport Plans for the Hunter and Central West (Chapter 2).
- The concerns, values and issues that are important to the community along the Golden Highway (Chapter 3).
- The sources of transport demand along the road corridor (Chapter 4).
- The performance of the Golden Highway in meeting specific targets, standards and objectives (Chapter 5). Measures include road safety, traffic and travel, road design and geometry and road pavement condition.
- How future transport demands that are likely to be placed on the Golden Highway over the next 20 years can be managed and what road corridor improvements are therefore likely to be needed (Chapter 6).
- Current and future challenges in meeting the objectives for the corridor and short, medium and long term priorities and actions to address these challenges on the Golden Highway (Chapter 7).

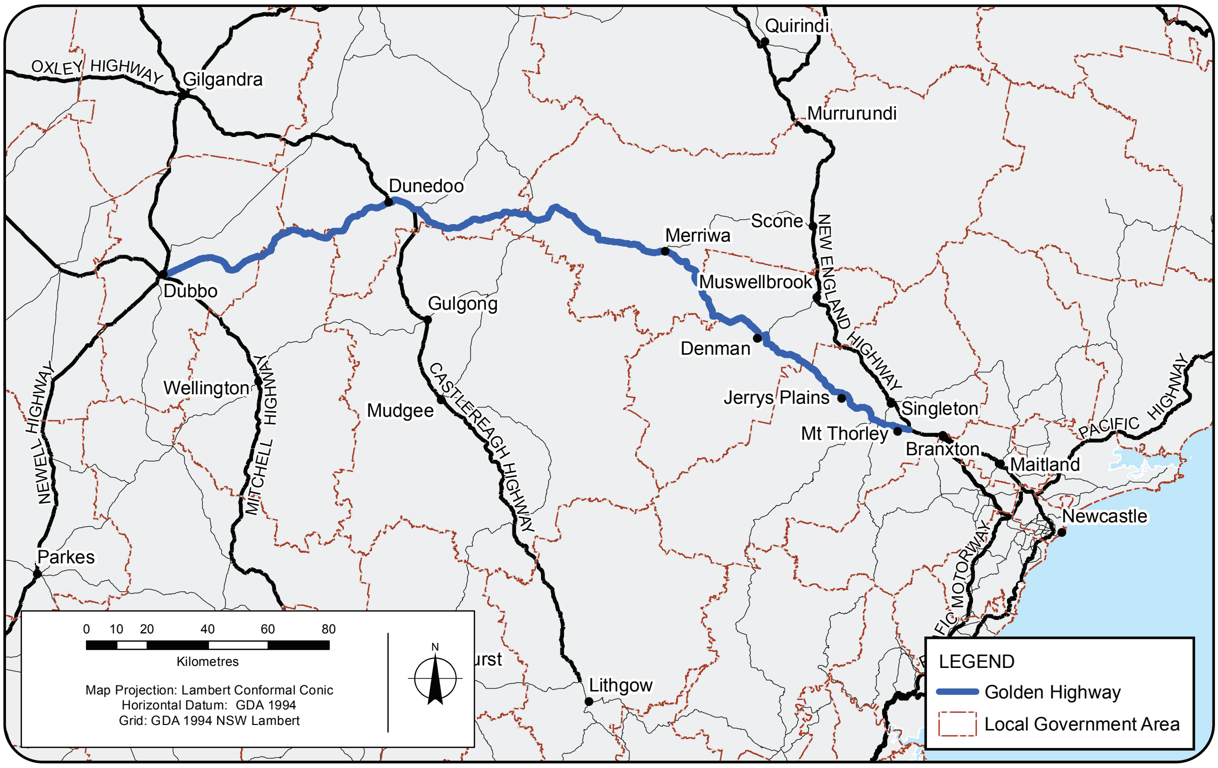
In assessing the performance of the road corridor against performance measures and targets the corridor has been divided into 11 smaller sections. These include:

- Section 1: Belford to Mt Thorley.
- Section 2: Mt Thorley to Jerrys Plains.
- Section 3: Jerrys Plains.
- Section 4: Jerrys Plains to Denman.
- Section 5: Denman (township).
- Section 6: Denman to Merriwa.
- Section 7: Merriwa (township).
- Section 8: Merriwa to Dunedoo.
- Section 9: Dunedoo (township).
- Section 10: Dunedoo to Dubbo.
- Section 11: Dubbo (urban area).

The vision for the Golden Highway has been developed to explain what actions should be achieved over the next 20 years in order to improve the performance of the Golden Highway and meet the specific corridor objectives. The vision for the Golden Highway over the next 20 years is to:

- Boost productivity, support the development of agricultural and mining activities and operate as a critical freight route by enabling access for Performance Based Standards (PBS) Class 2B high productivity vehicles (up to 30 m in length) across the Great Dividing Range from western NSW to the Hunter region and the Port of Newcastle.
- Provide safe and efficient travel for all road users by providing a "2+1" lane arrangement east of Denman Road, and two lane two way with an increased number of overtaking/climbing lanes west of Denman Road, and by addressing high risk crash locations.

Figure A Locality plan



- Improve road network reliability and access by reducing the impact of flooding.

Average daily traffic (ADT) volumes along the Golden Highway vary in the rural sections from around 5,000 at the eastern end to around 11,000 east of Broke Road, 3,000 at Denman, 1,600 west of Merriwa and 1,500 west of Dunedoo. In the urban centre of Dubbo the average daily traffic volume exceeds 20,000 vehicles per day. The percentage of heavy vehicles along the corridor ranges from 19-21% west of the New England Highway at Belford and east of Dunedoo, decreasing to 12% near Broke Road and Dubbo where there is a higher volume of commuter traffic associated within mining areas and the urban centre of Dubbo, respectively. Annual traffic growth of 2% (linear) has been recorded at the eastern end of the corridor due to the strength of the mining sector, whilst the remainder of the corridor has experienced steady annual growth of between 1-2% (linear).

Key findings of the Golden Highway Corridor Strategy include:

Road safety:

- Of the 370 crashes reported between July 2008 and June 2014 along the Golden Highway corridor, 200 were 'casualty crashes', which caused either an injury or fatality to one or more of the people involved. Of the 200 casualty crashes, nine were fatal and 191 resulted in an injury.
- The most common crash type in the corridor is off road on curve crashes, representing 29% of all crashes. This is closely followed by off road on straight crashes at 25%. As such, single vehicle crashes account for 54% of all crashes on the Golden Highway.
- Most corridor planning sections illustrate crash rates at or below the state average of 0.18 to 0.2 crashes per kilometre (over a 5 year period). However there are discrete sections (5 km in length) which exhibit crash rates higher than the state average, these include Mt Thorley (0.3), east of Jerrys Plains (0.24), Denman (0.36), 20 km east of Merriwa (0.4), immediately west of Merriwa (0.24) and the Dubbo urban area (1.24).

Directional sign at the intersection of Golden and New England highways

- In terms of 100 million vehicle kilometres travelled (MVKT), discrete sections (5 km in length) exhibit relatively high crash rates include immediately west of Denman (up to 22.64), 25km west of Denman (up to 45.27), west of Merriwa (3 locations at 32.26), and west of Dunedoo (up to 26.14).

- There are a large number of tight curves between Jerrys Plains and Merriwa.

- There are steep grades between Jerrys Plains and Denman where the highway passes through Ogilvies Hill and Winery Hill. Heavy vehicles frequently slide on Ogilvies Hill due to the grades which are in excess of 10 percent at the steepest point.

- There is one section with lane widths less than 3.25 metres located 1.3 km west of Saddlers Creek, Jerrys Plains to Palace Street, Denman (35.0 km of 38.3 km). There is one short section of the Golden Highway with lane widths of only 3 metres located 2.6km west of Idaville Road to 2.3 km east of Glenroy Road, Merriwa (1.4 km).

- There are 12 bridges that are 7.8 metres in width or narrower that would benefit from enhanced delineation of the bridge and bridge approaches. The Krui River bridge is also only 6.0 m wide, with 2.8 m travel lanes.

- 128.5 km (or 41%) of the Golden Highway has sealed shoulders of less than 1 metre in width.

- Some of the narrowest clear zones are located west of the village of Jerrys Plains, near Rosemount Road, east of Westwood Road, near Redwell Road, east of Ulan Road, east of Elong Elong village, east of Ballimore and through Muronbung.

- There are five rail level crossings on the Golden Highway, of which the Denman level crossing has the highest risk of all high speed level crossings.

- Most intersections (85%) do not meet current network design standards

Travel speeds and level of service:

- The Level of Service (LoS) during peak hours is generally good (LoS C or better), however it declines to LoS D at the eastern end of the corridor between the New England Highway and Denman Road. This reduced performance is attributable to the impact of coal mining related traffic and the undulating terrain particularly between Jerrys Plains and Denman Road.

Freight productivity:

- Poor road geometry, insufficient heavy vehicle inspection sites, insufficient heavy vehicle rest areas and rest area facilities, and poor flood immunity at discrete locations restrict the ability of the Golden Highway to accommodate Higher Productivity Vehicles (HPVs).

- Given the strategic importance of the Golden Highway as a freight corridor including as an essential over-size over-mass route, its closure (including any detours) for the purposes of mining will need to be carefully considered, given the lack of alternate over-size over-mass (OSOM) routes in the immediate area.

Asset performance:

- The Golden Highway is currently being reconstructed or rehabilitated at a rate of 0.4 percent per year, based on works undertaken in the last ten years. This replacement rate is not sustainable in the long term.

- A large proportion of the corridor, 38.7%, has pavement greater than 40 years in age.

- There are two locations on the Golden Highway that are subject to flooding caused by rising waterways. These are the Talbragar River, Uarbry and Mudies Creek, Whittingham.

- There are four high risk slopes with an Assessed Risk Level (ARL) of 2. Additional funding is required to minimise slope risk.

- There are three high risk culverts with an Assessed Risk Level (ARL) of 1, and nine culverts with an ARL of 2. Additional funding is required to minimise the risk of culvert failure.

- The Golden Highway is a Higher Mass Limits (HML) 25/26 metre B-Double route. A recent load assessment has identified that bridges on the Golden Highway are able to accommodate PBS Class 2B A-Double and Super B Double vehicles operating at up to 91 tonnes.

- There are two bridges with a 'poor' Bridge Health Index (BHI). These are Cockfighter Bridge over Wollombi Brook and Halls Creek. Remediation works on these bridges should be undertaken in the short term.

- There are a number of narrow bridges on the Golden Highway which are less than the desirable width of 8.4m. The Krui River bridge is also only 6.0 m wide, with 2.8 m travel lanes.

Taking action:

Short term priorities:

To address some of the challenges associated with road safety, freight productivity and sustainable asset management, a number of short-term priorities (0 – 5 years) have been identified.

Lane and seal widening with clear zone works are proposed to address run-off road crashes east of Denman, Gungal and west of the Castlereagh Highway (east) intersection. Measures are proposed to prevent fatigue related crashes, increase driver awareness at narrow bridges, enable safe access for higher productivity vehicles and improve safety at level crossings. Speed limits will also be reviewed on a priority basis to ensure they are appropriate.

Overtaking lanes are proposed at more highly trafficked locations to improve traffic efficiency and reliability, improve safety for motorists, and support the productive movement of freight. More significant intersection upgrades are also proposed at busy locations to address traffic delays and safety issues. Flood immunity works are proposed at Mudies Creek and Uarbry.

Asset maintenance works are proposed to repair or upgrade bridges at Wollombi Brook and Halls Creek, sustainably manage high risk slopes and culverts and undertake accelerated pavement rehabilitation.

The NSW Government will work with Councils to improve school bus stops, work with Warrumbungle Shire Council to prepare a Pedestrian Access and Mobility Plan for Dunedoo, and work with Western Plains Regional Council to improve provision for pedestrians and cyclists along the highway within Dubbo.

Medium-term priorities:

Medium-term priorities (5 – 10 years) identified include completing lane and seal widening with clear zone works east of Denman and continuing

Guide sign immediately west of the intersection with the New England Highway

lane and shoulder widening between Denman and Dunedoo to reduce run-off road crashes. Intersection upgrades will be prioritised based on crash history, crash risk and traffic volumes. Rest areas and parking bays will be upgraded where necessary to enable safe access for higher productivity vehicles.

Constructing additional overtaking lanes east of Denman, and eastbound and westbound climbing lanes between Denman and Dunedoo where heavy vehicle performance is affected. The use of intelligent transport systems (ITS) for improved incident management and enforcement will be considered. Monitoring the amenity impact of heavy vehicle volumes and types on towns and undertaking traffic calming or other works where warranted has also been identified as a priority.

Asset maintenance works proposed include accelerated pavement rehabilitation (with lane and shoulder widening works), with priority areas including at Jerrys Plains, and between Denman and Dunedoo.

Long-term priorities:

To reduce crash risk, completing lane and seal widening and clear zone works between Denman and Dunedoo has been identified as a long-term priority. Intersections will be upgraded on a priority basis and the need for upgrades to rest areas and stopping bays monitored. All high speed level crossings on the highway are targeted to be upgraded to boom gates.

To improve travel times and reduce crash risk east of Denman a three lane configuration with alternating overtaking lanes is a long-term goal. The need for separation of opposing traffic will be investigated and potentially provided. Increasing capacity between Putty Road and Mount Thorley where warranted by providing two lanes in each direction. The completion of climbing lanes on all steep grades where heavy vehicle performance is affected is also a priority between Denman and Dunedoo. The need for overtaking lanes between Dunedoo and Dubbo will be continuously monitored. Traffic movements will continue to be monitored in Dubbo. Duplication of the Golden Highway between the level crossing near White Street and Yarrandale Road is also a long-term priority.

A full list of short, medium and long-term investment priorities proposed to address the Golden Highway corridor challenges over the next 20 years is provided in Chapter 7 of this strategy.GOLDEN HIGHWAY CORRIDOR STRATEGY

CONTENTS

1 A QUICK OVERVIEW

Golden Highway east of Dunedoo

The Golden Highway is 313 km in length and passes through five local government areas, connecting the Hunter region (Singleton, Muswellbrook and Upper Hunter) with the Central West region (Warrumbungle and Western Plains). At the eastern end the New England Highway, a national highway connecting the Golden Highway to Tamworth, Armidale and south-east Queensland in the north and Newcastle to the east. At the western end, the Newell Highway connects the Golden Highway to south-west Queensland in the north and central north Victoria to the south. West of Dubbo the Mitchell and Barrier highways connect Dubbo with South Australia.

The Golden Highway provides:

- Connection for local communities between Singleton, Muswellbrook, Denman, Merriwa, Dunedoo and Dubbo.
- Connection between mines, surrounding towns and villages, the Lower Hunter and Newcastle (via the New England Highway and the Hunter Expressway).
- Freight connection for goods moving west from Newcastle including supplies to mines in the east and fertiliser along the length of the corridor.
- Connection for agricultural industries between Dubbo, Dunedoo, Merriwa, Denman and Newcastle including the Port of Newcastle (via the New England Highway).
- Access to the Upper Hunter vineyards.
- Connection to the M1 Pacific Motorway and Sydney via the New England Highway and Hunter Expressway.
- Connections to south-west Queensland and central-north Victoria (via the Newell Highway) and to South Australia (via the Mitchell and Barrier highways).

The crossing of Great Dividing Range (692 m) on the Golden Highway

The Golden Highway rises from Belford to Sandy Hollow on a small grade before rising on a moderate grade to Cassilis. There are sections with steep grades east of Denman Road (especially Ogilvies Hill and Winery Hill), and between Denman and Cassilis. West of Cassilis the terrain falls on a gentle grade to Dubbo.

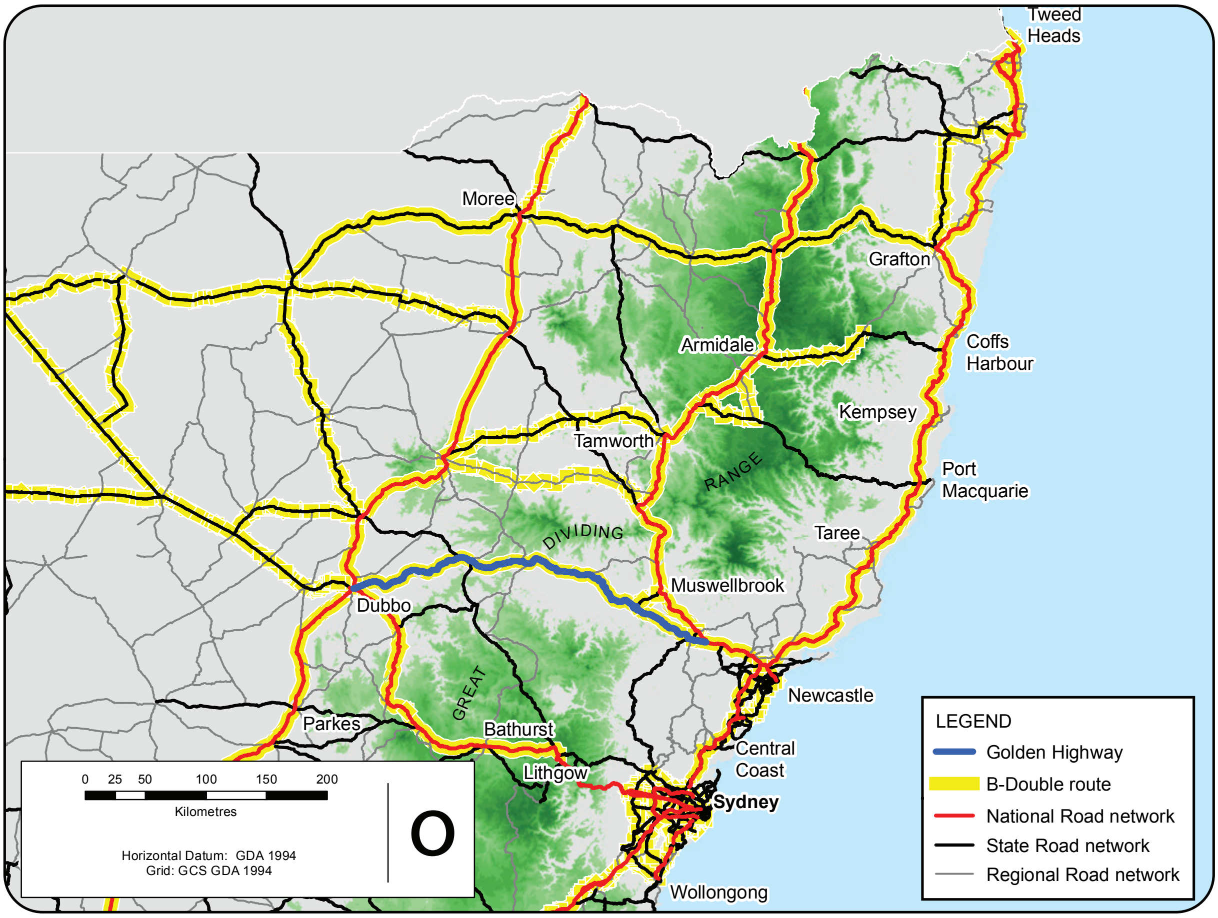
The horizontal curvature of the Golden Highway varies significantly between the east and west. There are sections of the highway with large proportions of less than desirable curve radii. These are east of Putty Road east, between Jerrys Plains and Denman, and between Sandy Hollow and Merriwa. West of Merriwa the horizontal curvature generally complies with current standards, except for the small radius curve (315 m) immediately east of the Krui River bridge (which is only 6.0 m wide).

Average daily traffic (ADT) volumes in 2014 along the Golden Highway varied in the rural sections from around 5,000 at the eastern end to around 11,000 east of Broke Road, 3,000 at Denman, 1,600 west of Merriwa and 1,500 west of Dunedoo. In the urban centre of Dubbo the average daily traffic volume exceeds 20,000 vehicles per day. The percentage of heavy vehicles along the corridor ranges from 19-21% west of the New England Highway at Belford and east of Dunedoo, decreasing to 12% near Broke Road and Dubbo where there is a higher proportion of commuter traffic associated within mining areas and the urban centre of Dubbo. Annual traffic growth has experienced steady annual growth of between 1-2% (linear) over the period 2004 – 2014.

The Golden Highway is an approved HML B-Double route. It is one of only three east-west B-Double routes north of Sydney over the Great Dividing Range, the others being the New England Highway and the Gwydir Highway. The Golden Highway crosses the Great Dividing Range at an altitude of 692 metres Australian Height Datum (AHD) at Stotts Road, Cassilis. This crossing is relatively easy in comparison to that of the routes to the south, the Great Western Highway (maximum height of 1170 metres AHD) and Bells Line of Road (maximum height of approximately 1000 metres AHD).

The *Hunter Regional Transport Plan* identifies two potential future improvements for the

Figure 1.1 B-Double road freight routes across the Great Dividing Range



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Data source: Geoscience Australia, 250K Topographic Data Series 3.

Golden Highway – regrading or realignment of Ogilvies Hill (around 2.5 km east of Dalswinton Road, Denman) and Winery Hill (at Edderton Road, Jerrys Plains)[1].

In March 2015, the NSW State Government committed a combined package of $170 million in upgrades along the Golden Highway corridor. This included $85 million towards a grade separated interchange with the New England Highway at Belford, which includes a duplication of the New England Highway from the Golden Highway to the Belford deviation. A further $85 million was provided under the Regional Freight Pinch Point and Safety Program towards a program of safety and productivity improvements between Belford and Dubbo. In February 2015, the Federal Government also committed $47.6 million, on a 50/50 arrangement basis with the NSW State Government, under the Heavy Vehicle Safety and Productivity Programme (HVSPP) to undertake a program of freight productivity and safety works to facilitate the introduction of larger HPVs.

This corridor strategy sets out the objectives, current performance, current and future challenges and the NSW Government's strategic response to managing the Golden Highway corridor over the long term. Asset improvement works are required to address sections of poor pavement. Safety works are required to address intersection and run off road crashes and improve safety at railway level crossings, and significant works are required in order to improve the productivity of the increasing freight task along this strategic freight corridor. Such works include additional overtaking

1 Transport for NSW 2012, *NSW Long Term Transport Master Plan*, TfNSW, Sydney

Eastbound queues on the Golden Highway near the New England Highway intersection

opportunities, road widening, improved rest areas, on road enforcement sites and works to improve flood immunity on the corridor.

1.1 Recent major achievements on the Golden Highway corridor

Over the past five years the NSW Government has invested heavily in pavement rehabilitation and works to improve skid resistance along the Golden Highway corridor. Investigations are also underway to address run-off road crashes.

In July 2016, the upgraded intersection of Palace and Crinoline streets was opened to traffic through Denman. Funded through the Resources for Mining Affected Regions program, the project involved realigning the Golden Highway to bypass the existing four-way intersection. The existing access to St Joseph's Primary School was also improved as part of the works.

In March 2014 improvement works to the value of $5 million were undertaken at the intersection of the Golden Highway and the New England Highway at Belford to address right turning vehicles from the Golden Highway colliding with northbound vehicles on the New England Highway. The left turn deceleration lane on the New England Highway was lengthened and protected near the Golden Highway. Rumble strips were also installed on the Golden Highway, along with a central concrete median and signage improvements.

2 INTRODUCTION

2.1 Why a corridor strategy?

Transport for NSW and Roads and Maritime Services (Roads and Maritime) are progressively preparing network and corridor strategies to cover every state road in regional NSW as a response to the challenge of how to best manage transport infrastructure to maximise benefits for our customers. Network and corridor strategies provide the following benefits for the State Road Network in regional NSW:

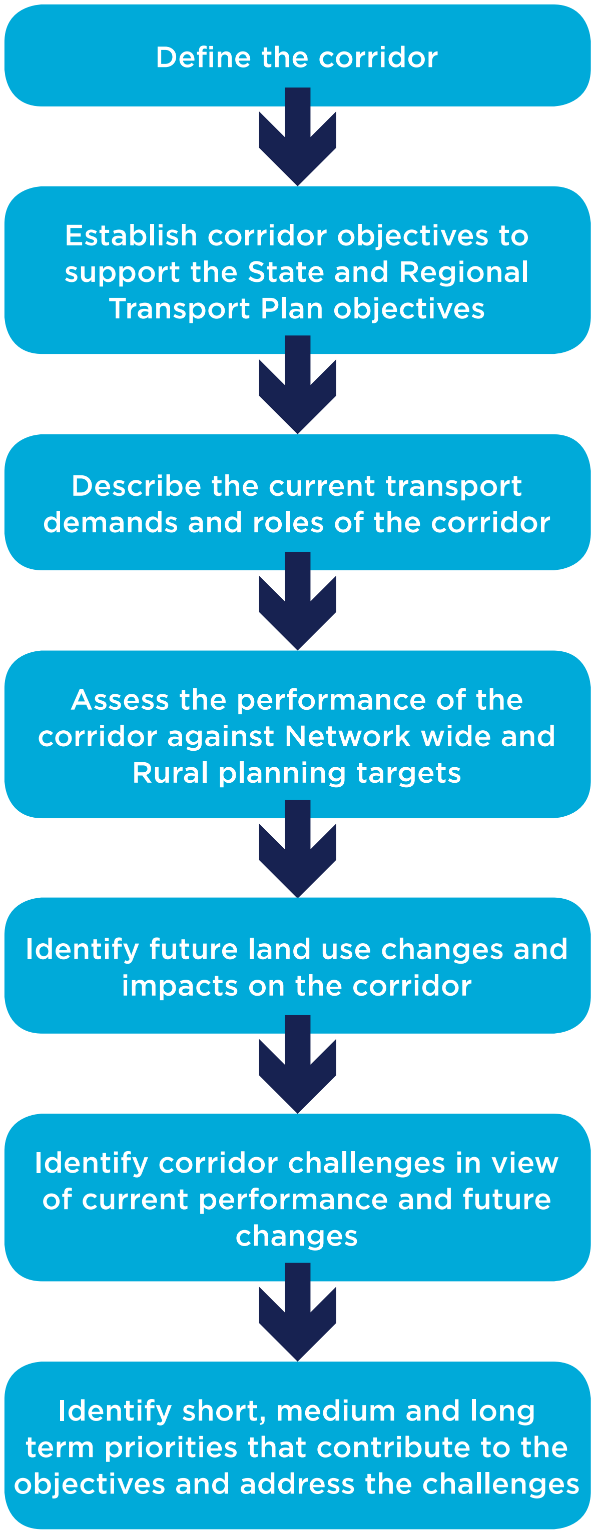
- A **plan** for network/corridor improvement with consideration to all **modes** of transport
- **Transparency** to the community, councils and other government agencies with regard to planning and investment decisions
- **Consistency** in planning, management and operation of roads
- Facilitate the **integration** of road safety, traffic and asset maintenance projects.

Drawing together a variety of elements, as shown in Figure 2-1, corridor strategies identify:

- Corridor-specific objectives that support the *NSW Long Term Transport Master Plan* and related State, national and Regional Transport Plan objectives
- The performance of transport infrastructure in meeting the corridor-specific objectives
- Current and future challenges in meeting these corridor-specific objectives
- Key transport demands likely to be placed on the corridor over the next 20 years
- Short, medium and long term priority actions for managing the corridor.

Corridor strategies include priorities for future road maintenance, operation, safety, traffic and development. They set a 20 year framework, which brings together road safety, traffic efficiency and asset management activities, together with policy in relation to freight access.

Figure 2.1 Corridor planning process



Why the Golden Highway?

The Golden Highway is the only approved 26 m east-west B-Double route between the Hume Highway (and its connections) south of Sydney and the New England Highway. It provides access across the Great Dividing Range at low to moderate grades unlike other highways such as the Great Western Highway to the south and Oxley Highway to the north, with the highest altitude for the Golden Highway being only 692 metres AHD at the highest point at Stotts Road, Cassilis. The Great Western Highway is only a 19 metre B-Double route and has significant grades, black ice in winter, high local traffic volumes and resistance from some residents of the area to larger heavy vehicles. Freight traffic is expected to continue to grow significantly across the State over the next 20 years and the NSW Government is supportive of improving the productivity of freight transport by seeking to accommodate higher productivity vehicles where feasible.

Freight productivity makes a valuable contribution to the nation's economic performance[2]. Freight productivity, in turn, is dependent on the productivity of the vehicles allowed to travel on the road. On strategic freight corridors east of the Newell Highway generally the objective is to accommodate Performance Based Standards (PBS) Class 2B vehicles including A-Double Road Trains and Super B-Doubles of up to 30m in length. The *Hunter Regional Transport Plan* identifies the expectation that the Golden Highway will become a critical freight corridor, with inbound mining freight flows forecast to exceed the levels currently seen on the New England Highway by 2031.[3]

The *NSW Long Term Transport Master Plan* identifies significant investment to address pinch points on the Golden Highway. The *Hunter Regional Transport Plan* identifies two potential future improvements for the Golden Highway – the regrading / realignment of Ogilvies Hill (around 2.5km east of Dalswinton

Guide sign on the Golden Highway east of Dubbo

2 *"Improvements in freight productivity and efficiency reduce the cost of moving freight, adding directly to national economic output." Bureau of Infrastructure, Transport and Regional Economics 2011, Truck Productivity: Sources, Trends and Future Prospects,* BITRE, Canberra, p. xiii

3 Transport for NSW 2014, *Hunter Regional Transport Plan,* p35

Road, Denman) and Winery Hill (at Edderton Road, Jerrys Plains).[4]

Since 2009, Roads and Maritime Services has had various requests from industry to improve access by HPV on the Golden Highway, including for up to PBS Class 2B vehicles of up to 30 m in length. This vehicle type is only up to 4 m longer than existing 26 m B-Double vehicles and tracks in a similar manner to B-Double vehicles. These vehicles could be accommodated on the Golden Highway with less infrastructure requirements than those for B-Triple sized vehicles.

Undertaking enabling works on the Golden Highway within the short-term (5 years) to enable access by PBS Class 2B vehicles, would enable an alternative higher productivity freight route to that of the Great Western Highway through the Blue Mountains, which is limited to semi-trailer sized vehicles.

A study[5] undertaken by Hyder Consulting for Regional Development Australia recently identified capacity constraints at the eastern end of the route, a significant number of casualty crashes along the length of the route, limited overtaking opportunities east of the Great Dividing Range, a need to examine heavy vehicle access restrictions, and proposed bypasses of townships such as Denman to avoid safety and amenity impacts resulting from the increasing numbers of heavy vehicles using the route. In 2014 the NSW Government released an update to the State Infrastructure Strategy (SIS 2014)[6]. The SIS 2014 confirmed the need for infrastructure projects to be recommended from high quality long-term plans. Within the transport portfolio, the *NSW Long Term Transport Master Plan* provides the overarching strategy, which is in turn supported by road corridor strategies. The SIS 2014 recommended completion of corridor strategies for the Newell Highway, Golden Highway, New England Highway and Great Western Highway. These corridor strategies would inform investment priorities, which are recommended to be funded from the newly established Regional Freight Road Corridor Fund[6]. This Corridor Strategy has been prepared to support the SIS 2014, and guide investment priorities along the Golden Highway.

Process and methodology

This Corridor Strategy has been prepared by a multidisciplinary project team from Transport for NSW and Roads and Maritime with expertise in road safety, traffic, asset management, land use, environment, planning and development.

It draws on assessments of the Golden Highway's road conditions, traffic and safety carried out by both agencies. The corridor has been identified by describing its location and geography, key demand drivers and the transport role it fulfills. Transport for NSW and Roads and Maritime asset, traffic and safety data has been analysed to determine current levels of performance.

The corridor has been considered within the broader strategic planning context provided by key state and local government planning documents. Current population and employment data, together with future land-use plans for the corridor, have been sourced from the NSW Department of Planning and Environment, along with relevant local council documents and 2011 Australian Bureau of Statistics (ABS) Census data.

4 Transport for NSW 2014, *Hunter Regional Transport Plan,* p35

5 Linking the Hunter and Orana Regions: Establishing the case for improving the Golden Highway, November 2013

6 Infrastructure NSW, 2014 State Infrastructure Strategy Update, p. 127, 68

2.2 Planning frameworks

The NSW Government has made fundamental changes to infrastructure planning and investment. These changes ensure funding is allocated towards initiatives that deliver the best value, based on compelling evidence. Following this approach, a number of new 20 year plans have been developed to guide the State's future, including the *NSW Long Term Transport Master Plan*. Each of these plans contributes to achieving the NSW Government's State priorities. Delivering on these priorities will make the state better for all citizens.

Premier's Priorities and State Priorities

The NSW Government has recently announced 30 priorities, or reforms, to grow the economy, deliver infrastructure, and improve health, education and other services across NSW. Of these priorities, 12 are the Premier's personal priorities.

The Golden Highway Corridor Strategy contributes to achieving the following State priorities:

Reducing road fatalities: Reduce road fatalities by at least 30 per cent from 2011 levels by 2021

The Golden Highway Corridor Strategy supports the need to improve the road safety outcomes for all road users, by recommending safety improvements such as upgrades to intersections, and wider clear zones, lanes and shoulders. This strategy will adopt the safe systems approach[7] to achieve a safer road environment.

NSW Long Term Transport Master Plan

The *NSW Long Term Transport Master Plan* (LTTMP) outlines a clear framework to address transport challenges in NSW over the next 20 years. For the first time, it integrates planning for roads, freight and all other modes of transport and sets out initiatives, solutions and actions to meet NSW transport challenges. The NSW LTTMP identified the main transport challenges facing regional NSW as:

- Delivering better transport links to and within regional cities
- Improving accessibility through a better mix of transport options across regional NSW
- Providing convenient, reliable and safe travel in regional areas by modernising and making best use of our transport networks – especially our bus, rail, and taxi services
- Making sure State Roads in the regions support the needs of customers, communities and regional industries
- Finding workable transport solutions that will preserve the vitality, amenity and character of country towns
- Making walking and cycling easier and safer and giving customers choice when travelling within their towns
- Facilitating access to vital services for an ageing regional NSW population and people with disabilities
- Identifying and preserving key transport corridors

7 Department of Infrastructure and Regional Development 2015, National Road Safety Strategy' http://roadsafety.gov.au/nrss/safe-system.aspx

A key aim of the Master Plan is to provide essential access for regional NSW. The Golden Highway Corridor Strategy advances this objective by planning for the improvement of the Golden Highway between Belford and Dubbo, addressing asset condition, road safety, traffic efficiency and freight access.

The Master Plan also sets as a priority the need to support an efficient and productive freight industry. This Corridor Strategy includes actions to improve overtaking opportunities, the provision of rest areas, stopping bays and heavy vehicle inspection sites, carriageway widths, pavement condition, intersection layouts and flood immunity.

Figure 2.2 Planning Framework

Regional Plans

The NSW Department of Planning and Environment (DPE) drafted both the *Hunter Regional Plan* and the *Central West Regional Plan*. These regional plans incorporate land use planning, infrastructure planning and transport planning. The regional plans complement the LTTMP and manage long term growth and land use changes across NSW.

The following goals of the *Draft Hunter Regional Plan* are supported by the Golden Highway Corridor Strategy:

Goal 2: Grow the largest regional economy in Australia. The Corridor Strategy aims to support and improve the efficiency of the supply chains of the mining, viticulture and equine industries

Goal 4: Support robust regional communities. The Corridor Strategy aims to ensure the essential access to services, jobs, education and health services in regional centres is provided and maintained

The following goals of the *Draft Central West and Orana Regional Plan* is supported by the Golden Highway Corridor Strategy:

Goal 1: A growing and diverse regional economy. The Corridor Strategy aims to support and improve the efficiency of the agricultural and mining industries.

Goal 2: A region with strong freight transport and utility infrastructure networks that support economic growth. The Corridor Strategy aims to upgrade the Golden Highway to facilitate the movement of high productivity vehicles.

State Infrastructure Strategy

In November 2014, the NSW Government released an updated State Infrastructure Strategy, following extensive analysis and consultation.

The State Infrastructure Strategy recommended the completion of the Golden Highway Corridor Strategy and identified the Golden Highway as a priority corridor under the Regional Road Freight Corridor Program. It identified the need to improve the connectivity of the Hunter Valley to the Central West.

The strategy highlights the importance of sustaining productivity growth in the major centres and regional communities of NSW. Good transport infrastructure helps people get to where they are going quickly and safely, and ensures regional producers can transport goods to market on time and cost effectively. This brings social and economic dividends to regional communities.

The NSW Government's strategic priorities for regional and interstate transport that are relevant to the Golden Highway Strategy are:

- Safer, more efficient road freight corridors
- Remove constraints on the local road network
- Keep pace with regional population growth

Completing the corridor strategy for the Golden Highway has been programmed for mid-2016 to provide guidance for regional investment decision making on this corridor to support the growing NSW economy.

NSW Freight and Ports Strategy

The *NSW Freight and Ports Strategy* aims to create a transport network where goods move efficiently to their markets.

The corridor strategy contributes to the following freight-specific objectives in the *NSW Freight and Ports Strategy* and reflects the importance of the freight transport network in creating a competitive and productive NSW economy:

- 1D-3 Improve access for HPVs on State and local roads.
- 1H-2 Improve network connectivity between networks and key freight precincts.
- 2B Develop and maintain capacity for freight on the road network.
- 2G Develop and maintain projects to support network capacity.
- 3C-2 Improve heavy vehicle safety.

NSW Road Safety Strategy

The *NSW Road Safety Strategy 2012-2021* sets the direction of road safety in NSW. The NSW State Government is committed to reducing fatalities to at least 4.3 per 100,000 population by 2016 together with at least a 30 percent reduction in fatalities and serious injuries by 2021.

The Road Safety Strategy is underpinned by the Safe System approach to improving road safety. This takes a holistic view of the road transport system and interactions among the key components of that system – the road user, the roads and roadsides, the vehicle and travel speeds. It recognises that all these components have a role to play in helping to keep road users safe.

This corridor strategy contributes to implementing the Safe Systems approach through assessing the corridor's current performance in terms of casualty crash rates, crash types and contributing factors.

The corridor strategy supports road safety infrastructure improvements such as overtaking lanes, wider clear zones, wider sealed shoulders and lanes, as well as behavioural campaigns to reduce the number and severity of crashes along the corridor; in particular crashes relating to speed and driver fatigue.

Regional Transport Plans

Regional Transport Plans are built on the strategic direction, initiatives and state-wide context set by the LTTMP. The Hunter and Central West Regional Transport Plans identify specific challenges the regions' transport networks face and prioritises actions to address these challenges.

They include actions and projects that will deliver better transport services, ensure effective regulation and improve transport infrastructure over the short (0-5 years), medium (5-10 years) and long (10-20 years) term. Key actions in the Hunter and Central West Regional Transport Plans are reflected in this corridor strategy. The challenges identified in the Hunter and Central West Regional Transport Plans are discussed in Chapter 4.

Draft NSW Roads Plan (in development)

The Draft NSW Roads Plan has been developed to provide a framework for road planning in New South Wales. The Plan acknowledges the important inter-relationship between transport and land use in supporting sustainable long-term growth and prosperity. The Plan sets the strategic direction for improving our customers' journey experience through focusing on what our customers are telling us they need to improve their journeys.

The Draft NSW Roads Plan provides:

- Consolidation of road planning principles
- Framework for integrating land use and transport through the Road Planning Framework
- Suite of performance measures that informs a multi-modal evidence base to guide future investment decisions and the allocation of road space
- 'Right mode for the right road' approach, identifying the function of our roads and balances priorities to improve the journeys of our customers

This Corridor Strategy will support the long term planning for this corridor and the application of the planning principles within the NSW Roads Plan, particularly in the urban centres of the corridor, where there is a need to carefully balance the movement and place function of the road.

2.3 Key corridor challenges and issues

The Golden Highway corridor issues and challenges are either already evident or are expected to emerge as a result of the future changes and transport demands. These issues need to be overcome to maintain and improve the Golden Highway's roles and services for the community.

The key corridor issues evident on the Golden Highway provide a basis for determining corridor objectives and vision statements.

The key corridor issues and challenges are:

- The lack of overtaking lanes along the corridor increases travel times and the risk of head on and run-off road crashes.
- Poor road geometry, particularly in the eastern section of the corridor, reduces travel speeds, and increases travel time and crash risk.
- HPV access is restricted due to road geometry constraints, insufficient rest areas and lack of suitable road enforcement sites.
- Road closures from flooding at the Talbragar River at Uarbry and Mudies creeks at Whittingham.
- There are significant vegetation communities along the corridor that require protection.
- The existing facilities to help manage driver fatigue for heavy vehicle operators are limited.
- Rail level crossings without boom gates increase the safety risk for all road and rail users.
- Narrow bridges, road shoulders and clear zones increase the risk of run-off and hit object crashes.

2.4 A vision for the future

The vision for the future explains what actions should be achieved on the Golden Highway over the next 20 years in order to improve the performance of the highway and meet the specific corridor objectives.

The vision for the Golden Highway over the next 20 years is to:

- Boost productivity, support the development of agricultural and mining activities and operate as a critical freight route by enabling access for PBS Class 2B high productivity vehicles (up to 30 m in length) across the Great Dividing Range from western NSW to the Hunter region and the Port of Newcastle.
- Provide safe and efficient travel for all road users by providing a “2+1” lane arrangement east of Denman Road, and two lane two way with an increased number of overtaking/climbing lanes west of Denman Road, and by addressing high risk crash locations.
- Improve road network reliability and access by reducing the impact of flooding.

2.5 Corridor objectives

The key corridor challenges and issues are used to determine corridor objectives for the Golden Highway. These objectives are specific tasks that are required to address the identified issues along the Golden Highway.

The specific corridor objectives are in line with the following *NSW Long Term Transport Master Plan* objectives as shown in Figure 2.3 and Table 2.1.

Figure 2.3 Meeting the Master Plan's objectives: the Golden Highway Corridor

Table 2.1 Meeting the Master Plan's Objectives: the Golden Highway Corridor

***NSW Long Term Transport Master Plan* objectives**	**Golden Highway Corridor Objectives**
Improve liveability	• Improve travel efficiency for local and regional road users by providing adequate overtaking opportunities.
Reduce social disadvantage	• Address the active transport needs of bicycle riders and pedestrians in towns and within Dubbo.
Economic growth / productivity	• Improve the efficiency of freight movements to support agricultural and mining activity. • Enable access for Higher Productivity Vehicles (PBS Class 2B).
Regional development / accessibility	• Improve access to and from major regional facilities, as well as between existing and developing residential and commercial areas. • Minimise disruption to road users resulting from planned and unplanned road closures, recognising in particular the needs of isolated communities and those sections of the route which have no alternative access. • Progressively treat sites that are subject to nuisance flooding to improve the flood immunity of the corridor. • Maintain and improve where appropriate the asset condition by progressively upgrading the highway to ensure that the corridor remains fit for purpose and can continue to accommodate restricted access vehicles while optimising safety, efficiency and reliability.
Improve sustainability	• Mitigate and manage impacts of the highway on the natural environment. • Reduce fuel consumption and vehicle operating costs by providing consistent road conditions that meet class 3 and 4 road standards (see section 4.4). • Identify and protect sensitive native remnant vegetation, non-Aboriginal and Aboriginal heritage within the boundaries of the road corridor.
Safety and security	• Manage heavy vehicle drivers fatigue by providing adequate infrastructure and good quality rest facilities at regular intervals along the corridor. • Reduce fatalities and serious injuries by upgrading sections of the corridor with poor road safety history.
Improve transport planning process	• Support transport planning processes by responding to current and future land uses. • Work with local councils to provide a roadway that meets the current and future transport needs of all road users.

2.6 Taking action

The key challenges for the Golden Highway corridor will be progressively addressed through short, medium and long term improvements, in line with the Regional Transport Plans and the *NSW Long Term Transport Master Plan* as shown below. These actions will ensure that the objectives and vision for the Golden Highway are achieved. The Golden Highway priorities for responding to these challenges are explained in Chapter 7.

SPECIFIC ACTIONS RELEVANT TO THE GOLDEN HIGHWAY CORRIDOR IN THE *NSW LONG TERM TRANSPORT MASTER PLAN* AND THE REGIONAL TRANSPORT PLANS:

Short term

- Investigation of the Golden Highway as a freight corridor from the Central West region to the Port of Newcastle.
- Acceleration of the school zone flashing lights program, to ensure every school in NSW has a set of flashing lights by December 2015.

Medium to longer term

- Significant investment in upgrades to the Golden Highway, including potential Winery Hill regrading/realignment and potential Ogilvies Hill regrading/ realignment.

3 COMMUNITY AND STAKEHOLDER CONSULTATION

Improving the customer experience is an important aspect of the NSW Government's commitment to putting the customer at the centre of transport planning and service delivery.

This Corridor Strategy has been developed within a customer focused framework that identifies the result areas important in meeting customer needs (Figure 3.1).

Figure 3.1 Transport for NSW result areas in the Corporate Framework

3.1 Who uses the Golden Highway

There are many different customers of the road network, who have different purposes for their journeys and different preferences for time of travel. These customers also have different needs for the road and there is the potential for competing needs to cause conflict between the different groups. In order to appropriately cater for these customers it is important to understand their different needs. Table 3 1 shows the major road customer markets using the Golden Highway.

All road user groups on the Golden Highway have been considered during the development of this strategy.

Table 3.1 Key customer markets on the Golden Highway corridor

Longer distances (interregional trips)		
Longer distance travel for work, education, health, recreational and business		Trip purpose
Highly dispersed travel to the Central West and Hunter regions	Private vehicles, coaches, hire cars, mini bus	Location and mode
Dispersed in time and over the weekends		Time of Travel
Industrial centres		
Heavy goods movement		Trip purpose
Dispersed locations such as coal mines in the Hunter Valley, and agricultural areas in the Upper Hunter and Central West	Rigid and articulated vehicles	Location and mode
Mostly weekdays and business hours, some weekends and after hours		Time and travel
Light goods movement		Trip purpose
Commercial centres to highly dispersed locations	Small trucks, vans, utility vehicles	Location and mode
Mostly weekdays and business hours, some weekends and after hours		Time and travel

The road network comprises a number of different user networks sharing road corridors which needs to be considered in terms of the allocation of future road space. These include:

- bus network,
- freight network,
- cycling network, which includes off-road cycle ways and dedicated cycle lanes.

The approach promoted in this corridor strategy is to make the most effective use of the limited road space available. This involves giving priority to different road users and modes at different times of the day and week to balance mobility and access needs.

3.2 Consultation activities

Consultation on the *NSW Long Term Transport Master Plan*

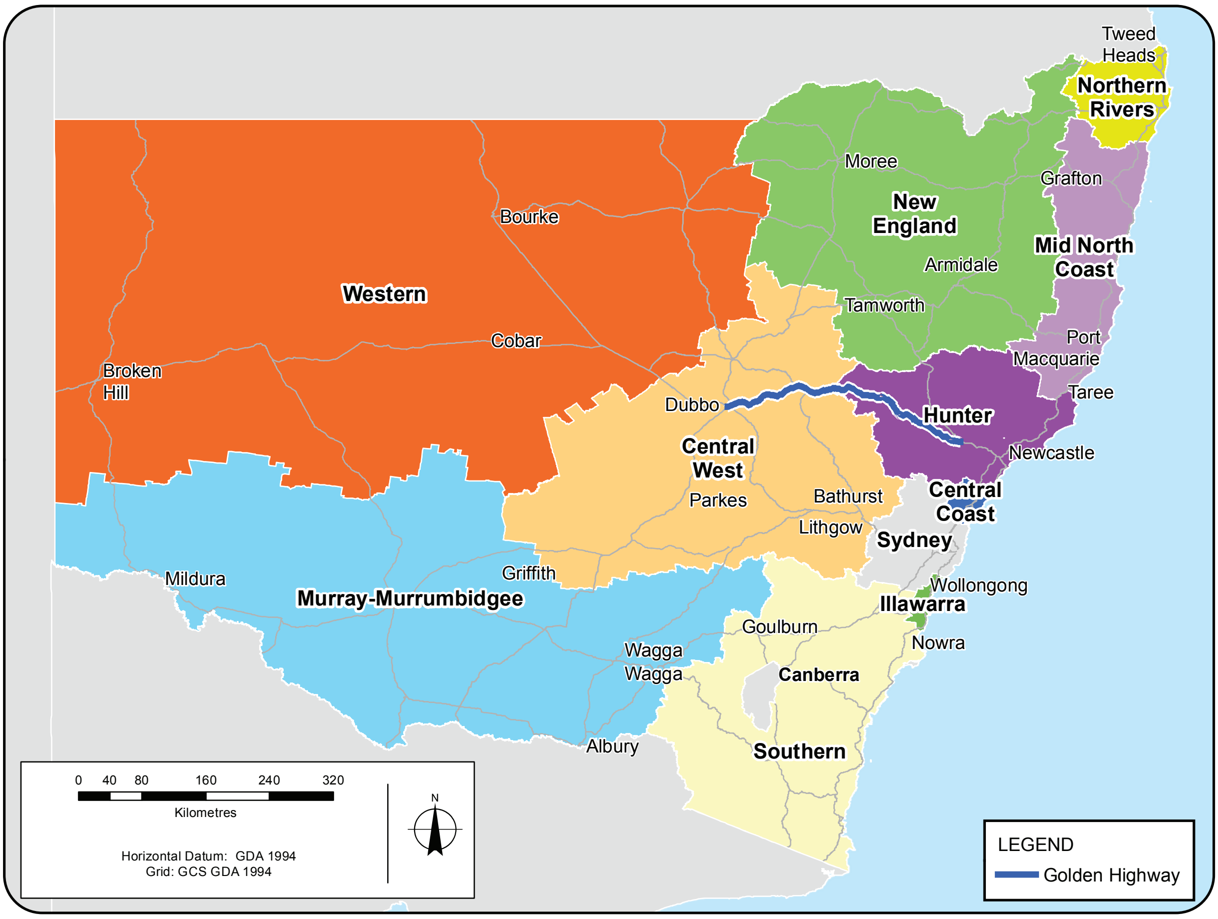
The *NSW Long Term Transport Master Plan*, released in December 2012, sets out how NSW will meet the future needs of its transport customers. The development of the Master Plan involved a wide range of consultation with customers directly affected by the transport network. The 12 month, State-wide consultation process to develop the Master Plan was widespread in its reach and involved:

- Over 1,000 people attending 14 regional forums across the state.
- Over 130,000 hits to the *NSW Long Term Transport Master Plan* website.
- More than 1,200 submissions to the Discussion Paper.
- Over 480 comments on the draft Master Plan.
- 270 stakeholders at the launch and industry briefing.
- 55 representatives on four Advisory Groups that engaged customers, the community, industry, transport specialists and local government.

Feedback raised through the consultation process varied greatly across each region. The Golden Highway corridor is within the Hunter and Central West regions (Figure 2.3).

The community consultation undertaken during the preparation of the *NSW Long Term Transport Master Plan* generated the

Figure 3.2 *NSW Long Term Transport Master Plan* regional boundaries



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Data source: Geoscience Australia, 250K Topographic Data Series 3.

following feedback identifying areas of focus for the regions that the Golden Highway passes through:

Hunter

- Coordinated land use and transport planning.
- Improved connections out of Newcastle and within the Hunter region.
- Road and highway maintenance and upgrades.
- Active transport – cycleways and pedestrian paths.
- Development of a Port Growth Plan for the Port of Newcastle.

Central West

- Improve public and community transport access, especially to support an aging population.
- Coordinated approach to land use planning and transport.
- Improving regional links.
- Prioritising key road infrastructure.
- Road safety and investment, for the long term.
- Collaboration between industry and government.
- Coordinate and integrate transport that connects the region with Sydney and other regional centres.

Regional Transport Plans have been developed to address specific transport challenges and solutions for these regions.

They include actions and projects that will deliver better transport services; ensure effective regulation; and improve transport infrastructure over the short (0-5 years), medium (5-10 years) and long (10-20 years) term.

Some of the key initiatives in the Hunter Regional Transport Plan are:

- Planning for the duplication of the New England Highway from Belford to the Golden Highway.
- Possible regrading/realignment of Winery Hill.
- Possible regrading/realignment of Ogilvies Hill.
- Manage demand and deliver arterial road upgrades.
- Improve road safety.
- Identify and protect future transport corridors.
- Address pinch points on the road network.
- Roll out the Walking Communities Program.
- Connecting Centres Cycling Program.
- Roll out the Cycling Towns Program.
- Improve information about walking and cycling routes and facilities.
- Improve the frequency and hours of bus operation for inter-regional routes.

Some of the key initiatives in the Central West Regional Transport Plan are:

- Investigation of the Golden Highway as a freight corridor between the Central West region and the Port of Newcastle.
- An acceleration of the school zone flashing lights program, to ensure every school in NSW has a set of flashing lights by December 2015.
- Invest in the road network providing connections to and from the Central West region, focusing on improving safety, increasing accessibility and enhancing freight efficiency.
- Identify and protect future transport corridors.
- Maintain the road network and support infrastructure to cater for expected future growth.
- Investigate the provision of rest areas along the main highways and roads, with a focus on meeting heavy vehicle needs.
- Continue to plan and implement bypasses to help remove heavy vehicles from passing through local towns.
- Provide safer roads by implementing treatments that target head-on and run-off crashes, such as clear zones, and intersection crashes.
- Provide safer road infrastructure on State roads leading to Aboriginal communities.
- Address the safety needs of vulnerable road users through infrastructure and traffic management treatments, including lower speed limits and traffic calming measures.
- Investigate infrastructure treatments to enhance road safety on the highway network for heavy vehicle drivers and to support enforcement activities.
- Rural highway upgrades and major arterial road upgrades in growing areas.
- Reviewing the roads that allow the operation of B-doubles, in order to simplify and improve safety for freight movements.
- Improve the frequency and hours of bus operation for inter-regional routes.
- Roll out the Walking Communities Program.
- Connecting Centres Cycling Program.
- Roll out the Cycling Towns Program.
- Improve information about walking and cycling routes and facilities.
- Address pinch points on the road network.
- Identify opportunities to improve the infrastructure that supports public transport services, such as bus stops and shelters, terminal facilities and customer information.

Consultation on the Draft Corridor Strategy

The Golden Highway Draft Corridor Strategy was released for public comment between the 30th March and 9th May 2016. The draft report was published on the Transport for NSW and Roads and Maritime Services websites for viewing by the general public and a process for providing feedback was detailed.

Stakeholder briefings were held with relevant stakeholders who were invited to provide comment and assessment. The list of key stakeholders can be found in Appendix A.

Stakeholders were encouraged to talk to the Roads and Maritime Regional Manager in the Hunter and Central West regions regarding any issues, contact the project team via the 1800 community number and submit written responses via the Golden Highway Corridor Strategy email account, mailing address and online survey.

Community members were also invited to attend four community drop in sessions held during the consultation period. The purpose of the drop in sessions was to provide the community an opportunity to view the display materials, talk with members of the project team and submit feedback in person. A total of 171 people were recorded as attending the drop in sessions. These sessions were held at:

- Saturday 2 April 8am – 12pm
  Denman Farmers Markets
  Lions Park, Main Street, Denman
  55 attendees at this drop in session.
- Saturday 9 April 8.30am - 1pm
  Dunedoo Farmers Markets
  Milling Park, Golden Highway, Dunedoo
  43 attendees at this drop in session.
- Saturday 16 April 9am – 12pm
  Merriwa Markets
  RSL Club, Bow Street, Merriwa
  28 attendees at this drop in session.
- Saturday 30 April 10am - 4pm
  Dubbo Show
  108 Wingewarra Street, Dubbo
  45 attendees at this drop in session.

Promotion of the drop in sessions and invitation to comment was provided via the Project website, newspaper advertisements, media release, static displays and letterbox drops. The project website received a total of 325 unique page visitors during the consultation period.

Twelve advertisements appeared in local newspapers to raise awareness of the display and invite comment. These included the Scone Advocate, Muswellbrook Chronicle, Mudgee Guardian, Singleton Argus and Dubbo Daily Liberal.

The media release announcing the display and inviting comment was distributed to local media outlets and was published in the Muswellbrook Chronicle and Hunter Valley News as the article 'Michael Johnsen announces Golden Highway Gateway Strategy funding'.

Community update postcards were delivered to the residents in Denman, Dunedoo and Merriwa. The Golden Highway Draft Corridor Strategy document was also available to view at local libraries at these locations. A static display of project materials i.e. community update postcards and frequently asked questions, were also distributed to local businesses to promote the drop in sessions and invite comment.

Stakeholders engaged with the project via mail, email, phone, online survey and drop in sessions. During the consultation period a total of 54 submissions were received including two letters, four phone calls, 15 emails, 18 feedback forms and 19 online surveys.

The feedback was sought to better inform the final strategy document and was vital when developing the corridor strategy to ensure local knowledge is at the heart of any future upgrade and maintenance decisions. It helps to ensure that the planned investment on the highway meets the needs of the local communities and industries it serves.

Principles for effective consultation

The consultation principles set out in Table 3.2 were adopted to guide community consultation throughout the development of the Corridor Strategy.

Table 3.2 Overview of consultation and engagement principles

Principle[8]	How this was applied to the development of the Golden Highway Corridor Strategy
Communicate early and often, ensuring 'no surprises' to communities and stakeholders	Roads and Maritime engaged the community from 30th March until 9 May to provide the opportunity to give feedback on the Golden Highway Draft Corridor Strategy. RMS gave the community 5 weeks to provide feedback on the strategy. This early communication with the community provided adequate time for the community to read, review and reply to the corridor strategy.
Set expectation to ensure that communities and stakeholders know the parameters of each engagement activity – what it includes and what it doesn't include	At the community information sessions RMS explained the process for collecting feedback from the community and how that feedback would be used to inform the draft corridor strategy.
Explain to communities and stakeholders how their input is being used or why it was not used	Community feedback is important to us and has been used to finalise the Golden Highway Corridor Strategy. Roads and Maritime Services has prepared a Community Consultation Report to respond to all submissions received during the display of the draft strategy. This report includes a summary of the submissions and responses to the issues that were raised.
Listen to feedback, investigate suggestions and use it in decision-making (where appropriate)	The Community Consultation Report has been finalised and a copy is available on the Roads and Maritime website. Community feedback will be considered in finalising the Golden Highway Corridor Strategy.
Provide ongoing opportunities for community and stakeholder participation and feedback	Public comment on the Golden Highway Draft Corridor Strategy closed on Monday 9 May.
Manage engagement activities to budget and timeframes	The engagement activities for the consultation for the Golden Highway Draft Corridor Strategy were completed within budget and within the set timeframes.

8 RMS Draft Stakeholder Engagement Toolkit, March 2015

3.3 Key findings of the consultation activities

A positive response has been received on the draft strategy from a number of stakeholders on the corridor including local councils, community and business groups, local industry and community members.

The feedback obtained has included expressions of support for this strategy as it provides a clear staging of improvements on the highway over the next 20 years. The strategy has provided a high degree of certainty for councils to consider their local road network needs based on the plans outlined in the strategy.

A number of councils have written and expressed their support for the aims and direction of the strategy, including:

- Dubbo City Council (now forms part of Western Plains Regional Council)
- Muswellbrook Shire Council
- Upper Hunter Shire Council
- Singleton Shire Council
- Warrumbungle Shire Council
- Wellington Shire Council (now forms part of Western Plains Regional Council)

Other stakeholders including TRUCKRIGHT and Regional Development Australia Orana have also expressed support for the improvements detailed in the strategy which aim to provide local and regional benefits.

Involvement from the community, other stakeholders and other government agencies was invaluable in the development of this Corridor Strategy. The information gathered has been considered alongside the findings of the technical studies described in Section 5 to develop the short, medium and long term priorities shown in Section 7.

A more detailed Community Consultation Report has been prepared and is available to view on the Transport for NSW website. This consultation report highlights the feedback received from all road customers and the responses to this feedback.

4 TRANSPORT DEMANDS AND ROLES

Newly widened and upgraded section of the Golden Highway east of Merriwa

4.1 The Golden Highway

The Golden Highway's transport roles reflect the rural populations and industries that it passes through. These roles include:

Supporting travel to and from the region:

- Transport of grain between the central west region of New South Wales, the Upper Hunter and the Port of Newcastle.
- Fertiliser, livestock and bloodstock transport between the central west and Newcastle.
- Movement of mining equipment to and from coal mines at the eastern end of the corridor and in the Ulan area.
- Tourist travel between Newcastle, Dubbo and other locations in north-western NSW.

Supporting travel within the region:

- Agricultural transport such as livestock and bloodstock from properties along the corridor to the urban centres of Newcastle and Dubbo.
- Transport of wine from the Upper Hunter to Newcastle.
- Fuel movements between the Port of Newcastle and coal mines.
- Movement of mining equipment to and from coal mines at the eastern end of the corridor and in the Ulan area.
- Employee related travel between the Lower Hunter, Singleton and Muswellbrook and the coal mines at the eastern end of the corridor.
- Recreational, shopping and commuter trips between towns along and close to the corridor such as Muswellbrook and Singleton.

Supporting travel in the major centres and towns:

- Work, shopping, education, health and recreational trips within and between Dubbo, Dunedoo, Merriwa and Denman.

The Golden Highway intersects with a series of road links. These are summarised in Table 4.1.

Table 4.1 Corridor corrections

Network connection (East-West)	Transport connection
New England Highway	Forms part of the National Land Transport Network that connects Newcastle with Toowoomba in Queensland via Tamworth (part of the inland Sydney to Brisbane route).
Putty Road (East)	Connecting Mount Thorley and Singleton.
Broke Road	Connecting Mount Thorley with Broke and Wollombi.
Putty Road (West)	Connecting Mount Thorley and Windsor via Putty.
Denman Road	Connecting Denman and Muswellbrook.
Ulan Road	Connecting Cassilis and Mudgee via Ulan.
Black Stump Way	Connecting Leadville and Coonabarabran via Coolah.
Castlereagh Highway (East)	Connecting Dunedoo and Lithgow via Mudgee.
Castlereagh Highway (West)	Connecting Dunedoo and Gilgandra via Mendooran.
Newell Highway	Forms part of the National Land Transport Network that connects Tocumwal and Goondiwindi via Dubbo (part of the Melbourne to Brisbane route).

The Golden Highway passes directly through or adjacent to the following towns and villages. From east to west:

- Mount Thorley, Warkworth and Jerrys Plains in Singleton Council.
- Denman and Sandy Hollow within Muswellbrook Shire.
- Gungal, Merriwa and Cassilis within Upper Hunter Shire.
- Uarbry, Dunedoo and Cobbora within Warrumbungle Shire.
- Elong Elong, Ballimore and Dubbo within the Western Plains Council.

4.2 Current population and employment in the corridor

The Department of Planning and Environment's *Lower Hunter Regional Strategy*[9] defines the Lower Hunter region extending from Newcastle in the east to Branxton in the west, Karuah in the north and Catherine Hill Bay in the south, covering an area of 4,291 square kilometres.

The Hunter region, extending west to Upper Hunter Shire, has a population of 604,600, whilst the Central West and Orana region, extending west from Warrumbungle, has a population of 276,850[10].

An estimated 113,350 people live along the Golden Highway corridor, with about 31 percent of this number in major regional towns and centres (35,505). This includes Dubbo at the western end of the corridor.

Key demographic data for each of the major towns is summarised in Table 4.2. The towns in the more isolated rural sections of the corridor have higher average ages than the larger urban centres. The percentage of the labour force employed full time is also substantially higher in the larger urban centres.

The median age in the Upper Hunter and Warrumbungle is higher than the State median age, whilst the median age of Dubbo residents is lower that the State median age.

The percentage of the labour force employed full time in Dubbo is higher than the State average, whilst the rate for Muswellbrook is similar to the State average. The percentage of the labour force employed full time in the more rural LGAs is substantially lower than the State average.

Table 4.2 Population LGA and urban centre demographics

LGA	2011 LGA Population	Urban Centres along the corridor	2011 Urban Population	% Aged over 65 years	% Aged 0-14 years	Median age	% Labour force employed full time	Main employment by industry in the LGAs
Singleton	23,450	None in corridor	-	N/A	N/A	N/A	N/A	Coal mining, cafes, restaurants and takeaway food services
Muswellbrook	16,300	Denman	1403	15.6%	21.5%	38	60.4%	Coal mining, cafes, restaurants and takeaway food services
Upper Hunter	14,200	Merriwa	973	22.6%	21.4%	43	53.2%	Sheep, beef cattle and grain farming, coal mining
Warrumbungle	9,950	Dunedoo	802	27.7%	19.8%	49	53.3%	Sheep, beef cattle and grain farming, school education
Wellington	8,950	None in corridor	-	N/A	N/A	N/A	N/A	Sheep, beef cattle and grain farming, school education
Dubbo	40,500	Dubbo	32327	14.5%	22.6%	35	62.4%	School education, hospitals
Total	**113,350**		**35,505**					
Averages				**14.7%**	**19.2%**	**38**	**60.2%**	

9 Department of Planning 2006, Lower Hunter Regional Strategy

10 Australian Bureau of Statistics 2011, Census Data

Key centres, towns and employment industries in the Golden Highway corridor are:


Ogilvie Street Denman


Golden Highway (Bettington Street) Merriwa

Denman

Located in Muswellbrook Shire, the Denman urban centre has a population of 1,403 and provides basic services such as a Multi-Purpose Service Centre (health), schools, stores and sporting fields.

Denman is at the junction of the Golden Highway with Yarrawa Road. Yarrawa Road connects to Bylong Valley Way which traverses through rural communities to the west. Denman Road, north of the Denman urban centre, connects Denman to Muswellbrook.

The percentage of the population of Denman that is 0-14 is 21.5%, higher than the NSW State average of 19.2%. The percentage of the population that is over 65 is 15.6%, a little higher than the NSW average of 14.7%. The median age of the Denman population at 38 is the same as the NSW median age. The population of Denman is not growing significantly despite continued growth in the coal mining industry in the area. The population only grew by 1.3% between 2006 and 2011.

The proportion of the Denman labour force that works full time is 60.4%, similar to the State average of 60.2%. The proportion of the labour force working part time is 27.0%, lower than the NSW average of 28.2%. The unemployment rate of Denman is 5.0%, which is lower than the State average of 5.9%. The largest employers by industry are coal mining (15.5%), cafes, restaurants and takeaway food services (4.5%) and school education (3.6%).

To the east of Denman are horse studs used to support the horse racing industry.

Merriwa

Situated in the western portion of the Upper Hunter shire, Merriwa urban centre has a population of 973 and provides basic services including schools, a Multi-Purpose Service Centre (health), numerous stores, a horse racing track and sporting facilities.

The Merriwa to Scone Road connects with the Golden Highway in the centre of the Merriwa central business district. The Merriwa to Scone Road connects to the New England Highway at Scone.

The population of Merriwa has a median age of 43, higher than the State median age of 38. The percentage of the population of Merriwa that is 0-14 is 21.4%, higher than the NSW State average of 19.2%. However, the percentage of the population that is over 65 is 22.6%, much higher than the NSW average of 14.7%. The population of the Merriwa urban centre grew by only 2.9% between 2006 and 2011.

The proportion of the Merriwa labour force that works full time is 53.2%, much lower than the State average of 60.2%. The proportion of the labour force working part time is 33.1%, higher than the NSW average of 28.2%. The unemployment rate of Merriwa is 6.7%, which is higher than the State average of 5.9%. The largest employers by industry are school education (8.0%), local government administration (6.3%) and sheep, beef cattle and grain farming (5.8%).

Golden Highway (Bolaro Street) Dunedoo

Talbragar Street Dubbo

Dunedoo

Dunedoo is located in the south of the Warrumbungle Shire and has an urban centre population of 802. There are services in Dunedoo that support the surrounding farming communities such as a Multi-Purpose Service Centre (health), a small number of stores, schools, a major heavy vehicle rest area, a golf course and other sporting facilities.

The Castlereagh Highway joins the Golden Highway in Dunedoo and east of the urban centre of Dunedoo. The western link connects Dunedoo with Gilgandra, Coonamble and south-west Queensland, whilst the eastern link connects Dunedoo with Lithgow via Mudgee.

The median age of residents of Dunedoo is 49, significantly higher than the State median age of 38. The percentage of residents aged over 65 is 27.7%, almost twice the State average of 14.7%. The percentage of the population of Dunedoo that is 0-14 is 19.8%, which is similar to the State average of 19.2%. The population of the Dunedoo urban centre did not grow between 2006 and 2011.

The proportion of the Dunedoo labour force that works full time is 53.3%, significantly lower than the State average of 60.2%. The proportion of the labour force working part time is 30.5%, a little higher than the NSW average of 28.2%. The unemployment rate is 10.2% which is much higher than the State average of 5.9%. The largest employers by industry are sheep, beef cattle and grain farming (14.3%), school education (10.7%) and supermarket and grocery stores (4.0%).

Dubbo

The Dubbo urban centre has a population of around 32,000, a similar population to Orange and Bathurst. Dubbo is a major service centre for the central west.

Dubbo is at the junction of the Golden Highway, Newell Highway and Mitchell Highway. The Newell Highway connects Dubbo with Victoria via Parkes and Queensland via Moree. The Mitchell Highway connects Dubbo to Orange and Bathurst to the south-east and Nyngan, Bourke and Queensland to the north-west.

The percentage of the population of Dubbo that is 0-14 is 22.6%, higher than the NSW State average of 19.2%. The percentage of the population that is over 65 is 14.5%, similar to the NSW average of 14.7%. The median age of the Dubbo population is 35, lower than the NSW median age of 38. The population of Dubbo continues to grow steadily, increasing by 5.7% between 2006 and 2011.

The proportion of the Dubbo labour force that works full time is 62.4%, which is higher than the State average of 60.2%. The proportion of the labour force working part time is 27.3%, slightly lower than the NSW average of 28.2%. The unemployment rate of Dubbo is 5.3%, which is lower than the State average of 5.9%. The largest employers by industry are school education (6.2%), hospitals (4.4%) and cafes, restaurants and takeaway food services (4.4%).

The Taronga Western Plains Zoo is located in Dubbo, a major tourist attraction in the central west. Charles Sturt University and The University of Sydney also have campuses in Dubbo.

4.3 Industry and economic development

Transport moves goods produced in the regions to domestic and international markets, in turn contributing to the NSW economy. The regional road, rail and air freight network support agricultural, manufacturing and mining industries, along with the local businesses associated with these sectors.

In relation to the Golden Highway corridor, the Port of Newcastle and Dubbo City Regional Airport supports movement to export markets.

At the eastern end of the corridor, the Golden Highway provides access for the supply of mines including fuel, explosives and equipment. At the western end of the corridor from Dubbo to Denman, the Golden Highway provides access for the movement of agriculture related goods such as fertiliser, livestock and bloodstock. Grain is also transported along the full length of the corridor, to the Port of Newcastle.

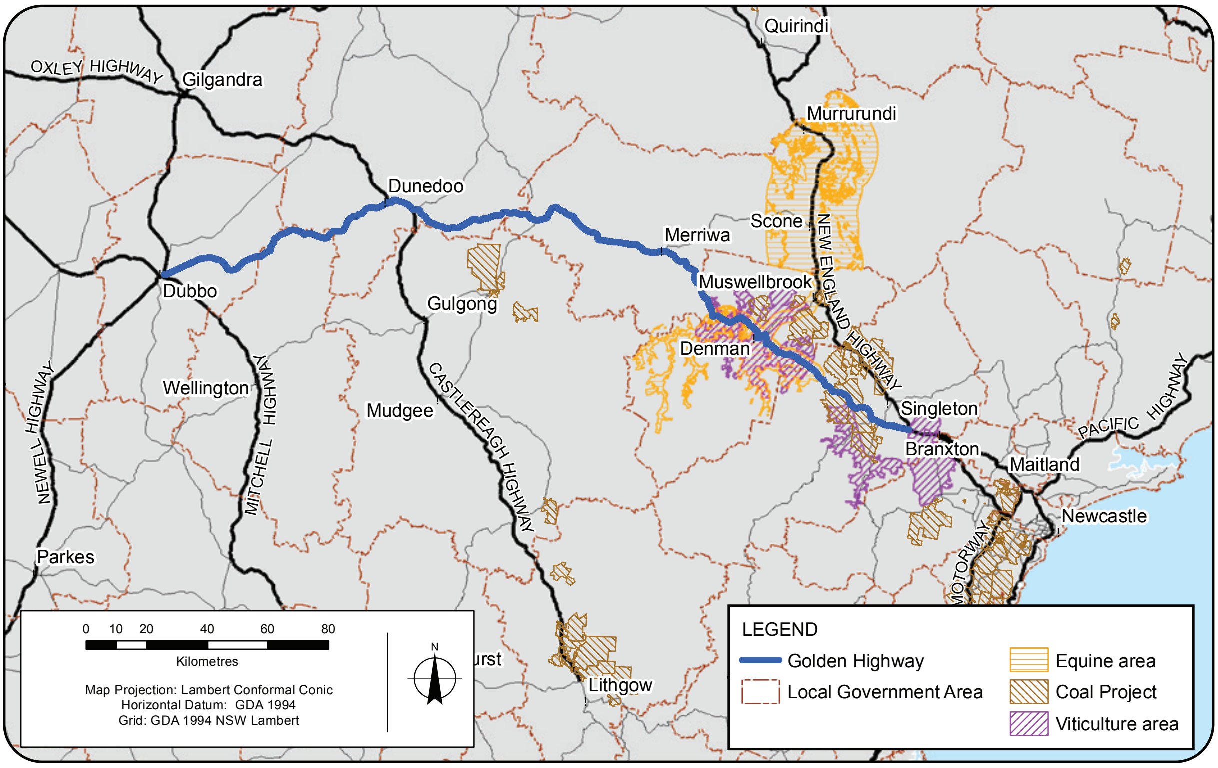
Industry in the region

In regional NSW, a large area is dominated by agriculture. Agricultural land in the Golden Highway corridor varies across different sectors, but generally includes:

- Viticulture, wine making and horse breeding between Jerrys Plains and Sandy Hollow.
- Mixed farming including beef cattle/sheep and broad acre crops (such as wheat, sorghum, barley, sunflowers and canola) as well as lucerne production generally occurs west of Sandy Hollow.

Demand for freight transport from these agricultural industries is impacted by seasonal fluctuations and crop sizes. It has been estimated that the volume of grain moving along the Golden Highway to the Port of Newcastle or to domestic customers is 200,000 to 300,000 tonnes per annum, or approximately 25-40 loaded truck movements per day. Trucks often return along the highway empty after having unloaded the grain, increasing the total number of truck movements attributable to the movement

Figure 4.1 Locality plan for coal projects, equine and viticulture areas in proximity to the Golden Highway



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Data source: Geoscience Australia, 250K Topographic Data Series 3; DEP, SRLUP, 2013.

of grain to 50-80 per day during peak grain harvest seasons.[11]

Coal mining and supporting industries are significant at the eastern end of the corridor between the New England Highway at Belford and Jerrys Plains. Employee related traffic and mining supplies generate significant traffic during peak periods in this area. There is around 150,000 hectares of intensive coal mining between Singleton and Muswellbrook.[12]

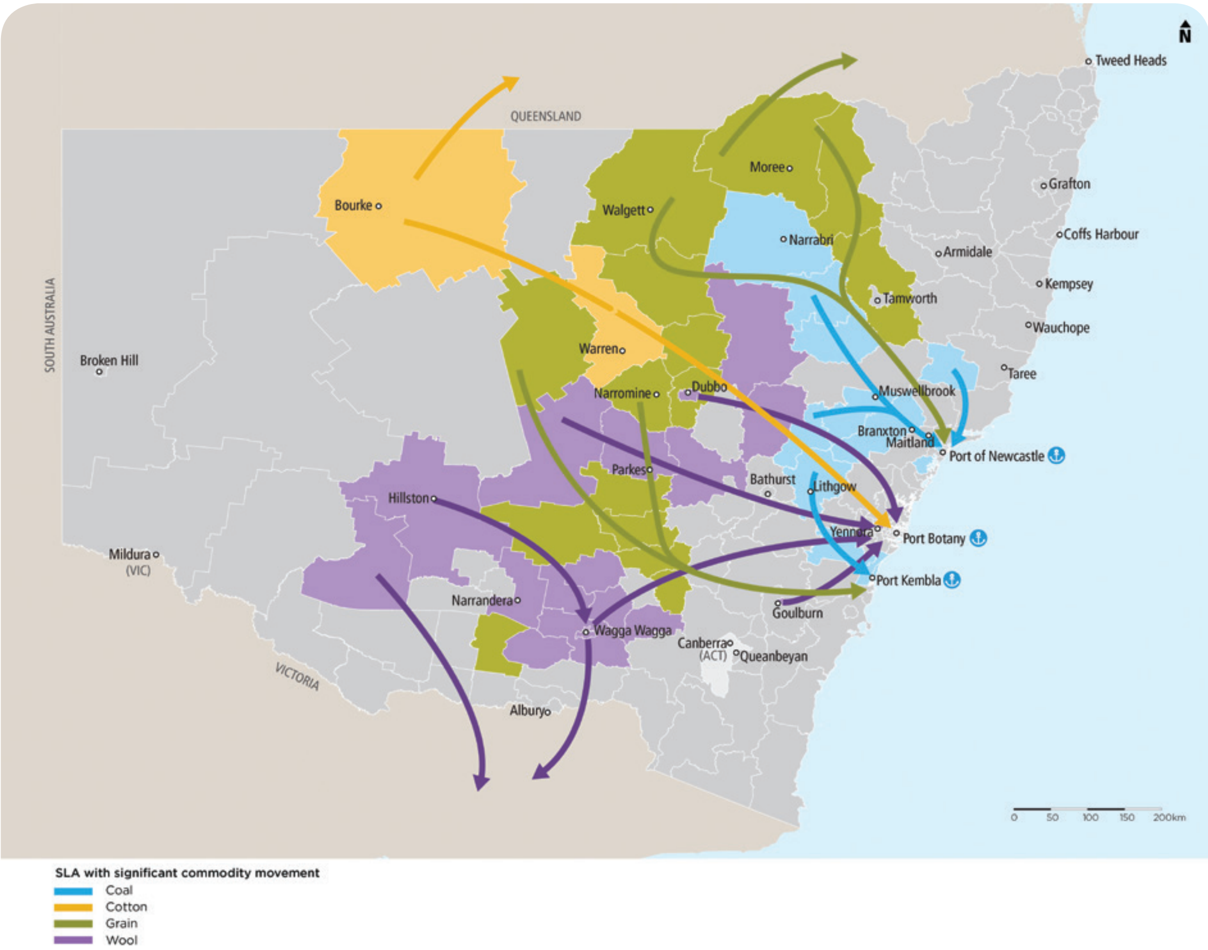
Current freight task and movements

Freight enables goods to be exchanged within the economy and distributes the benefits of this economic activity across the nation.

The 2011 movement of different goods across NSW is shown in Figure 4.2, with estimated truck volumes and kilotonnes transported in Table 4.3.

Freight at the eastern end of the Dubbo corridor primarily consists of mining supplies from Newcastle and beyond, travelling in a westerly direction to mines. Wine is transported in an easterly direction to Newcastle and beyond. Bloodstock is transported to and from horse studs at the eastern end. Along the corridor grain and other crops are carried in an easterly direction to the Port of Newcastle. The most significant freight transported along the majority of the corridor, west of Mount Thorley,

Figure 4.2 Selected commodity movement in NSW in 2011[13]



11 Hyder Consulting for Regional Development Australia 2013, *Linking the Hunter and Orana Regions: Establishing the case for improving the Golden Highway*, p. 23

12 NSW Department of Planning and Infrastructure 2012, *Upper Hunter Strategic Regional Land Use Plan*, p. 64

13 Transport for NSW 2013, *NSW Freight and Ports Strategy*, TfNSW, Sydney, p.99

Table 4.3 Forecast year daily truck annual tonnage (2011)[14]

From	To	Daily Trucks (2011)			Annual kilotonnes		
		Forward	Reverse	Total	Forward	Reverse	Total
New England Highway	Putty Rd (E)	420	420	840	3650	450	4100
Putty Rd (E)	Denman Rd	170	170	340	1300	350	1650
Denman Rd	Castlereagh Hwy (E)	170	170	340	1350	350	1700
Castlereagh Hwy (E)	Castlereagh Hwy (W)	220	220	440	1500	600	2100
Castlereagh Hwy (W)	Dubbo	80	80	160	600	150	750

is fertiliser to farms. This is transported in a westerly direction from Newcastle.

The major exports carried on the corridor are:

- Grain and other crops transported to the Port of Newcastle for processing and export to international markets.
- Coal, although all of this is taken by rail to the Port of Newcastle where it is loaded on ships bound for Asian markets. The Hunter Valley Coal Rail Network is spread over 450 kilometres and is the largest coal export operation in the world, comprising 35 coal mines, more than 30 coal loading points, three coal terminals, and around 1,000 coal vessels a year moved and loaded from the Port of Newcastle.[15]

The Golden Highway is also a significant corridor that accommodates over size and over mass (OSOM) loads in the Lower Hunter. These movements are only permitted in off-peak times. The Golden Highway is used to accommodate OSOM loads which cannot pass under the Singleton rail bridge (Gowrie Gates), or under the Liddell overpass on the New England Highway. On average, there is approximately one load per day exceeding 6 m, and one load every second day which exceeds 8 m in width. The total mass of these loads often exceeds 270 tonnes. These OSOM loads are typically machinery destined for the coal mines in the eastern part of the corridor, however some loads may have destinations as far west as South Australia. Several wind turbine projects are proposed for the Liverpool Plains. The Golden Highway will be used to transport wind turbine components, which may be up to 10 OSOM movements per day, over several years. The ability of the Golden Highway to accommodate these loads, in addition to daily traffic needs, requires investigation. Works to accommodate these OSOM vehicles may include additional and more regularly spaced truck parking bays and rest areas which are wide enough to store OSOM loads. In addition to this, it is expected that additional OSOM loads will originate from the Port of Newcastle, as part of its future development. In addition to a lack of parking bays to store OSOM loads, other infrastructure restrictions on the Golden Highway for OSOM movements include the Cockfighters bridge across Wollombi Brook, and the Hunter River bridge at Denman, which have width and height restrictions.

OSOM load travelling on the Golden Highway through Jerrys Plains

14 Transport for NSW Strategic Freight Model (SFM) 2013

15 NSW Department of Planning and Infrastructure 2012, Upper Hunter Strategic Regional Land Use Plan, p. 38

4.4 Rail freight

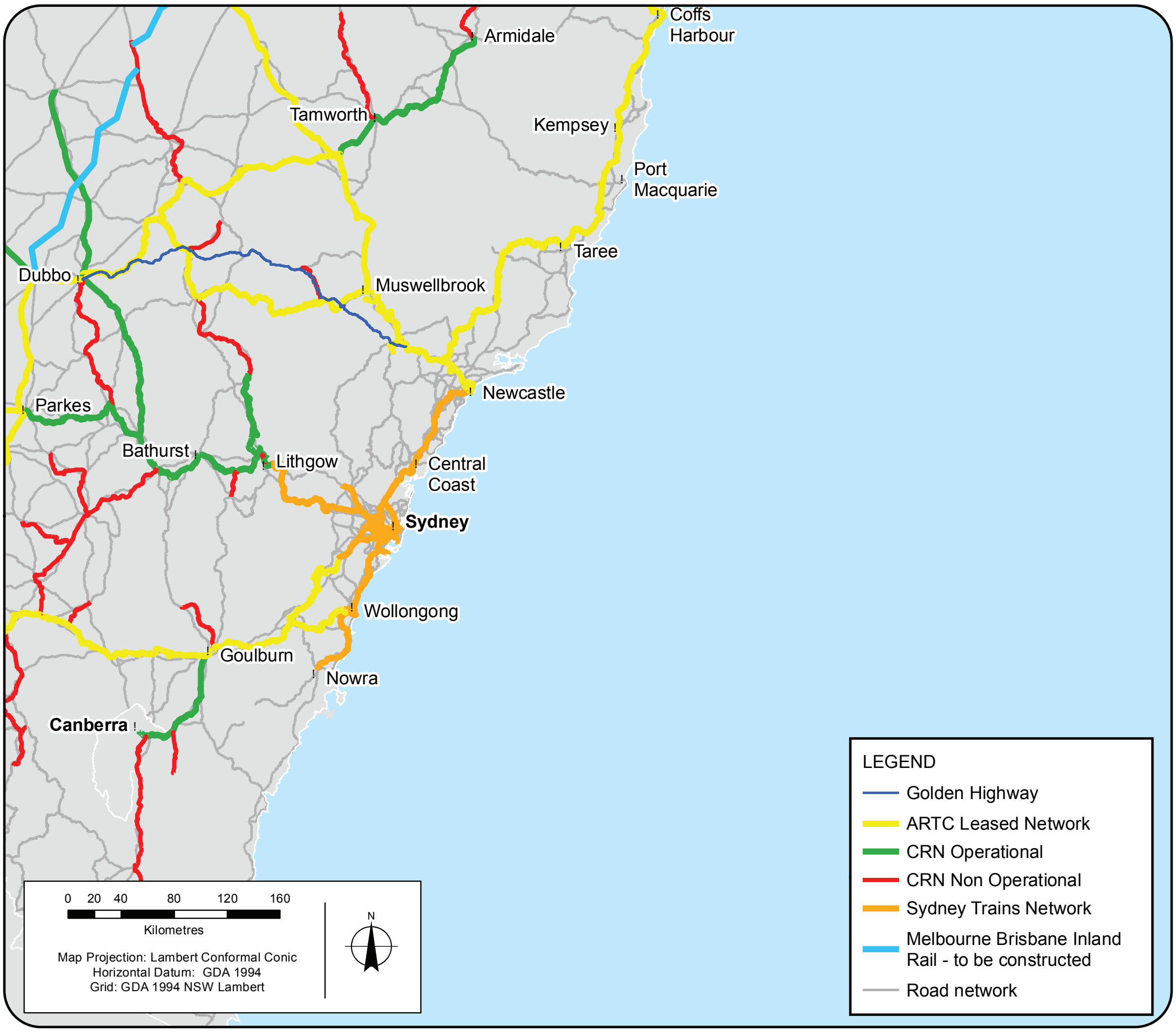
The freight rail network in the vicinity of the Golden Highway consists of two networks. The Australian Rail Track Corporation (ARTC) network consists of the main east-west lines in the Hunter Valley. These extend west to Dubbo through two branch systems connecting to Dubbo via the Ulan Line, and via Werris Creek. This rail network principally services the coal supply chain in the Hunter Valley, and to a lesser extent bulk grain, both of which are exported through the Port of Newcastle.

The second freight rail network, the Country Regional Network, is operated by John Holland on behalf of the NSW State Government. The Main Western Line which connects Dubbo to Lithgow joins the Sydney Trains network connecting to Sydney and Port Botany.

A figure showing the rail freight network in the vicinity of the Golden Highway is shown in Figure 4.3.

The majority of freight (by weight) transported between Ulan, around 30 kilometres south of the Ulan Road intersection at Cassilis), and the Upper Hunter is moved by rail, with rail freight being four to five times the volume of road freight. The majority of this freight moves in an easterly direction. In 2011 it was estimated that 7,650 kilotonnes of freight (including an estimated 7,150 of coal), moved in an easterly

Figure 4.3 Rail freight network (ARTC and Country Regional Network)



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Data source: Geoscience Australia, 250K Topographic Data Series 3.

direction between Ulan and Bengalla Junction, around 25 kilometres north-east of Denman. Conversely, the rail line between Ulan and Merrygoen, north-west of Dunedoo, is estimated to carry only a quarter of the volume that road freight carries between Ulan and Dunedoo. Road freight west of Dunedoo and rail freight west of Merrygoen are estimated to carry similar volumes of freight[16]. Rail freight that travels through Ulan to Newcastle consists of coal, minerals and grain operations. Interstate freight also uses the line during diversions. There are also several copper concentrate train services which operate from Cobar and Parkes to the Port of Newcastle.

ARTC has released the *2015 – 2024 Hunter Valley Corridor Capacity Strategy*. The strategy tempers previous prospective coal volumes from the 2014 strategy, and concludes that the Ulan system between Ulan and Bengalla has sufficient capacity for the expected increase in coal contracts. The largely single track system with passing loops only requires additional passing loops by 2022 at Mt Pleasant and Widden Creek by 2023 to accommodate future coal tonnages.

On the ARTC leased sections of track from Werris Creek to Dubbo and from Ulan to Merrygoen, the ARTC can operate trains to a length of 850 m operating at 20 tonne axle loads at 60 km/hr. The ARTC is currently exploring options to increase both train lengths and axle weights to improve the efficiency of the rail service. The operation of longer and heavier trains will improve the competitiveness of the rail service, potentially shifting road freight off the Golden Highway. Given the NSW Government's desire to improve the efficiency of both road and rail freight, the ARTC are encouraged to further explore the cost and benefits of improving the efficiency of rail freight on the Dubbo to The Gap, and Dubbo to Ulan lines. An efficient road and rail freight system provides opportunities to reduce transport costs, and improve the global competitiveness of rural industries.

The majority of exports from the Central West are transported to Port Botany via Lithgow.

Level crossing in Fitzroy Street Dubbo

Transport for NSW is working on improvements to the Main Western line between Lithgow and Dubbo to support future growth in freight on the corridor. East of Lithgow there are capacity constraints resulting from the density of passenger train services however there are currently sufficient freight paths available to meet demand.

Intermodal terminals

There is an intermodal rail terminal located on Yarrandale Road in Dubbo which has a 1.5km rail siding and 450 m of train loading hard stand area. The purpose of the terminal is to service the rail movement of containerised agricultural commodities, mining commodities and sheep meat products from the nearby abattoir to Port Botany.[17]

Fletchers rail terminal in Dubbo

16 Bureau of Freight Statistics 2011, Golden Highway Corridor Freight Movements, 2011 and 2013 (Strategic Freight Model), Transport for NSW, Sydney

17 Transport for NSW 2013, Website at *http://freight.transport.nsw.gov.au/strategy/action-programs/casestudies/case-study-17.html*

4.5 Current traffic volumes and heavy vehicles

Annual daily traffic (ADT) volumes along the Golden Highway vary significantly in the rural sections. At the eastern end there are around 5,000 vehicles per day. This increases to 11,000 east of Mount Thorley, 3,700 west of Putty Road, falling to 3,000 through Jerrys Plains and Denman, 2,100 through Sandy Hollow, 1,600 to Merriwa, 1,500 west of Dunedoo. Traffic volumes increase on the eastern approach to Dubbo, where volumes exceed 20,000 near the Newell Highway.

The number of heavy vehicles along the corridor ranges from 1,000 per day near the New England Highway at Belford, to 350 per day at Denman and 225 per day at Mugga Downs (east of Dubbo).

4.6 Public transport in the corridor

The Golden Highway currently has limited public transport services, which reflects the low level of demand along the corridor.

Public bus services

There are no regular bus services operating from the Singleton area to Dubbo. There is a bus service operated by Dubbo Buslines that goes to Columbia Drive (Dubbo suburb of Apollo). The distance between towns along the corridor affects the viability of public transport.

Dubbo

Dubbo's local bus network, operated by Dubbo Buslines, operates one route that uses the Golden Highway corridor as it passes through the town. Route 571 services North Dubbo and the eastern suburbs of Dubbo from Monday through to Saturday. Services run approximately once per hour in each direction on weekdays between 7:30am and 6:00pm. On Saturdays there are three services in each direction in the morning and early afternoon. The route services Dubbo Hospital and Western Plains Medical Centre.

School bus routes

School buses operate along the Golden Highway, providing a service for students living in agricultural areas. Many school bus stops are unformed, and typically are provided at local road intersections where a widened shoulder or clearing is provided. Opportunities to improve the safety of school bus stops through adjacent road or maintenance works should be examined along the Golden Highway in consultation with council and school bus operators.

Coaches

There is a regular coach service operated by NSW Train Link connecting Dunedoo with Coonabarabran in the north and Gulgong, Mudgee and Lithgow in the south. These coaches cross the Golden Highway via the Castlereagh Highway (B55) and Black Stump Way.

Sid Fogg also operate a three times weekly coach service (Monday, Wednesday and Friday) between Newcastle and Dubbo. The service operates via the New England Highway until Muswellbrook, before joining the Golden Highway at Denman.

Rail services

Freight trains operate between the Singleton area and Dubbo. Dubbo is connected to Sydney (via Lithgow) as well as towns to the north, south and west via the NSW Train Link network.

Air services

There is a regional airport to the north-west of the Dubbo urban centre. Direct flights operate to Sydney, Brisbane, Broken Hill and Newcastle using Regional Express (Rex), Qantaslink, Jetgo and Fly Pelican. There are 158 regular flights per week with the majority of flights made for business purposes.[18]

18 Dubbo City Regional Airport 2015, Website at *http://www.dubboairport.com.au*

4.7 Walking and cycling in the corridor

The NSW Government is committed to supporting the development of alternative transport options that are economical, environmentally sustainable and that enhance the wellbeing of the public. Delivering cycle ways and encouraging walking to connect residents with different land uses in an integrated and accessible fashion is a key part of achieving this objective.

Walking and cycling opportunities via dedicated infrastructure are generally restricted to urban centres. Between towns the sealed road shoulder should provide a facility for bicycle travel. *AUSTROADS* (2010) recommends two to three metre shoulder width where a speed limit is up to 100 km/h.[19]

The number of cyclists is low due to the long distances between the small towns located along the corridor. Shoulder widths along the majority of the corridor do not meet current standards for on-road cycling, although shoulders widen through towns and are wider in isolated locations along the corridor. There are no off-road cycle paths.

East of the Dubbo urban area, due to the long distances between towns the number of pedestrian movements is generally low. There are no footpaths with the exception of short lengths within Denman, Sandy Hollow, Merriwa and Dunedoo. These footpaths should be completed through the towns to encourage pedestrians not to walk on the road.

All towns have pedestrian crossing facilities where there are pedestrian desire lines with the exception of Dunedoo where a crossing facility between the rest area and town centre may be warranted.

In Dubbo there is a short shared path that runs between Tony McGrane Place and Caroline Street. There are footpaths west of Myall Street. On road cycle lanes and a footpath on the southern side of the highway between Merrilea Road and Wheelers Lane would improve safety for pedestrians and cyclists on this section.

The Regional Transport Plans identify programs to improve facilities for cyclists between towns and pedestrians and cyclists within towns.

Local Council initiatives for the towns along the corridor are identified below.

Denman

Muswellbrook Shire Council in consultation with Strategic Leisure Group developed a Walk and Cycle Plan for Muswellbrook and Denman in 2009. The aim of the study was "to formulate a realistic, connective and safe network of walking and cycling facilities, supported by a prioritised schedule of works"[20]. The study identifies the provision of a new off-road path on the western side of the Golden Highway between Crinoline and Merton Street as a high priority for action. A very short section of this path has been constructed.

Dubbo

Dubbo has a 100 km footpath and cycle network. In 2010 and 2012 the disused Dubbo to Molong railway corridor south of the city was used by Dubbo City Council to construct the Tracker Riley Cycleway in two stages, a total of 6.38 km. Joint funding was provided by Council, The Regional Local Community Infrastructure Program and Roads and Maritime Services. An extension to High Street is planned as the third and final stage of the cycleway. This will take users to the showgrounds near the centre of the city.[21]

19 *AUSTROADS* 2010, Guide to Road Design: Part 3: Geometric Design, *AUSTROADS*, Sydney

20 Muswellbrook Shire Council 2009, Walk and Cycle Plan for Muswellbrook and Denman (2009)

21 Rail Trails Australia 2012, Dubbo Tracker Riley Cyclepath extension (at: *http://www.railtrails.org.au/archive-2012/418-dubbo-tracker-riley-cyclepath-extension*)

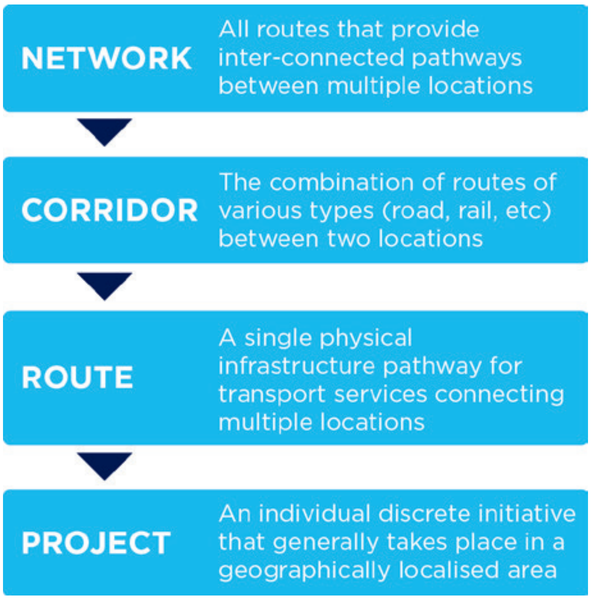
5 CURRENT CORRIDOR PERFORMANCE

Transport for NSW has adopted the *National Guidelines for Transport System Management in Australia*[22] to guide its advice to the NSW Government on the future of the road network.

Decision making in transport is complex. A robust planning framework is needed to break down this complex process into progressive phases.

The framework starts at the high level of network and corridor planning, progressing through to specific route and project levels, as shown in Figure 5.1.

Figure 5.1 Road transport system planning levels[23]



Road network management hierarchy and corridor strategies

The Road Network Management Hierarchy organises the network into logical groupings to ensure roads can be managed according to their relative importance.

For strategic planning purposes, Transport for NSW classifies all existing roads across the network into distinct road classes. This means roads with the same classification can be compared in terms of average safety, traffic and asset performance.

Transport for NSW measures the actual performance of the State Road network against network planning targets and average class performance, spanning road safety, traffic efficiency and asset condition. To undertake this comparative analysis, the State Road network is categorised into six distinct classes of roads. The classifications range from Class 6 urban (6U) and Class 6 rural (6R) standard roads to lower order Class 1 urban (1U) and Class 1 rural roads (1R).

The hierarchy is directly linked to the Infrastructure Maintenance sub-network ranking system used for asset management. It is important for both planning and asset management processes that both hierarchies are consistent and align with the objectives of providing an integrated management framework for the State Road network.

The Network Performance Measures and Network Planning Targets[24] indicate that the Golden Highway has been classified as Class 3R for the majority of its length, west of Denman Road at Denman. East of Denman Road the Golden Highway is classified as a Class 4R.

The *Network and Corridor Planning Practice Notes*[25] state that:

> *"Class 3R roads do not contribute to the National Land Transport Network. However, they do provide a strategic freight function. They are typified by moderate levels of traffic volumes including freight, commercial vehicle and public transport travel. They provide an acceptable standard of travel and serve inter/intra-regional functions. Typically they have undivided carriageways with 2 lanes."*

22 Australian Transport Council 2006, *National Guidelines for Transport System Management in Australia, ATC, Canberra*

23 Adapted from this source: Australian Transport Council 2006, *National Guidelines for Transport System Management in Australia, ATC, Canberra*, p. 9 & 15

24 Roads and Maritime Services 2010, *Network Performance Measures and Network Planning Targets*, RMS, Sydney, p. 17

25 Roads and Maritime Services 2008, *Network and Corridor Planning Practice Notes*, RMS, Sydney, p. 20

Class 3R roads typically experience:

- Average annual daily traffic volumes of 4,500 vehicles per day
- Average heavy vehicle volumes of 500 vehicles per day
- Speed limits ranging from 60 km/h to 110 km/h

For Class 4R roads, the Network and Corridor Planning Practice Notes state that:

> *"Class 4R roads are important rural State Roads and contribute to the National Land Transport Network. They are typified by moderately high traffic volumes including freight, commercial vehicle and public transport travel. They provide a good standard of travel and serve some interstate, inter-regional and intra-regional functions with direct access to abutting land controlled. Typically they have undivided carriageways with 2 lanes with overtaking lanes."*

Class 4R roads typically experience:

- Average annual daily traffic volumes of 10,000 vehicles per day
- Average heavy vehicle volumes of 1,000 vehicles per day
- Speed limits ranging from 80 km/h to 110 km/h.

Corridor planning sections

In addition to road classification, road segmentation is needed so planning targets can be tailored to specific areas to respond to changes in nearby land use, terrain and property access arrangements. Planning sections are manageable lengths of road that are uniform in nature.

For the purpose of this analysis, the Golden Highway corridor has been divided into 11 corridor planning sections. These are shown in Table 5.1, and Figure 5.2.

Table 5.1 Corridor planning sections

Corridor Planning Sections	Description	Land Use (Fringe Urban, Rural, Vegetation Conservation, Urban or Urban Commercial)	Chainage (km)		Length of the planning section (km)	Sub-network ranking
			From	To		
Section 1	New England Hwy, Belford to Mt Thorley Rd Overpass	Rural	0.0	13.4	13.4	4R
Section 2	Mt Thorley Rd Overpass to Redmanvale Ck, Jerrys Plains (Mt Thorley to Jerrys Plains)	Rural	13.4	36.8	23.4	4R
Section 3	Redmanvale Creek to Bowmans Crossing of Hunter River, Jerrys Plains	Rural	36.8	46.8	10.1	4R
Section 4	Bowmans Crossing of Hunter River, Jerrys Plains to Hunter River Bridge (western abutment), Denman (Jerrys Plains to Denman)	Rural	46.8	65.5	18.6	4R
Section 5	Hunter River Bridge to 440m west of railway crossing, Denman	Fringe Urban	65.5	70.5	5.0	3R
Section 6	440m west of railway crossing, Denman to Prices La, Merriwa (Merriwa to Denman)	Rural	70.5	116.8	46.3	3R
Section 7	Prices La to Merriwa River, Merriwa	Fringe Urban	116.8	119.6	2.8	3R
Section 8	Merriwa River, Merriwa to 1.043km east of Digilah East Rd, Dunedoo (Merriwa to Dunedoo)	Rural	119.6	221.8	102.2	3R
Section 9	1.043km east of Digilah East Rd to Avonside North Rd, Dunedoo	Fringe Urban	221.8	225.8	4.0	3R
Section 10	Avonside North Rd, Dunedoo to Buninyong Rd, Dubbo (Dunedoo to Dubbo)	Rural / Fringe Urban	225.8	308.8	83	3R
Section 11	Buninyong Rd, Dubbo to Newell Hwy, Dubbo	Fringe Urban / Urban	308.8	313.3	4.5	3R
Total			**0.0**	**313.3**	**313.3**	

Performance measures and targets

The *NSW Long Term Transport Master Plan* sets out the NSW Government's 20 year vision for delivering a world-class public transport, roads and freight network across the State.

Meeting community expectations of safe, efficient and well-maintained roads requires a clear set of performance measures that align with these expectations and needs. Transport for NSW and Roads and Maritime Services measure and monitor road performance against network performance measures and targets to achieve this.

A measure is not in a unit or dimension that enables current and future performance to be assessed. Network measures can be used to identify priorities across the network and guide funding over the long term. Network measures are a way of comparing performance both spatially and over time, and can form the basis for developing strategies to move towards improved performance levels.

Network planning targets set out in this document are either:

- Network wide targets – condition targets that apply to the entire network, unless otherwise specified
- Rural planning targets that apply to regional NSW, not including Sydney, the Lower Hunter, Central Coast and the Illawarra.

To assess the Golden Highway's current corridor performance, the following sources have been used:

- *Network Performance Measures and Network Planning Targets*[26]
- *Network and Corridor Planning Practice Notes*[27]

Road characteristics

There are two types of road characteristics. The first type is the road's geometric or physical layout, which does not usually change significantly over time. Examples of these characteristics include lane width, alignment and shoulder width.

The second type is characteristics of the road that may vary significantly over time due to wear, loading or physical degradation. These characteristics are associated with the 'condition' of the road. Targets are used to guide the management of road conditions. The minimum acceptable condition is based on an assessment of the risks associated with road conditions, and the upper end of road conditions is determined based on the level of available investment.

This document groups the Golden Highway's current corridor performance into the following sections:

Section 5.1 - Road safety

Section 5.2 – Traffic

Section 5.3 - Heavy Vehicles

Section 5.4 - Road design and geometry

Section 5.5 - Road pavement condition

Section 5.6 - Environment.

Road characteristics data sources

Information on the road characteristics and performance for each planning section is stored in various Roads and Maritime Services databases.

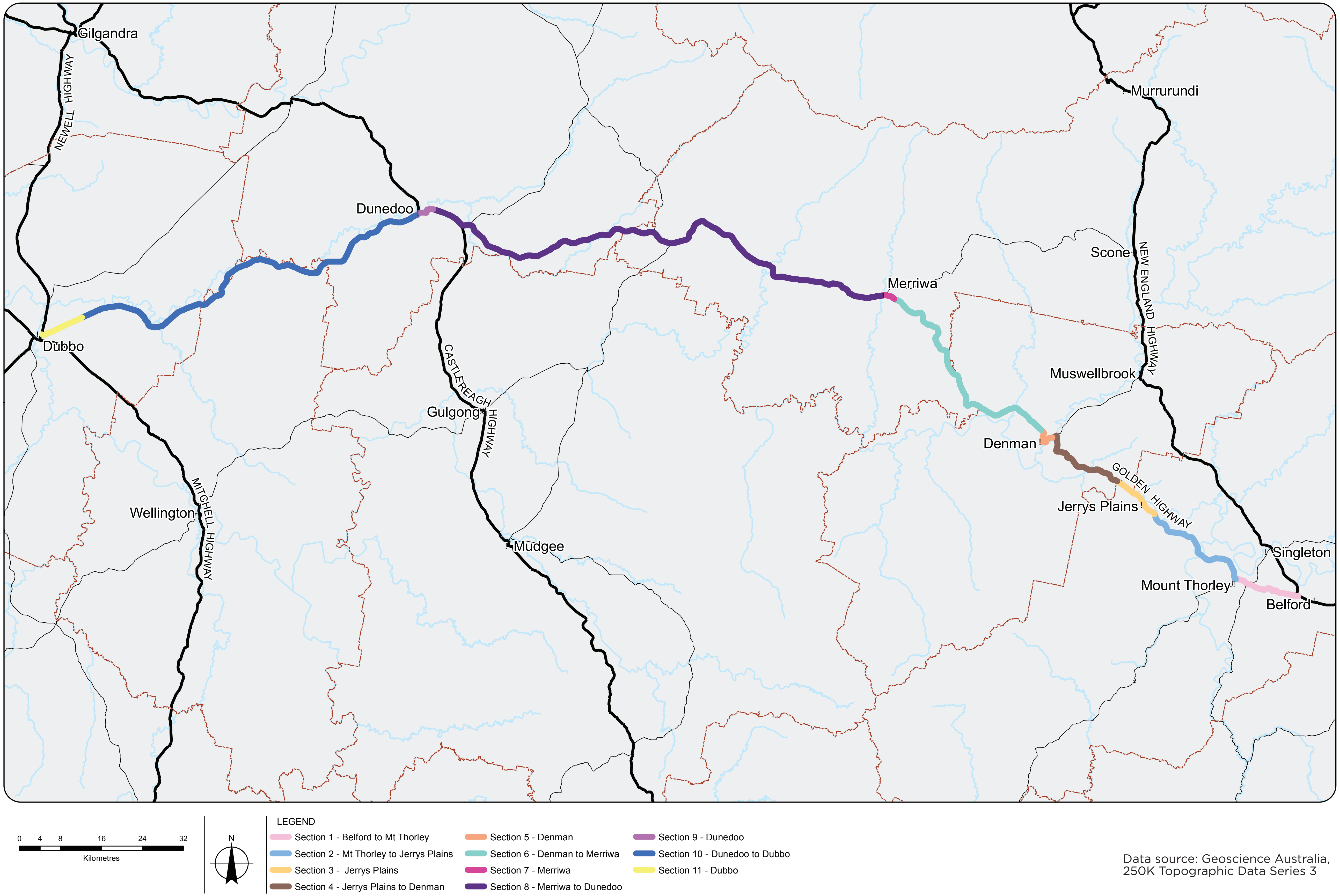
For this study, data has been drawn from the following sources:

- Road Asset Management System (RAMS) database.
- NSW Centre for Road Safety's crash database (CRASHLink).
- Road Slope Management System (RSMS) database.
- Global-Inertial Positioning Systems Image Capture for Asset Management (GIPSICAM).

26 Roads and Maritime Services 2010, *Network Performance Measures and Network Planning Targets*, RMS Sydney

27 Roads and Maritime Services 2008, *Network and Corridor Planning Practice Notes*, RMS, Sydney

Figure 5.2 Corridor planning sections



Data source: Geoscience Australia, 250K Topographic Data Series 3

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5.1 Road safety

Speed zones

Speed zones are determined according to the *Roads and Maritime Services Speed Zoning Guidelines* and are posted to provide motorists safe passage along roads, in relation to the geometry and environment.[28]

The Speed Zoning Guidelines are used to determine appropriate speed limits on all roads, applied in conjunction with enforcement measures, engineering treatments and education to reduce speeding. Roads and Maritime Services regularly reviews speed limits in NSW, taking into account factors such as road geometry, surrounding conditions, road usage, nearby development, vehicle types and volumes, crash records and access points along the route.

The speed limit along the Golden Highway is generally 100 km/h in rural areas. Within towns, the speed limit is 60 km/h in Jerrys Plains, Denman, Sandy Hollow and Dubbo. In Merriwa and Dunedoo the speed limit through the centre of town is 50 km/h. There is a short 60 km/h zone either side of Merriwa and a short 70 km/h section at the eastern end on the approach to the New England Highway intersection. There are short 80 km/hr speed zones on the approach to Dubbo and Denman, through Warkworth, and on the northern side of the Mount Thorley interchange. West of Jerrys Plains, there is an extended 80 km/hr zone approximately 2 km long in which two stock crossings are provided for an adjacent dairy. There are also two school zones, one at Denman (Saint Joseph's Primary School) and the other at Sandy Hollow (Sandy Hollow Public School).

Within towns there is a need to balance the tension between achieving a safe road environment and an amenable main street with supporting the productivity of freight and minimal travel times for motorists.

The locations of speeds zones along the Golden Highway are shown in Figure 5.3.

Fixed speed cameras

Criteria for fixed speed camera locations are based on crashes, injuries and travelling speeds to ensure cameras are installed on lengths of road with a high crash rate, and a known speeding problem.

There are no fixed speed cameras located along the Golden Highway corridor. There is a point to point camera enforcement area targeting heavy vehicle compliance which will be discussed in Section 5.3.

Number of crashes

Of the 370 crashes reported between June 2009 and July 2014 along the Golden Highway corridor, 206 were 'casualty crashes', which caused either an injury or fatality to one or more of the people involved. Of the 200 casualty crashes, nine were fatal and 191 resulted in an injury (Figure 5.4 and Figure 5.5).

Figure 5.4 shows the breakdown of fatal, injury and non-casualty crashes for each planning section. The majority of crashes that have occurred in Jerrys Plains, Denman, between Denman and Dunedoo, and between Dunedoo and Dubbo have been casualty crashes. There was one fatal crash between Mount Thorley and Jerrys Plains, three fatal crashes between Denman and Merriwa, two fatal crashes between Merriwa and Dunedoo, and three fatal crashes between Dunedoo and Dubbo. There have been no fatal crashes in the urban areas of the corridor.

In addition to measuring the number and severity type of crashes, a range of other measures have been developed to compare road safety criteria across different roads.

This corridor strategy examines three of these measures over the five year period:

1. Annual casualty crashes per kilometre per year.

2. Annual casualty crash rate per 100 million vehicle kilometres travelled (100 MVKT).

28 NSW Centre for Road Safety 2011, *NSW Speed Zoning Guidelines*, RMS, Sydney

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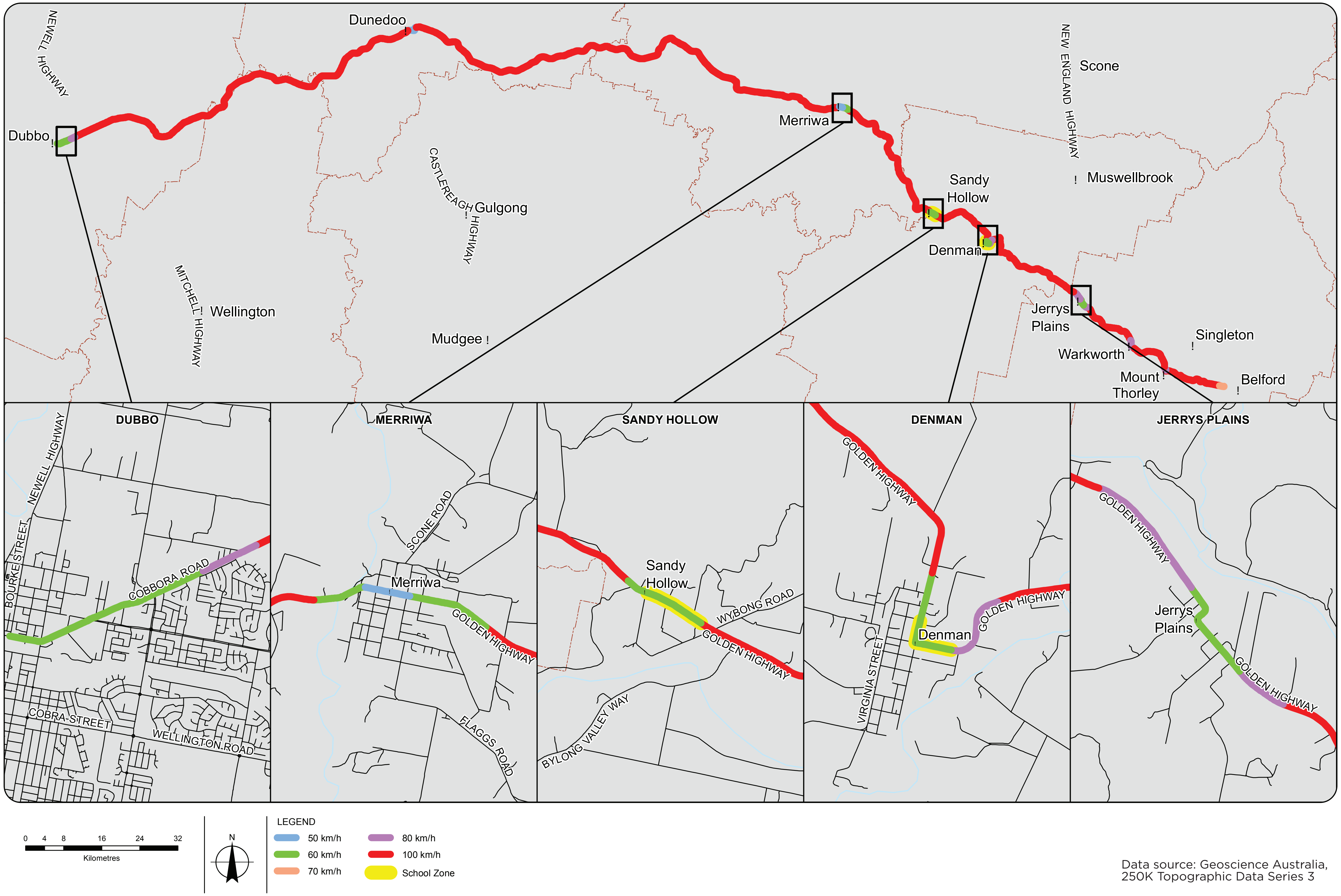
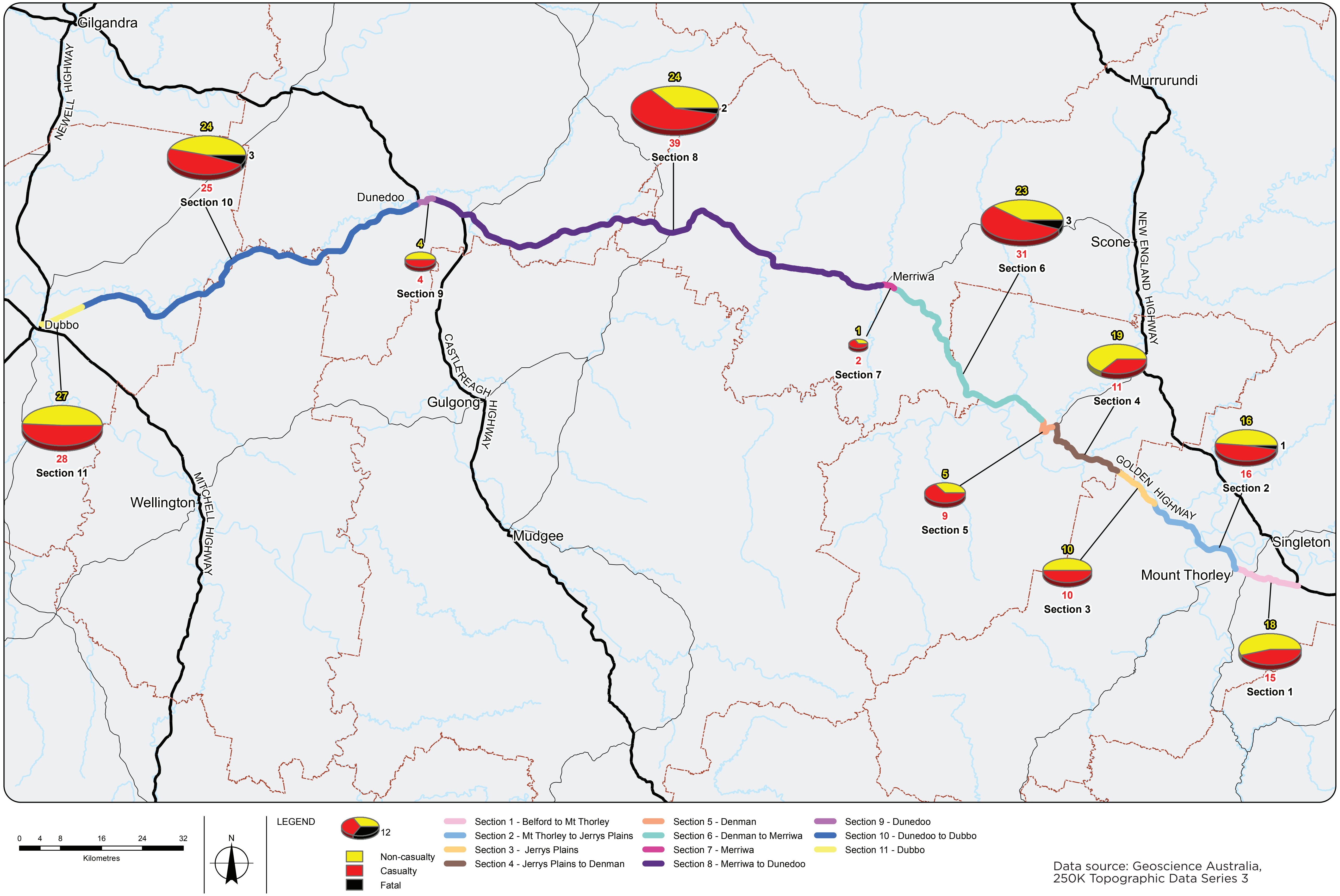
Figure 5.3 Golden Highway corridor speed zones



Data source: Geoscience Australia, 250K Topographic Data Series 3

Figure 5.4 Location and severity of crashes, July 2009 to June 2014



Data source: Geoscience Australia, 250K Topographic Data Series 3

Casualty crash rates

Table 5.2 sets out the class averages for the casualty crash rates on the rural network of Class 4R and Class 3R roads.

Table 5.2 Network class average performance for the rural road network (2008-2012)[29]

Rank	Land use	Average number of casualty crashes per kilometre per year
4R	All	0.30
3R	"	0.26
4R	Fringe Urban, Rural and Vegetation Conservation	0.20
3R	"	0.18
4R	Urban and Urban Commercial	1.70
3R	"	1.14

Table 5.3 compares annual casualty crash rates per kilometre on the Golden Highway with class averages in NSW. Assessment was undertaken over (on average) 5 km sections. This assists in the identification of poorer performing sections of the Golden Highway, and hence informs the prioritisation of road safety improvements along the corridor, such as shoulder widening and clear zone works.

From Table 5.3, most corridor planning sections illustrate crash rates at or below the State average. However, there are discrete sections (5 km in length) which exhibit crash rates higher than the State average. These include Mt Thorley (0.3), east of Jerrys Plains (0.24), Denman (0.36), 20 km east of Merriwa (0.4), immediately west of Merriwa (0.24) and the Dubbo urban area (1.24).

Table 5.3 Casualty crashes per kilometre (July 2009 to June 2014)

Corridor Planning Sections	Rural Hierarchy Class	Land Use	Chainage (km)	Golden Highway Crashes per km	NSW class average (2008 - 2012)
1. Belford to Mt Thorley	4R	Rural	13.4	0.22	0.2
2. Mt Thorley to Jerrys Plains	4R	Rural	23.4	0.15	0.2
3. Jerrys Plains	4R	Rural	10.1	0.20	0.2
4. Jerrys Plains to Denman	4R/3R	Rural	18.6	0.12	0.2 & 0.18
5. Denman	3R	Fringe	5	0.45	0.18
6. Denman to Merriwa	3R	Rural	46.3	0.15	0.18
7. Merriwa	3R	Fringe Urban	2.8	0.14	0.18
8. Merriwa to Dunedoo	3R	Rural	102.2	0.08	0.18
9. Dunedoo	3R	Fringe Urban	4	0.20	0.18
10. Dunedoo to Dubbo	3R	Rural/Fringe Urban	83	0.07	0.18
11. Dubbo	3R	Fringe Urban/ Urban	4.5	1.24	0.18 & 1.14

29 TfNSW update September 2014, *Network Performance Measures and Network Planning Targets*, p.1

However, the annual casualty crash rate per kilometre does not take into account the potential for significant variations in traffic volumes along routes. This means it may understate relatively high crash rates on particular lengths of the road that operate with significantly lower traffic volumes.

For this reason, a second measure of casualty crashes per 100 million vehicle kilometres travelled is also used. This is particularly useful to compare casualty crash rates on roads that carry higher than average and lower than average traffic volumes.

The casualty crash rate per 100 million vehicle kilometres (MVKT) travelled is calculated as follows:

$$\textit{Crash rate} = \frac{\textit{No. of crashes x } 10^8}{L.A.365.M}$$

Where:

L= length in kilometres

A = ADT (traffic year used should be within the crash data range (or similar))

M = number of years of crash data

The casualty crash rate per 100 MVKT ranges from 8.32 between Mt Thorley and Jerrys Plains, to 16.86 between Denman and Merriwa. Crash rates in the urban centres such as Denman, Dunedoo and Dubbo could not be calculated due to a lack of sufficient traffic survey data. As per the previous assessment, casualty crash rates on a per 100 MVKT basis were also assessed over (on average) 5 km sections.

From Table 5.4, most corridor planning sections illustrate crash rates less than 16.44 crashes per 100 MVKT. However, discrete sections (5 km in length) exhibiting higher crash rates include east of Jerrys Plains (18.81), immediately east of Denman (17.42), immediately west of Denman (up to 22.64), 25 km west of Denman (up to 45.27), west of Merriwa (3 locations at 32.26), east of Dunedoo (21.51) and west of Dunedoo (up to 26.14).

Table 5.4 Casualty crashes per 100 MVKT (July 2009 to June 2014)

Corridor Planning Sections		Land Use (Fringe, Urban, Rural and Vegetation Conservation)	Crash rates per 100 MVKT	Section Length (km)
1.	Belford to Mt Thorley	Rural	8.32	13.4
2.	Mt Thorley to Jerrys Plains	Rural	8.97	23.4
3.	Jerrys Plains	Rural	15.81	10.1
4.	Jerrys Plains to Denman	Rural	9.44	18.6
5.	Denman	Fringe Urban	N/A*	5
6.	Denman to Merriwa	Rural	16.86	46.3
7.	Merriwa	Fringe Urban	9.62	2.8
8.	Merriwa to Dunedoo	Rural	10.60	102.2
9.	Dunedoo	Fringe Urban	N/A*	4
10.	Dunedoo to Dubbo	Rural	11.16	83
11.	Dubbo	Fringe Urban	N/A*	4.5

Notes:

**N/A Insufficient traffic survey data on this section to calculate a crash rate.*

Crash types

Table 5.5 and Figure 5.5 detail the most prevalent crash types recorded on the Golden Highway during the five year period to June 2014.

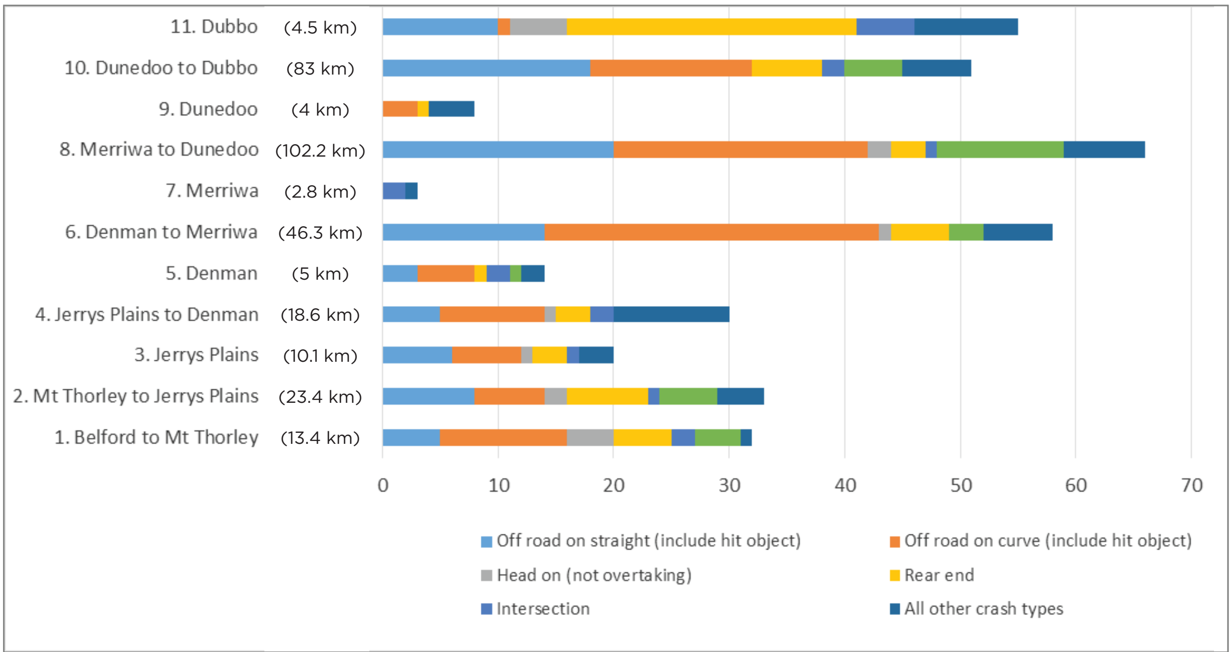
Table 5.5 Crash types within the corridor (July 2009 to June 2014)

Crash Types	Number of Crashes	Percent of Crashes
Off road on straight (include hit object)	89	25%
Off road on curve (include hit object)	106	29%
Head on (not overtaking)	16	4%
Rear end	59	16%
Intersection	18	5%
Hit Animal	29	8%
All other crash types	53	14%

The most common crash type in the corridor is off-road on curve crashes, representing 29% of all crashes. This is closely followed by off road on straight crashes at 25%. As such, single vehicle crashes account for 54% of all crashes on the Golden Highway. Rear end crashes accounted for 16% of all crashes, whilst intersection and hit animal crashes accounted for 5% and 8% respectively.

Crash type by corridor planning section is shown below in Figure 5.5.

Figure 5.5 Crash types July 2009 to June 2014



From Figure 5.5, off-road crashes (on straight or on curve) is the predominant crash type in all rural sections, whilst rear-end crashes significantly increase in urban areas such as Dubbo.

Cross carriageway crashes include off-road crashes that involve vehicles crossing to the other side of the carriageway, crashes involving a vehicle overtaking a vehicle turning right, and head on crashes (both overtaking and non-overtaking). The number of cross carriageway crashes by corridor planning section is shown in the table below.

Table 5.6 Cross carriageway crashes by planning section (July 2009 to June 2014)

Corridor Planning SectionS	Number of Cross Carriageway Crashes	Section Length (km)	Cross Carriageway Crashes Per Kilometre Per Year
1. Belford to Mt Thorley	11	13.4	0.16
2. Mt Thorley to Jerrys Plains	7	23.4	0.06
3. Jerrys Plains	4	10.1	0.08
4. Jerrys Plains to Denman	8	18.6	0.09
5. Denman	5	5	0.20
6. Denman to Merriwa	16	46.3	0.07
7. Merriwa	0	2.8	0.00
8. Merriwa to Dunedoo	21	102.2	0.04
9. Dunedoo	2	4	0.10
10. Dunedoo to Dubbo	12	83	0.03
11. Dubbo	3	4.5	0.13
Total cross carriageway crashes	**89**	**313.3**	**0.06**

The largest number of cross carriageway crashes per kilometre per year occur between the intersection of the New England Highway and Mt Thorley, and within the urban area of Denman.

Contributing factors

In analysing road safety information, it is important to draw on as much information as possible about the nature of each crash to determine the potential contributing factors. This information allows Roads and Maritime and TfNSW to understand crash patterns that may be developing on particular roads, and in turn, help to formulate responses to prevent these crashes through engineering, maintenance or behavioural strategies.

Table 5.7 summarises the contributing factors recorded by the NSW Police for all reported crashes within the five year period to June 2014.

Table 5.7 Contributing factors in crashes on the Golden Highway (July 2009 to June 2014)

Crash Factor*	Number of Crashes	Percent of Crashes
Heavy Vehicle Involvement		
Heavy truck crashes (excluding crashes involving a small rigid vehicle)	44	11.9%
Road Surface Conditions		
Wet	88	23.8%
Dry	281	75.9%
Snow or ice	1	0.3%
Natural Lighting		
Dawn	16	7%
Daylight	228	61.6%
Dusk	11	3%
Darkness	105	28.4%
Weather		
Fine	256	69.2%
Rain	69	18.6%
Overcast	26	7%
Fog or mist	15	4.1%
Unknown	4	1.1%
Behavioural Factors		
Speeding	100	27%
Fatigue	62	16.8%
Alcohol	17	4.6%

**These categories are not mutually exclusive.*

The majority of crashes occurred on a dry road surface in fine weather and in daylight hours. Only 12 percent of crashes involved heavy vehicles. Speed was a major contributing factor to crashes (27 percent) as was fatigue (17 percent).

In considering these statistics, it is important to note that 'speeding' does not always indicate non-compliance with the posted speed limit, but simply that the speed of a vehicle was reported as not appropriate for the condition of the road at the time, for example, during wet weather. In addition, due to the isolated location of many casualty crashes, it is difficult to identify the involvement of speed in all instances. In turn, the number of crashes identifying speed as a factor should be considered a minimum number.

In terms of crashes per kilometre, there are a large number of wet surface crashes between Jerrys Plains and Denman. The long distance between towns and facilities along the corridor may have contributed to the large number of fatigue related crashes. The long shifts worked by coal miners east of Jerrys Plains may also explain the high number of fatigue related crashes over this section. Speed related crashes are highest east of Denman, whilst alcohol related crashes are highest in Denman however the number of crashes is small.

Rail crossings

Rail crossings can be either a level crossing – the intersection of a road or walkway and a railway line at the same grade – or a grade separated crossing, where the road and rail line are either under or over one another.

There are currently four rail crossings on the Golden Highway. One of these is a rail tunnel under the road. Two of these three have narrow shoulders, one of which has a curved approach from the east (Table 5.8).

There are five rail level crossings on the Golden Highway (Figure 5.6) at the following locations:

- Denman – 1.27 km north of Kenilworth Street.
- Dunedoo – 80 m south of Whiteley Street.
- Barbigal – 140 m east of Lesslies Road.
- Beni – 40 m west of Boothenba Road.
- Dubbo – 30 m west of White Street.

Individual rail and road agencies are responsible for the management of safety of the various components of their level crossing infrastructures. Roads and Maritime works with the rail network manager, ARTC, to jointly manage level crossings. The objectives are to improve safety for road and rail users, maintain the State transport network's efficiency, and comply with legislative requirements. Improvements to level crossing safety in NSW are prioritised using the Australian Level Crossing Assessment Model (ALCAM). The higher the ALCAM score, the higher the assessed safety risk to motorists.

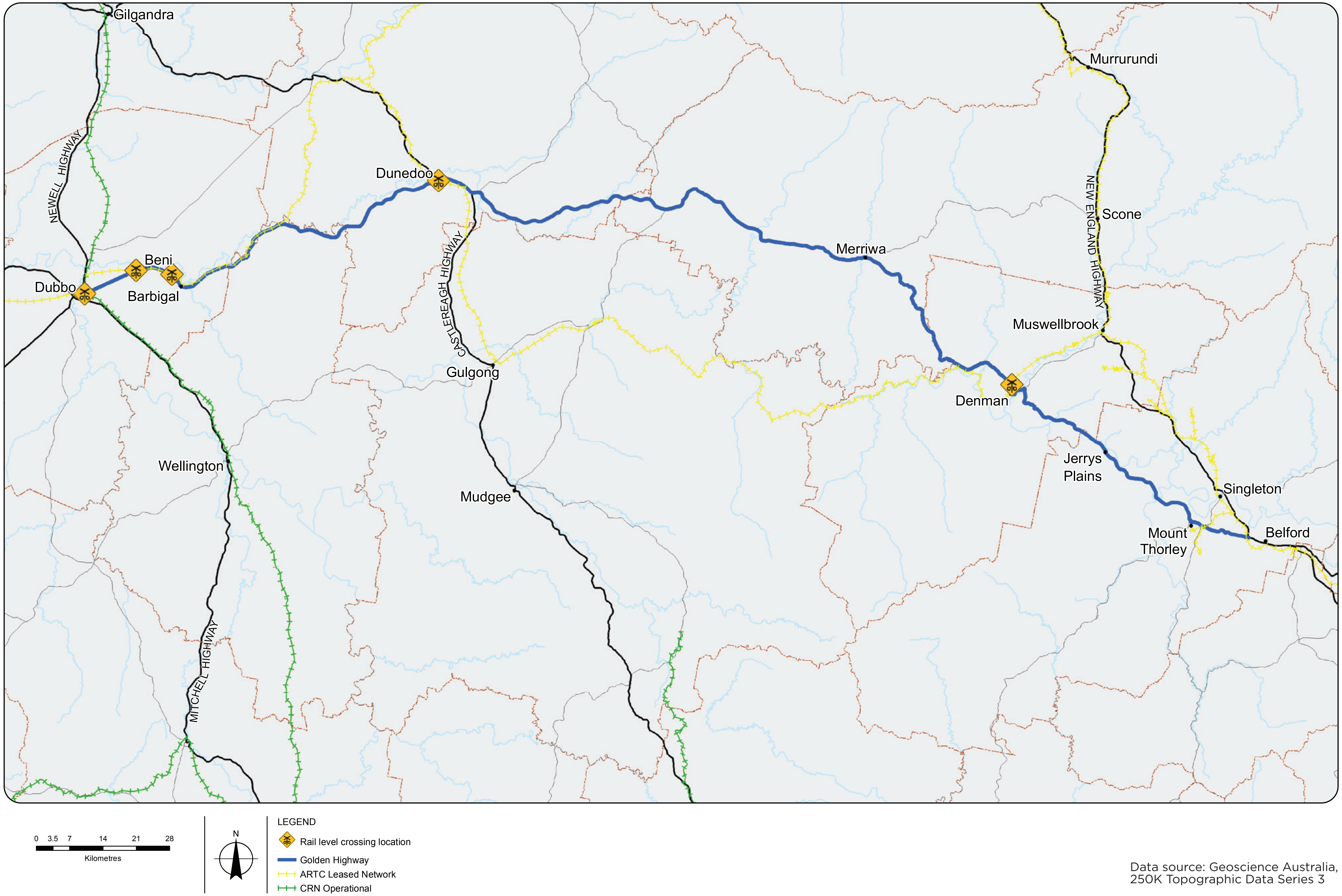
ALCAM captures detailed survey information to create an inventory of rail crossings. It also assesses risk and allows each rail crossing to be ranked. This, in turn, helps inform decisions about which level crossings require further treatment and what would be the most effective way to upgrade the crossing.

Safety reviews have been undertaken for all railway crossings along the Golden Highway

Table 5.8 Road over rail bridges and rail tunnels

Location	Description of Bridge	Additional comments
Whittingham – 650 metres west of the New England Highway	Bridge over ARTC network.	Bridge with wide lanes and very narrow shoulders. Pavement in good condition.
Mount Thorley – 80 metres east of Putty Road (E)	Bridge over ARTC network.	Bridge with wide lanes and narrow shoulders. Pavement in good condition. Curved approach from east.
Mount Thorley – 1.87 kilometres west of Broke Road	Bridge over ARTC network.	Bridge with 1 to 2.5 metre wide shoulders. Pavement in good condition. On gentle curve.
Warkworth – 1.43 kilometres east of Wallaby Scrub Road	Road over ARTC network tunnel.	Rail tunnel.

Figure 5.6 Rail level crossing locations



Data source: Geoscience Australia, 250K Topographic Data Series 3

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(Table 5.9). The existing railway level crossing at Denman has a relatively high ALCAM score and is located in a 100 km/h speed environment, with the rail line expected to accommodate an increase in train movements due to an increase in coal movements on the Muswellbrook – Ulan rail line. Boom gates at this crossing would improve safety for motorists and train drivers.

There were nine crashes at or within 50 m of the Dubbo rail level crossing in the five years from June 2009 to June 2014. Of these crashes, five were injury crashes, most being rear-end crashes. Flashing lights at the Barbigal level crossing were raised and duplicated following a rail level crossing crash between a train and a truck.

It is recommended that the Denman level crossing be upgraded to boom gates in the short-term.

Other safety measures, such as reducing the regulatory speed limit on approaches to level crossings to 80 km/hr, should also be investigated. Reduced speed limits on the approaches to level crossings have been adopted across Victoria, following a number of level crossing crashes.

It is noted that operating patterns of freight trains at Dunedoo includes the requirement for westbound trains to stop and close the Golden Highway for up to five minutes, whilst the driver communicates for operating clearance to continue west to Merrygoen. It is recommended ARTC improves the coordination of train movements to reduce the disruption to the Golden Highway at Dunedoo.

Table 5.9 Rail crossing locations

Location of rail level crossing	Rural or Urban	ALCAM rating and safety management plan prepared?	Flashing Lights	Boom Gates	Additional comments
Denman	Rural	Yes Risk Score: 40,040,000	Yes	No	Expected increase in coal train movements. 100 km/h speed road and rail environment. Narrow road shoulder. Signage and line marking improvements completed in 2013.
Dunedoo	Rural	Yes Risk Score: 4,779,200	Yes	No	Pedestrian fencing is non-standard, no ramps or holding rails. Power poles in clear zone. Queuing risk. Truck stop parking and Council depot have accesses close to crossing. Tight curve on southern side.
Barbigal	Rural	Yes Risk Score: 6,249,600	Yes	No	Poor sight distance due to crest on eastern side.
Beni	Rural	Yes Risk Score: 9,771,200	Yes	No	
Dubbo	Urban	Yes Risk Score: 122,781,120	Yes	Yes	High risk score and high ALCAM priority ranking. Multiple tracks, queuing and short stacking are risks. Upgrades to pedestrian guidance required.

Level crossing at Denman on the Golden Highway

Summary of road safety issues

On a crashes per kilometre basis, sections which exhibit higher than state average crash rates include: Mt Thorley; east of Jerrys Plains; Denman; 20 km east of Merriwa; immediately west of Merriwa; and the Dubbo urban area. Using the casualty crash rate per 100 MVKT, sections which exhibit high crash rates (higher than 16.44 crashes per 100 MVKT) include: Jerrys Plains; immediately west of Denman; 25 km west of Denman; west of Merriwa (three locations totalling 20 km); and west of Dunedoo (three locations totalling 15 km). The predominant crash type was single vehicle crashes (either off-road on straight or off-road on curve), whilst fatigue (17 percent) and speeding (27 percent) were key behavioural factors involved in crashes.

Road safety interventions on the Golden Highway should focus on sections which exhibit higher crash rates and focus on addressing single vehicle crashes in rural areas. Behavioural factors such as fatigue should also be considered, whereby the standard and spacing of rest areas should be considered, as well as measures such as audio-tactile line marking.

There are three high speed rail level crossings on the Golden Highway. It is recommended that the Denman level crossing be upgraded to boom gates in the short-term.

5.2 Traffic

Traffic volumes

Average daily traffic (ADT) volumes along the Golden Highway vary in the rural sections from around 5,000 at the eastern end to around 11,000 east of Broke Road, dropping to 1,500 west of Dunedoo, to 20,000 within the urban areas of Dubbo. The percentage of heavy vehicles along the corridor ranges from 19-21 percent west of the New England Highway at Belford and east of Dunedoo, decreasing to 12 percent near Broke Road and Dubbo, where there is a higher proportion of commuter traffic associated within mining areas and the urban centre of Dubbo. Annual traffic growth has been strong at the eastern end due to the strength of the mining sector, and relatively steady for the remainder of the route.

Freight along the Golden Highway is largely fertiliser, mining equipment (at the eastern end), livestock and grain.

In terms of seasonal variations, large volumes of grain following large harvests are generally trucked to port during January to April as this is typically the peak export period[30]. Grain is trucked in an easterly direction along the Golden Highway towards the Port of Newcastle.

30 Hyder Consulting Pty Ltd 2012, Grain Case Study – *NSW Road Freight Model (Draft Report)*, Chapter 3, p. 4

Table 5.10 Estimated Average Daily Traffic (ADT) volumes, 2014 (rural sections)

Corridor Planning Sections	ADT (Vehicles per day)	Average Heavy Vehicles per day	% Heavy Vehicles	Section Length (km)
1. Belford to Mt Thorley	4975 – 11370[1]	1036 - 2160	19	13.4
2. Mt Thorley to Jerrys Plains	3748	449	12	23.4
3. Jerrys Plains	3042	365	12	10.1
4. Jerrys Plains to Denman	3042	365	12	18.6
5. Denman	N/A	N/A	N/A	5.0
6. Denman to Merriwa	2089	355	17	46.3
7. Merriwa	3522	493	14	2.8
8. Merriwa to Dunedoo	1644-2223[2]	345-467[2]	21	102.2
9. Dunedoo	N/A	N/A	N/A	4
10. Dunedoo to Dubbo	1507	316	21	83
11. Dubbo	6000 - 20800[3]	281	21	4.5

Notes:

[1] Between Putty Road and Mt Thorley.
N/A Traffic counts were not available which were representative of the Denman and Dunedoo urban areas.
[2] Between Castlereagh Highway East and Dunedoo
[3] Estimate based on a 12 hr weekday count undertaken in 2014. Volume varies from west of Wheelers Lane to west of Fitzroy Street.

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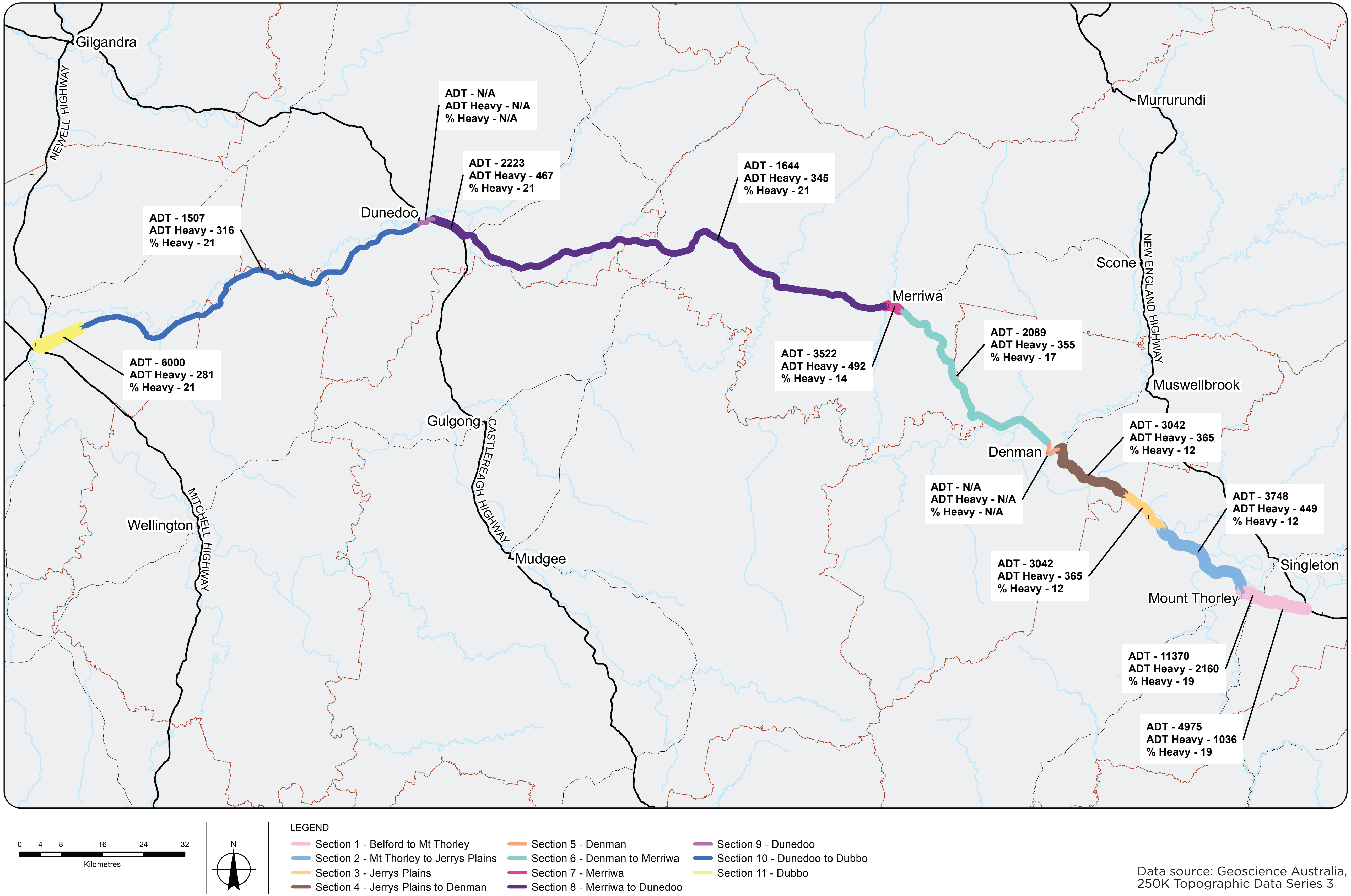
Figure 5.7 Estimated Average Daily Traffic Volumes 2014 (rural sections)



Data source: Geoscience Australia, 250K Topographic Data Series 3

Table 5.11 Corridor performance for 2015, 2025 and 2035

Corridor Planning Sections - Section		Direction	2015						2025						2035					
			Peak 1[1]			Peak 2[1]			Peak 1[1]			Peak 2[1]			Peak 1[1]			Peak 2[1]		
			PTSF[2] (%)	km/hr	LoS	PTSF[2] (%)	km/hr	LoS	PTSF[2] (%)	km/hr	LoS	PTSF[2] (%)	km/hr	LoS	PTSF[2] (%)	km/hr	LoS	PTSF[2] (%)	km/hr	LoS
1	New England Hwy to Putty Rd	EB	69.1	74.8	C	64.5	70.0	C	74.0	73.3	D	66.4	68.8	C	77.8	71.6	D	71.3	67.6	D
		WB	74.6	67.8	D	59.0	75.7	C	79.7	65.6	D	61.4	75.1	C	82.7	63.4	D	66.4	73.6	C
	Putty Rd to Mt Thorley	EB	67.2	79.7	C	66.3	73.3	C	71.6	78.6	D	69.9	71.9	C	73.0	77.5	D	72.5	71.1	D
		WB	68.5	76.5	C	63.4	81.7	C	73.2	75.0	D	66.6	81.1	C	74.6	73.7	D	69.0	80.5	C
2	Mount Thorley to Jerrys Plains	EB	70.7	82.1	D	66.9	76.3	C	74.9	80.0	D	71.6	73.8	D	77.9	78.6	D	74.8	71.8	D
		WB	81.7	71.3	D	57.5	83.6	C	84.3	69.2	D	63.0	82.7	C	86.9	67.6	E	66.1	81.8	C
3	Jerrys Plains to Edderton Road	EB	33.7	81.6	A	35.4	81.3	A	35.7	81.1	A	39.6	80.6	A	39.7	80.0	A	43.4	79.5	B
		WB	33.1	80.7	A	35.9	80.3	A	35.4	78.9	A	39.9	79.0	A	39.6	78.4	A	43.6	78.0	B
	Edderton Rd to Denman Rd	EB	45.4	71.5	B				49.7	70.9	B				54.4	69.3	B			
		WB	47.0	73.0	B				49.8	71.8	B				54.6	70.4	B			
4	Denman Rd to Denman	EB	44.1	76.7	B	51.3	77.3	B	51.1	75.5	B	56.9	76.6	C	54.4	75.1	B	60.5	75.8	C
		WB	43.6	77.9	B	52.4	74.3	B	50.0	76.3	B	57.6	73.0	C	54.2	75.4	B	61.4	71.9	C
6	Denman to Sandy Hollow	EB	29.8	87.6	A				32.6	86.9	A				36.4	85.2	A			
		WB	30.0	85.3	A				33.2	83.6	A				38.0	82.5	A			
	Sandy Hollow to Merriwa	EB	37.3	86.2	A				42.4	84.5	B				46.6	83.3	B			
		WB	37.7	83.7	A				42.0	82.7	B				46.2	81.4	B			
8	Merriwa to Ulan	EB	34.0	83.8	A				40.7	81.0	B				44.5	81.1	B			
		WB	35.1	79.4	A				41.5	78.2	B				47.0	75.4	B			
	Ulan to Dunedoo	EB	28.6	88.2	A				32.5	87.6	A				35.2	87.1	A			
		WB	28.6	88.4	A				32.6	87.4	A				36.0	86.9	A			
10	Dunedoo to Dubbo	EB	36.5	88.4	A				45.5	85.4	B				53.0	83.5	B			
		WB	37.7	86.7	A				43.5	85.8	B				51.2	83.4	B			

1 Peak 1 usually corresponds to an AM peak and Peak 2 to a PM peak, however in sections where the AM and PM traffic flows where only a single peak is observed and modelled.

2 PTSF - Percentage time spent following

Number of lanes and level of service

The Level of Service (LoS) a road provides is a measure of how easily traffic flows on the road. It assesses the operating condition of a road based on various factors, including traffic volumes, proportion of heavy vehicles, terrain and frequency of intersections. Levels of service range from 'A' to 'E' with 'A' representing free-flowing traffic and 'E' representing severe congestion. On uninterrupted two-lane rural highways, the level of service is measured using percent time spent following (Table 5.12).

The Golden Highway corridor between the New England Highway at Belford and White Street in Dubbo is generally one lane in each direction. West of White Street in Dubbo there are two lanes in each direction to the end of the corridor where the Golden Highway meets the Newell Highway. The Roads and Maritime Services Network Planning Target[31] for number of through lanes on both 4R and 3R class roads is two, one in each direction of travel, with an increase to four if required to provide Level of Service (LOS) C. If the travel demand for any particular road is such that target LOS C is forecast to be reached within the planning horizon, an assessment should be made as to the viability of increasing the number of lanes available. In urban environments Level of Service D is generally acceptable.

Table 5.12 Level of service definitions*

Level of Service	Average travel speed ATS (km/h)	% time following (two-lane highways)	Description[32]
A	> 90	≤ 35	Free flow conditions. Drivers are virtually unaffected by others in the traffic stream. Ease of selection of desired speed and maneuverability. General level of comfort and convenience is excellent.
B	> 80 - 90	> 35 - 50	Stable flow conditions. Reasonable ease of selection of desired speed and maneuverability. General level of comfort and convenience is a little less than for LOS A.
C	> 70 - 80	> 50 - 65	Stable flow conditions. Restricted selection of desired speed and maneuverability. General level of comfort and convenience declines noticeably at this level.
D	> 60 - 70	> 65 - 80	Approaching unstable flow conditions. Severely restricted selection of desired speed and maneuverability. General level of comfort and convenience is poor. Small increases in traffic will generally cause operational problems.
E	≤ 60	≥ 80	Select desired speed and maneuverer. Minor disturbances will cause breakdown.

** Level of Service criteria for a Class 1 Two-Lane Highway from the Highway Capacity Manual 2010*

31 Roads and Maritime Services 2010, *Network Performance Measures and Network Planning Targets,* Sydney, p. 41

32 *AUSTROADS* 2009, Guide to Traffic Management Part 3, p. 28 and p.38

Roads and Maritime Services Network Performance Measures and Network Planning Targets[33] recommend an overtaking lane should be provided at locations where 65 percent of time is spent following other vehicles or the level of service is 'C' or lower.

Rural – level of service

The LOS along the Golden Highway corridor has been modelled using the TRARR (Traffic on Rural Roads) model for the AM and PM peaks, by direction (eastbound and westbound) for 2015, 2025 and 2035. The LOS is best at the western end of the corridor towards Dubbo where traffic volumes are lower and the terrain is flatter. Percent time following is higher (and average speeds are lower) at the eastern end of the corridor between the New England Highway and Denman Road. Over this section, the modelled percent time following varies from 45 percent to 82 percent, whilst average travel speeds vary from 71 km/ hr to 82 km/ hr. This reduced performance is attributable to the impact of coal mining related traffic, particularly commuter traffic associated with the start and end of shifts, but also due to the undulating terrain between Jerrys Plains and Denman Road.

There is also significant queuing during peak hours (typically 5:45 am – 6:45 am and 3:45 pm – 4:45 pm) at the New England Highway intersection at Belford and at Putty Road (E) at Mount Thorley, with queues often extending more than 500 m during peak hours, blocking access to the abattoirs on Old North Road. Modelled level of service analysis on the rural sections is presented in Table 5.12 for the AM and PM peak hours. Where no discernible AM or PM peak occurred, modelling was only undertaken for a single peak (typically during the middle of the day on western sections of the Golden Highway).

Golden Highway near Winery Hill

33 Roads and Maritime Services 2010, *Network Performance Measures and Network Planning Targets*, Sydney, p. 42

Overtaking opportunities and level of service

Providing overtaking lanes and other opportunities to pass slower vehicles improves travel time and the Level of Service (LoS). In addition, overtaking opportunities reduce driver frustration and unsafe behaviour, reducing the risk and incidence of road trauma. Overtaking on the opposite side of the road is permitted in NSW on undivided roads where there is a broken centre line, adjacent to the direction of travel.

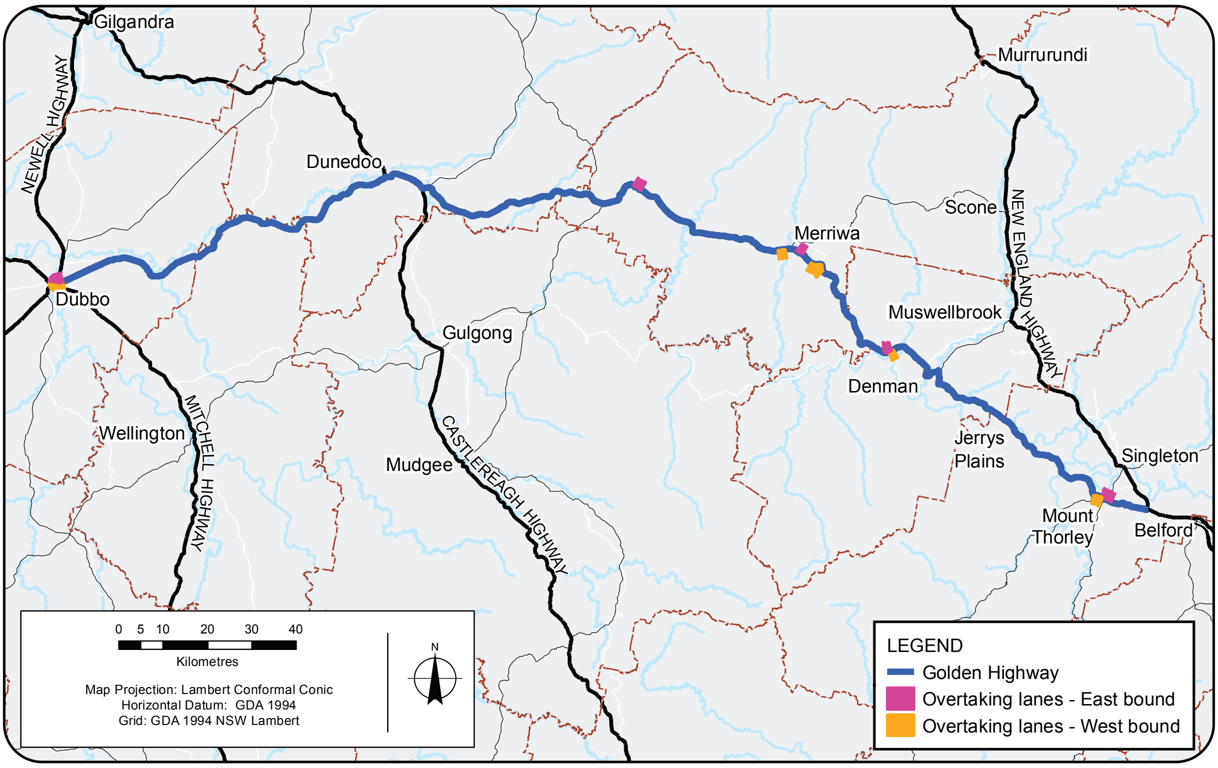
There is currently only a limited number of overtaking lanes provided along the Golden Highway. Excluding four lane sections in Dubbo, there are only four westbound overtaking lanes and five eastbound overtaking lanes. The eastbound overtaking lanes are located between Broke Road and Putty Road (E), Mount Thorley (780m), west of Reedy Creek Road, Hollydeen (1.21km), east of Merriwa (1.62km), east of Cassilis Road, Cassilis (2.27km), and east of Black Stump Way, Leadville (320m). The westbound overtaking lanes are located east of the Mount Thorley interchange (1.55km), west of Reedy Creek Road, Hollydeen (1.28km), east of Merriwa (3.18km) and west of Cullingral Road, Merriwa (810m). In addition to this there is 790m of four lane road within Dubbo.

In summary, overtaking lanes are provided for only 2.3% of the corridor, including the four lane sections within Dubbo. The average distance between overtaking lanes is 51.1km eastbound and 61km westbound.

From Table 5.11, the warrant for overtaking lanes and/or climbing lanes is highest between the New England Highway and Denman, where LOS D is exhibited. The Golden Highway west of Denman is generally expected to perform in a satisfactory manner over the medium to long term, except for sections of steep grades where heavy vehicle performance is affected. As such, planning for overtaking lanes and/or climbing lanes is recommended to be prioritised between the New England Highway and Denman.

The lack of overtaking opportunities at the eastern end of the corridor contributes to localised congestion. The provision of overtaking opportunities between Belford and Denman is a high priority, due to the higher traffic volumes and undulating terrain on these sections. There are no overtaking lanes between the section immediately to the west of Merriwa and on the eastern approach to Dubbo.

Figure 5.8 Existing eastbound and westbound overtaking lanes



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Data source: Geoscience Australia, 250K Topographic Data Series 3.

Priority locations for overtaking lanes include east of Putty Road (E), Winery Hill east of Edderton Road and Ogilvies Hill west of Edderton Road, Jerrys Plains (climbing lanes). Ogilvies Hill is also regularly affected by broken down or jack-knifed heavy vehicles.

Travel Time

Travel time surveys by direction (eastbound and westbound) for heavy vehicles along the Golden Highway was undertaken between Mount Thorley and west of Merriwa in September 2014 to assess the impact of rolling terrain on heavy vehicle performance. Average speeds for heavy vehicles (by vehicle class) were measured using vehicle mounted GPS data loggers, and are shown in Table 5.13.

Table 5.13 Average travel speeds for heavy vehicles by direction along the Golden Highway (km/hr) by vehicle type

Section (east to west)	Direction	Rigid	Semi-trailer	B-Doubles	Comment
Coolmore Stud Access to Edderton Rd (2.31km)	Eastbound	90.52 (3)	94.67 (6)	86.54 (9)	-
	Westbound	74.71 (11)	68.20 (18)	63.76 (14)	Steep grades (12%) at Hollydene (Winery) Hill
Edderton Rd to Woodlands Rd (3.75km)	Eastbound	81.96 (3)	79.34 (7)	80.15 (9)	Steep grades (7%) east of Woodlands
	Westbound	93.13 (11)	88.79 (18)	85.68 (14)	-
Quarry Access to Duggans Rd (3.97km)	Eastbound	60.84 (3)	72.90 (7)	75.07 (9)	Steep grades (12%) at Ogilvies Hill
	Westbound	80.61 (11)	70.54 (17)	63.40 (13)	
Denman Rd to Mangoola Rd (5.49km)	Eastbound	71.42 (3)	65.56 (7)	79.79 (9)	Includes Denman township
	Westbound	68.26 (9)	62.36 (14)	66.53 (13)	
Mangoola Rd to Bylong Valley Way (12.65km)	Eastbound	94.45 (3)	92.63 (8)	86.66 (10)	-
	Westbound	86.74 (8)	86.07 (15)	81.67 (10)	Steep grades (9%) at Pikes Gap
Bylong Valley Way to Dunblane Rd (24.26km)	Eastbound	82.85 (4)	83.67 (8)	79.85 (10)	-
	Westbound	72.83 (6)	73.46 (11)	83.30 (5)	Steep grades (9%) east of Merriwa
Dunblane Rd to Vennacher St (11.76km)	Eastbound	82.18 (2)	77.21 (5)	73.03 (11)	Includes Merriwa township
	Westbound	79.50 (3)	72.06 (9)	69.16 (14)	
Vennacher St to Pembroke Rd (26.41km)	Eastbound	85.20 (2)	83.46 (7)	79.79 (11)	-
	Westbound	75.01 (2)	78.95 (9)	72.57 (12)	Steep grades (9%) west of Merriwa
Pembroke Rd to Cassilis Rd (15.14km)	Eastbound	90.57 (2)	83.18 (8)	87.89 (12)	Steep grades (7%) east of Cassilis Road
	Westbound	85.21 (2)	82.97 (9)	75.92 (11)	-
Cassilis Rd to Ulan Rd (8.68km)	Eastbound	98.43 (2)	92.38 (8)	93.51 (12)	Steep grades (7%) west of Cassilis Road
	Westbound	89.54 (3)	85.24 (9)	79.38 (12)	
Ulan Rd to Vinegaroy Rd (3.80km)	Eastbound	99.86 (2)	99.42 (8)	98.98 (12)	-
	Westbound	86.83 (3)	70.40 (8)	71.80 (11)	Steep grades in the vicinity of Ulan Road

Note: ( ) vehicle sample size included in brackets

From Table 5.13, there are a significant number of sections on the Golden Highway where steep grades (steeper than 6%) impact heavy vehicle performance, particularly in the westbound direction. Constructing additional climbing lanes on these steep grades will reduce localised platooning, and provide additional overtaking capacity along the Golden Highway.

B-Double heavy vehicle on Ogilvies Hill

Incident management

Traffic incident management refers to the delivery of planning and operational tasks by the responsible road authority in response to a planned or unplanned incident. This is achieved through collaboration with emergency services and other key stakeholders to facilitate effective management of incidents for road users, the road network and infrastructure.

An Incident Response Plan (IRP) has been developed for the Golden Highway east of Ulan Road to minimise the impact of any road closures and to reduce the risk of secondary incidents. IRPs can be used to deal with extended disruptions as a result of a motor vehicle crash, bushfire or flooding. The IRP that has been developed for the Golden Highway covers closures at various locations along the corridor between Ulan Road at Cassilis and the New England Highway at Belford.

For highway closures associated with flooding of the Talbragar River near Uarbry village, the designated route is via the Mitchell Highway to Goolma Road at Wellington, via Goolma Road to Cope Road at Gulgong, via Cope Road to Ulan Road at Ulan, and via Ulan Road to the Golden Highway at Cassilis. There are other options in this area such as the Castlereagh Highway (E) and Cobbora Road. A formal IRP is required to be completed for the Golden Highway for the section west of the Talbragar River.

IRPs are designed to support a total closure of the corridor as needed. They define the agreed diversion route and the roles and responsibilities of the agencies involved. The IRPs also incorporate a unique signposting approach that guides motorists along the diversion route until they reach permanent signs to their destination.

The length of additional distance added to the existing route for detours within this IRP ranges from 7 to 300 kilometres, with the average being between 30 and 65 kilometres, depending on the section of the corridor (see Table 5.14 and Figure 5.9).

Table 5.14 Incident management detour lengths

Detour	Average length	Shortest detour	Longest detour
Belford to Mt Thorley	24 km	9 km	43 km
Mt Thorley to Warkworth	22 km	14 km	30 km
Wallaby Scrub Rd to Comleroi Rd, Warkworth	6 km	6 km	6 km
Warkworth to Jerrys Plains	54 km	27 km	75 km
Jerrys Plains to Denman	32 km	27 km	37 km
Denman to Sandy Hollow	37 km	6 km	62 km
Sandy Hollow to Merriwa	122 km	122 km	122 km
Merriwa to Cassilis	307 km	307 km	307 km
Cassilis to Dubbo	145 km	145 km	145 km

The Golden Highway is the primary diversion route in the event of an incident requiring closure of the New England Highway in the Upper Hunter. The Golden Highway also provides an alternate route to the Central West during closures of the Great Western Highway and Bells Line of Road, such as during major bushfires in the Blue Mountains.

There are currently no permanent variable message signs (VMS) along the Golden Highway. As the importance of the Golden Highway increases due to freight and vehicle movements, Roads and Maritime should consider the role and benefit of installing new VMS at strategic locations along the highway to improve the dissemination of information to road users. Any new VMS along the Golden Highway would need to be cost effective in terms of the benefits they provide to motorists versus the costs of installation and maintenance. Other options for communicating incidents and detour routes to motorists include SMS, broadcasts to trucking fleets, internet and print media.

Regional centres and town bypasses

The need for town bypasses on the Golden Highway has been assessed using the principles set out in the *NSW Long Term Transport Master Plan*. This included consideration of road hierarchy classification of the State Road Network, where higher-order roads carry higher levels of through-traffic and generate greater benefits, than those where through-traffic is much lower. The approach in the *NSW Long Term Transport Master Plan* is aimed to provide a bypass on higher order roads adjacent to significant commercial activity (shops and businesses).

In terms of traffic efficiency and road safety, the impact of existing traffic volumes on towns relating to inter-regional traffic is small, however a small number of concerns have been raised, notably in Sandy Hollow where the local school fronting the highway has interaction with heavy vehicles stopping and using the service station.

The Golden Highway currently bypasses the main commercial centre of Denman. At the western end of the corridor heavy vehicles enter the urban centre of Dubbo interacting with other users of the corridor, although Boothenba Road provides a bypass of the Dubbo urban centre for heavy vehicles whilst also providing a direct alternate access to the logistics/industrial precinct in Dubbo and a bypass to the Newell Highway.

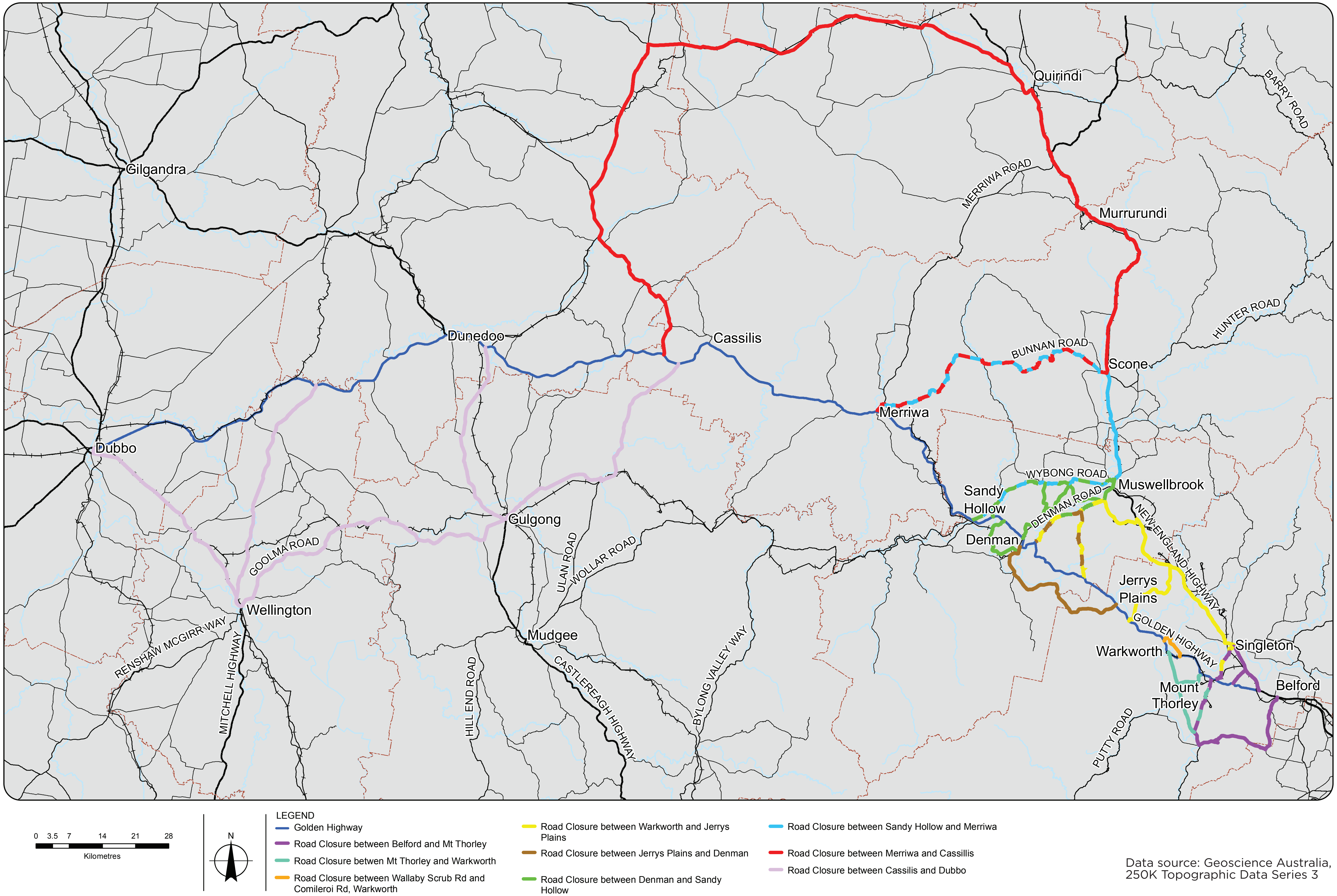
The NSW Government acknowledges that the Dubbo City Council has endorsed the *Dubbo's Road Transportation Strategy to 2045* in 2012. The strategy identifies council's desire to implement a ring road (or Freightway) around the city of Dubbo in a staged manner over a 30 year period (2016 to 2046), which would intersect with all major highways entering the city, but also provide a sub-arterial and distributor function to Dubbo's existing road network. With respect to the Golden Highway, Dubbo City Council has identified an extension of Purvis Lane as an alternate freight corridor for the Golden Highway, which would provide access to the industrial areas in the vicinity of Yarrandale Road, but also access to the Newell Highway. Roads and Maritime Services will work with Dubbo City Council to examine the justification, viability and timing of these road proposals.

Roads and Maritime and TfNSW will continue to liaise with local government, and continue to monitor the safety and efficiency of the Golden Highway through each town along the corridor.

Summary of traffic issues

Traffic volumes are highest east of Denman and in the Dubbo urban area. The lack of overtaking lanes and steep grades causes localised queuing. Overtaking lanes are recommended in the short-term between the New England Highway and Mt Thorley, whilst climbing lanes are recommended in the short-term at Winery Hill and Ogilvies Hill. A program of climbing lanes is also recommended for delivery in the medium and long term, to provide climbing lanes at all locations where heavy vehicle performance is affected.

Figure 5.9 Detour routes for incident management



Data source: Geoscience Australia, 250K Topographic Data Series 3

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5.3 Heavy vehicles on the Golden Highway

Freight productivity is affected by the type of vehicles allowed on a road, the access they are provided and the regulatory, safety and asset management costs of that access. Consequently, Transport for NSW and Roads and Maritime Services manage all these aspects of heavy vehicle productivity, providing dedicated resources to:

- Assess access requests for restricted vehicles on the network.
- Meet heavy vehicle driver needs.
- Improve safety.
- Enforce heavy vehicle road regulations.

Following commencement of the National Heavy Vehicle Law (in NSW the *Heavy Vehicle National Law (NSW)*), which creates a nationally consistent legislative framework for Australia's heavy vehicle industry, the National Heavy Vehicle Regulator (NHVR) has been established as a new national one stop shop for heavy vehicle access applications. The NHVR will consider requests for access and liaise with road managers, including Roads and Maritime Services and local councils, to grant access.

The Golden Highway is an important freight corridor as the only east-west HML B-Double route between Sydney and the Upper Hunter. Fertiliser is transported from the Port of Newcastle west along the corridor, grain is transported along the corridor to the Port of Newcastle, livestock and bloodstock between the Central West and Newcastle, mining equipment and fuel is moved to and from mines at the eastern end of the corridor and in the Ulan area, and wine is transported from the Upper Hunter to Newcastle.

Freight is projected to nearly double over the next two decades, with most of the additional freight on the Golden Highway corridor expected to be carried by road or rail in the eastern part of the corridor[34]. This is discussed in more detail in Chapter 6.

Heavy vehicle types and productivity

In NSW heavy vehicles are categorised as 'general access' and 'restricted access' depending on the mass, dimensions and configuration.

General access vehicles, which can travel on all roads in the NSW network, are vehicles up to and including the allowable mass for a conventional 19 metre semi-trailer – this includes 19 metre long B-doubles not greater than 4.3 metres high (including its load) and carrying less than 50 tonnes.

Vehicles larger than those currently permitted to operate on any particular road are known as Higher Productivity Vehicles (HPV). HPVs include:

- Restricted Access Vehicles (RAV), which is a general term for all vehicles whose length, width, height or mass is greater than that of a standard 19 metre semi-trailer.
- Higher Mass Limit (HML) vehicles, which are a subset of RAVs that can carry more mass than the general access limit and meet a number of requirements, such as road friendly suspension and enrolment in the Intelligent Access Program.
- Oversize and/or overmass (OSOM) vehicles, which are a subset of RAVs that have a height, length, rear overhang, forward projection or mass exceeding statutory dimensions or mass limits. OSOM loads are commonly large indivisible items, special purpose vehicles (e.g. cranes) or agricultural machines/implements.
-

34 Bureau of Infrastructure, Transport and Regional Economics 2011, *Truck Productivity: Sources, Trends and Future Prospects*, BITRE, Canberra, p.iii.

A more productive movement of freight can be achieved, with fewer vehicle movements, through the use of vehicles carrying greater loads. Vehicles that are generally considered to be 'High Productivity Vehicles' are those that are larger than a B-double operating at HML (e.g. B-triple, A-double). These vehicles, as well as B-doubles, have restricted access to the network and can operate under the Performance Based Standards (PBS) scheme or the Restricted Access Vehicle (RAV) system.

The Performance-Based Standards (PBS) scheme offers the heavy vehicle industry the potential to achieve higher productivity and safety through innovative and optimised vehicle design to handle the freight task. PBS vehicles are designed to perform their tasks as productively, safely and as sustainably as possible, and to operate on networks that are appropriate for their level of performance. The shift to the use of PBS vehicles in the future should benefit road managers and the community through enhanced safety associated with these modern vehicles and fewer truck movements on the road network for a given freight task.

The PBS road network has been classified into four levels:

- Level 1: Similar to General access
- Level 2: Similar to B-double routes
- Level 3: Similar to Double (Type I) road train routes
- Level 4: Similar to Triple (Type II) road train routes

Enabling access for higher productivity vehicles

Despite the ability of High Productivity Vehicles to enhance the productive use of the road network, their access to some key parts of the network, including the Golden Highway, is currently restricted. This restriction can be attributed to insufficient infrastructure to support HPV access, such as bridges that cannot support heavier vehicles, or roads that are not wide enough to accommodate longer vehicles when turning. Currently the largest vehicle permitted to operate on the Golden Highway without a special permit is a HML 26 metre B-Double.

The vision for the Golden Highway is to enable access for Performance Base Standards (PBS) Class 2B heavy vehicles of up to 30 m in length in the short term, following completion of enabling works including overtaking lanes, heavy vehicle inspection sites, flood immunity works, truck parking bays, upgrade of the Denman level crossing, enhanced delineation of narrow bridges, and the grade seperation of the New England Highway.

Table 5.15 Maximum lengths for PBS vehicles

Vehicle Performance level	Network access by vehicle length, L (m) Class 'A'	Class 'B'	Comparable prescriptive vehicle for Class 'A'
Level 1	L ≤ 20 (General access*)		Semi-trailer
Level 2	L ≤ 26	L ≤ 30	B-double
Level 3	L ≤ 36.5	L ≤ 42	Type 1 road train
Level 4	L ≤ 53.5	L ≤ 60	Type 2 road train

**General Access is subject to a 50.5 tonne gross mass limit, posted local restrictions and restrictions or limitations specified by the road authority.*

Point-to-point speed enforcement

Point-to-point speed enforcement was introduced to enforce heavy vehicle speeds in NSW. Point-to-point technology can enforce speed limits over long stretches of road. It is on these longer stretches that heavy vehicle speeding is of greatest concern. Heavy vehicles make up only three percent of vehicle registrations, and seven percent of kilometres travelled by NSW vehicles. However, they are involved in almost 20 percent of road fatalities. Research by the National Transport Council has suggested that there would be a 29 percent reduction in heavy vehicle crashes if all heavy vehicles complied with speed limits. Sites are selected based on criteria including the frequency of heavy vehicle crashes, heavy vehicle speeds and road conditions. Heavy vehicles constitute 12 percent of vehicles at the eastern end of the corridor, increasing to 17 percent west of Merriwa and 21 percent west of Dunedoo. In Dubbo the percentage of heavy vehicles declines as light vehicle traffic increases and some heavy vehicles divert to Boothenba Road.

There is one point-to-point enforcement area on the Golden Highway (Figure 5.10), which includes two camera installations:

- 1.3 km west of Giants Creek Road, Sandy Hollow.
- 2.2 km east of Prices Lane, Merriwa (enforcement length is 27.4 kilometres).

Point to point camera on the Golden Highway west of Sandy Hollow

Safe-T-Cam network

The Safe-T-Cam program is an initiative that aims to reduce the risk associated with heavy vehicle driver fatigue in an effort to prevent heavy vehicle crashes. The Safe-T-Cam system is an automated monitoring system that uses digital camera technology to read heavy vehicles' number plates to enable Roads and Maritime Services to monitor heavy vehicle movements.

Safe-T-Cam detects and provides data on heavy vehicle incidents relating to:

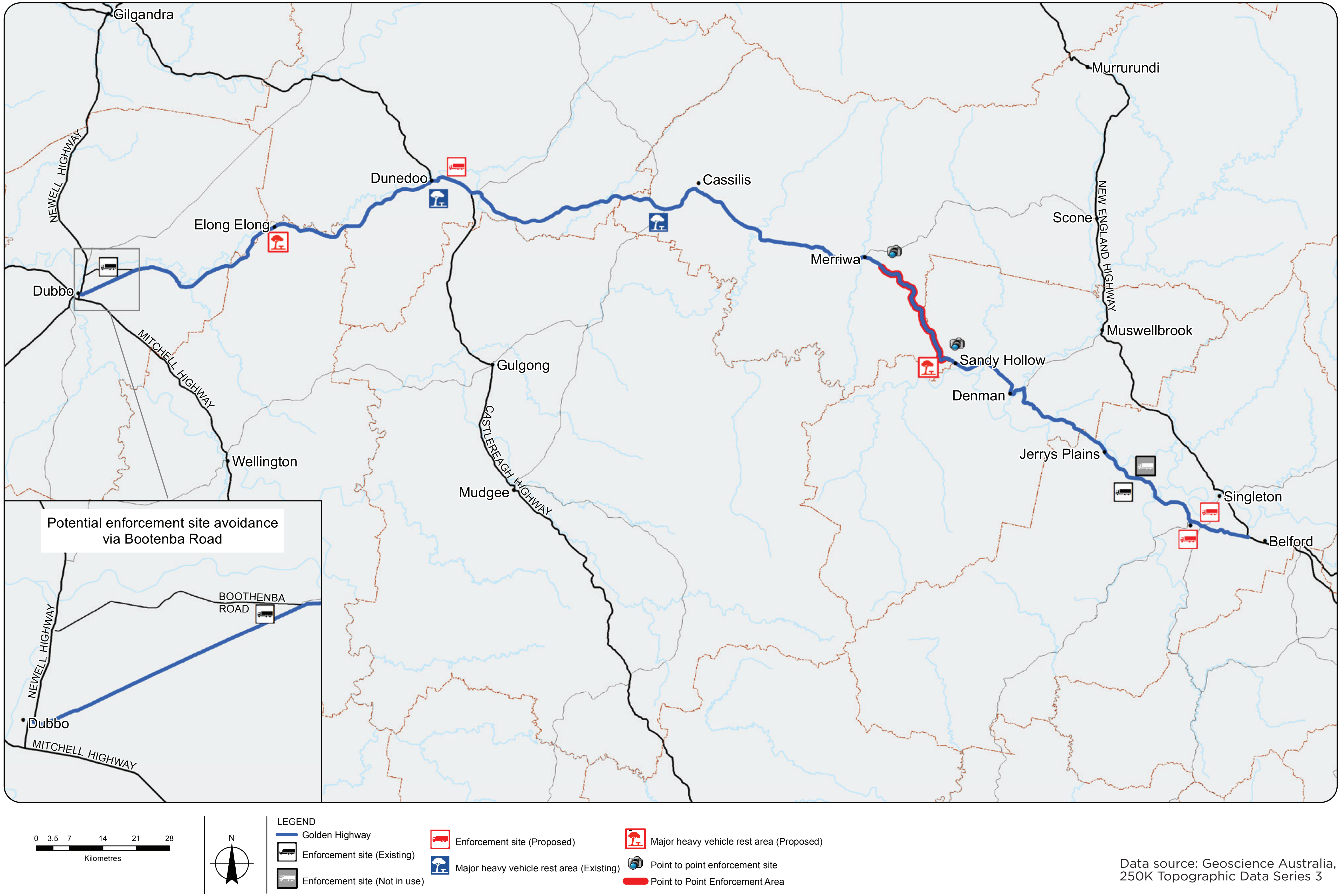
- Failure to comply with fatigue legislation
- Registration
- Failure to enter Heavy Vehicle Checking Station

The broad objectives of the Safe-T-Cam program are to:

- Improve road safety by reducing the incidence of heavy vehicle crashes and changing driver and operator behaviour in relation to travel time (driver fatigue).
- Promote compliance with enforcement systems by detecting incidents of heavy vehicle avoidance behaviours.
- Identify unregistered heavy vehicles operating on NSW roads and enforce vehicle registration regulations.
- Improve the efficiency of Roads and Maritime Services' enforcement strategies by establishing improved intelligence of vehicle movements.
- Improve traffic management by generating accurate information on heavy vehicle movements throughout NSW.

The Safe-T-Cam network consists of 24 sites located on major routes throughout NSW, clearly marked with roadside signage. Although there are no Safe-T-Cam sites along the Golden Highway, the Safe-T-Cam sites located on the New England Highway at Branxton, and the Newell Highway at Coonabarabran, south of Tomingley or Nyngan, would monitor heavy vehicle movements that travel along the Golden Highway between these sites. The warrant for a Safe-T-Cam site on the Golden Highway should be monitored for the medium to long term.

Figure 5.10 Point-to-point enforcement sites and rest areas



Data source: Geoscience Australia, 250K Topographic Data Series 3

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Heavy vehicle inspection sites at Warkworth

Heavy vehicle enforcement sites

Heavy vehicle road enforcement sites are part of the Roads and Maritime Services heavy vehicle enforcement program, which includes mobile enforcement and the Safe-T-Cam network across NSW. Roads and Maritime Services uses heavy vehicle enforcement sites to intercept and inspect heavy vehicles which may be operating illegally or in an unsafe manner on NSW roads and which therefore pose significant risk to road users, the road infrastructure and the environment.

Currently there is one westbound and two eastbound heavy vehicle enforcement sites along the Golden Highway (See Figure 5.10). There is a need to relocate the existing heavy vehicle enforcement site west of Boothenba Road which can be bypassed by heavy vehicles using Boothenba Road as an alternative access into Dubbo. A site between the northern and southern legs of the Castlereagh Highway east of Dunedoo would allow the inspection of Castlereagh Highway traffic in addition to Golden Highway traffic. The site at Warkworth (4.6 km west of Comleroi Road) should be relocated to the east at Mount Thorley, or on the New England Highway south of the Golden Highway intersection.

The existing enforcement sites are also of insufficient size to accommodate multiple large heavy vehicles and are lacking facilities for inspectors. The eastbound Warkworth site is near a crest where there is poor sight distance at the access points, creating a safety risk. For this reason, this enforcement site is no longer used.

Any new enforcement site needs to be designed to accommodate PBS Class 2B vehicles of up to 30 m in length, as well as all OSOM vehicles.

Heavy vehicle rest areas

In moving freight by road, heavy vehicle operators are often required to drive for extended periods of time. Fatigue is a recognised workplace safety issue for many truck drivers. Heavy vehicle driver fatigue has been identified as a contributor to road crashes and presents a safety risk to all road users.

Rest areas enable heavy vehicle operators to meet their legislated rest breaks under fatigue legislation, which states that:

> *"A person must not drive a regulated heavy vehicle on a road or road related area while he or she is impaired by fatigue".*[35]

Better trip planning can help avoid driver fatigue. Rest areas and stopping bays need to be strategically located and signposted.

Major rest areas

In 2005, the National Transport Commission released the National Guidelines for the Provision of Rest Area Facilities with guidelines for three categories of rest areas, including major rest areas:

> *"Major rest areas - designed for long rest breaks, offering a range of facilities and separate parking areas for heavy and light vehicles where possible".*[36]

In 2010, Roads and Maritime Services published a strategy for Major Heavy Vehicle Rest Areas on Key Rural Freight Routes in NSW[37], which outlines requirements major rest areas must meet, in response to NSW fatigue management legislation.

As a minimum, major heavy vehicle rest areas should:

- Be generally located at 100 km intervals. While geographical and other physical constraints may require the interval range to be between 80 and 120 km, the maximum limit should be 120 km.
- Provide sites on both sides of the road on parts of the network with high demand.
- Be well signposted for heavy vehicle drivers and have suitable access for ingress and egress.
- Provide designated hard stand parking for heavy vehicles and an appropriate number of parking spaces in line with demand.
- Meet the basic needs of heavy vehicle drivers, including provision of sealed pavements particularly for ingress and egress lanes and ramps, at least one toilet on each site, shaded areas, rubbish bins and tables and chairs.

There are two major heavy vehicle rest areas on the corridor (see Figure 5.10). One of these is located westbound 2.5 km east of Ulan Road at Cassilis. The other is located in Dunedoo adjacent to the railway line. A further two sites have been identified for heavy vehicle rest areas, at Sandy Hollow and in the vicinity of Elong Elong. Various other rest area upgrades, stopping bays and signage improvements have also been identified for the Golden Highway.[38]

The Heavy Vehicle Safety and Productivity Program (HVSPP) is an Australian Government initative and provides funding support (50% of project costs) to improve safety and productivity of heavy vehicle operations across Australia. Its objectives are to:

- Reduce the proportion of road crashes involving heavy vehicles by targeting heavy vehicle driver fatigue
- Increase productivity by enhancing the capacity of existing roads.

35 Road Transport (General) Regulation: under *Road Transport (General Act 2005*, clause 45 (NSW)

36 National Transport Commission, 2005, *National Guidelines for the Provision of Rest Area Facilities*, Melbourne, pg. 26

37 Roads and Maritime Services, 2010, *Roads and Maritime Services Strategy for Major Heavy Vehicle Rest Areas on Key Rural Freight Routes in NSW*, RMS, Sydney

38 Roads and Maritime Services, 2010, *Roads and Maritime Services Strategy for Major Heavy Vehicle Rest Areas on Key Rural Freight Routes in NSW*, RMS, Sydney

In February 2015 Roads and Maritime Services successfully secured $47.6 million for a program of upgrades under the HVSPP to facilitate access to the Golden Highway by high productivity vehicles (HPVs). These works include:

- Flood immunity works at Mudies and Uarbry creeks.
- Three new heavy vehicle inspection sites (an eastbound and westbound site at Mt Thorley, and a bi-directional site east of Dunedoo).
- An upgrade of the Denman level crossing to boom gates (which includes an upgrade of Mangoola Road).
- Enhanced delineation of 11 narrow bridges.
- Seven new parking bays and an upgrade to four parking bays, green reflector sites and an upgrade to rest area route signage.
- Climbing lanes at Ogilvies Hill.

In reference to the major rest areas identified by Roads and Maritime Services for enhancement in 2010 there are still a number of upgrade works outstanding. These are:

- Upgrade the Sandy Hollow rest area near the service station. Formalise the rest area by acquiring land, providing suitable access and shelter with tables/chairs and bins. Heavy vehicle operators park in this location and use the facilities provided by the nearby service station. Roads and Maritime Services is committed to formalising and enlarging this area by providing a heavy vehicle rest area.
- Upgrade the Gungal rest area by providing two toilets, predominantly for eastbound vehicles, and by planting trees for shade.
- Upgrade the Cassilis rest area by improving access for heavy vehicles, providing shade and an additional toilet.

It is expected that these works will be completed in the short-term as funding permits, with the Sandy Hollow heavy vehicle rest area a high priority.

Heavy vehicle parking on the Golden Highway at Sandy Hollow

Other heavy vehicle rest areas

The rest areas along the Golden Highway are split into three categories, with each offering different levels of facilities and functions (Table 5.16).

Table 5.16 Rest areas along the corridor

Types of rest area	Target frequency along the corridor	Compliance with the Target?
Major heavy vehicle rest areas	100 km	No. There are no major heavy vehicle rest areas east of Denman. Denman is around 100 km east of Cassilis. There are major heavy vehicle rest areas on the Hunter Expressway to the south-east.
Minor rest areas	50 km	Yes. Facilities could be improved.
Informal truck parking bays or Green reflector sites	30 km	No. Between Merriwa and Dunedoo and west of Dunedoo the number of these is below the target.

In addition to major heavy vehicle rest areas, there are 12 locations where there are minor rest areas – or 'hard stand' opportunities – for all drivers, including local traffic, light vehicles and caravans. Some of these are provided in both directions at these locations. These minor rest areas are provided through truck parking bays and informal heavy vehicle stopping areas including green reflector sites.

Informal heavy vehicle stopping areas (or Green reflector sites) also provide additional informal rest area locations on the side of the highway. Green reflectors are mounted on roadside guide posts in rural areas, providing advance notice to heavy vehicle drivers that they are approaching an informal heavy vehicle stop area.

> *"Minor Rest Areas: These areas are designed for shorter rest breaks, and at a minimum should provide sufficient parking space for both heavy and light vehicles. While it is not anticipated that these stops will be used for long rest breaks/sleep opportunities, separate parking areas for heavy and light vehicles may be required at some locations."*

> *"Truck Parking Bays: These areas are primarily designed to allow drivers of heavy vehicles to conduct short, purpose-based stops including load checks, completing logbooks and addressing associated operational needs."*[39]

The Causey Park rest area near Denman and the Battery Rock rest area near Gungal are located with poor sight distance for approaching motorists, whilst access to the Cassilis rest area could be improved. The Causey Park rest area is located close to Denman where there are existing services. It is the intention that access to Causey Park rest area be closed or relocated in consultation with Muswellbrook Shire Council. It is recommended that vehicular access to the Battery Rocks, Gungal, Cassilis and Dunedoo rest areas be upgraded in the short-term.

Towns including Jerrys Plains, Denman, Sandy Hollow, Merriwa, Dunedoo, Elong Elong and Dubbo provide services and facilities for passing motorists. Roads and Maritime will work with these local government areas to improve on road and in-town rest area facilities. The NSW Government also recognises the benefit of passing trade that motorists provide to these communities, and the opportunities to improve local tourism opportunities.

The adequacy of the major heavy vehicle rest areas in meeting driver needs will continue to be monitored and improved where necessary. The frequency of minor rest areas

39 National Transport Commission 2005, *National Guidelines for the Provision of Rest Area Facilities*, NTC, Melbourne, pg. 26

is acceptable however facilities could be improved. The frequency of informal parking areas is currently below the target and new areas will be developed in order that the above targets can be met. Informal green reflector sites (heavy vehicle parking bays) should also be provided where it is safe to do so.

Summary of heavy vehicle issues

Access for HPVs to the Golden Highway is currently restricted. Access to the Golden Highway HPVs including up to PBS Class 2B vehicles of up to 30 m in length would provide significant benefits to freight operators. These vehicles have the ability to carry two forty-foot shipping containers directly to the Port of Newcastle.

Although the application of Safe-T-Cam and point to point camera sites are limited along the Golden Highway, the increase in traffic volumes including heavy vehicle volumes should be monitored to enable an assessment of whether further deployment is justified in the medium to long term.

Horizontal curves

Curves are needed to allow motorists to negotiate the road at a gradual rate. The curve radius is dependent on the design speed, super elevation (fall of the road) and friction of the roadway. One important consideration in assessing curve radii is the sight distance provided relative to the design speed. Motorists need to be able to navigate through curves efficiently while at the same time assessing any potential danger on the roadway in enough time to avoid to avoid a crash.

The Roads and Maritime Services' Network Performance Measures and Planning Targets guideline recommends a target operating speed of 110 km/h for rural sections of the Golden Highway east of Denman Road, as it is a Class 4R asset. West of Denman Road the guideline recommends the same operating speed however a reduction is considered for vertical alignment in steep terrain as it is a Class 3R asset[40]. To allow for an operating speed of 110 km/h, the *AUSTROADS* Guide to Road Design recommends providing a minimum horizontal curve of 600 metres.[41]

5.4 Road design and geometry

Table 5.17 Corridor planning sections by curve radii for 100 km/hr speed zones

Corridor Planning Sections	Curve radii (metres) - Total length of curves in km					Total curves length (km)
	< 90 m	90-240 m	240-460 m	460-600 m	> 600 m	
1. Belford to Mt Thorley	Nil	0.13	0.12	0.28	4.35	4.9
2. Mt Thorley to Jerrys Plains	Nil	Nil	0.07	0.23	9.45	9.8
3. Jerrys Plains	Nil	Nil	0.07	0.04	2.59	2.7
4. Jerrys Plains to Denman	0.07	0.04	0.80	0.57	6.08	7.9
5. Denman	Nil	0.02	0.09	0.02	1.91	2.0
6. Denman to Merriwa	0.03	0.19	1.3	1.28	18.03	20.9
7. Merriwa	Nil	0.03	0.04	0	0.77	0.8
8. Merriwa to Dunedoo	0.08	0.15	0.71	0.89	43.57	45.4
9. Dunedoo	Nil	Nil	Nil	0.06	0.05	0.6
10. Dunedoo to Dubbo	0.07	0.01	0.32	0.58	37.9	39.5
11. Dubbo	N/A	N/A	N/A	N/A	N/A	N/A
Total (by length km)	**0.25**	**0.44**	**3.52**	**3.95**	**124.7**	**129.7**

40 Roads and Maritime Services 2010, *Network Performance Measures and Network Planning Targets*, Roads and Maritime Services, Sydney, pg. 38.

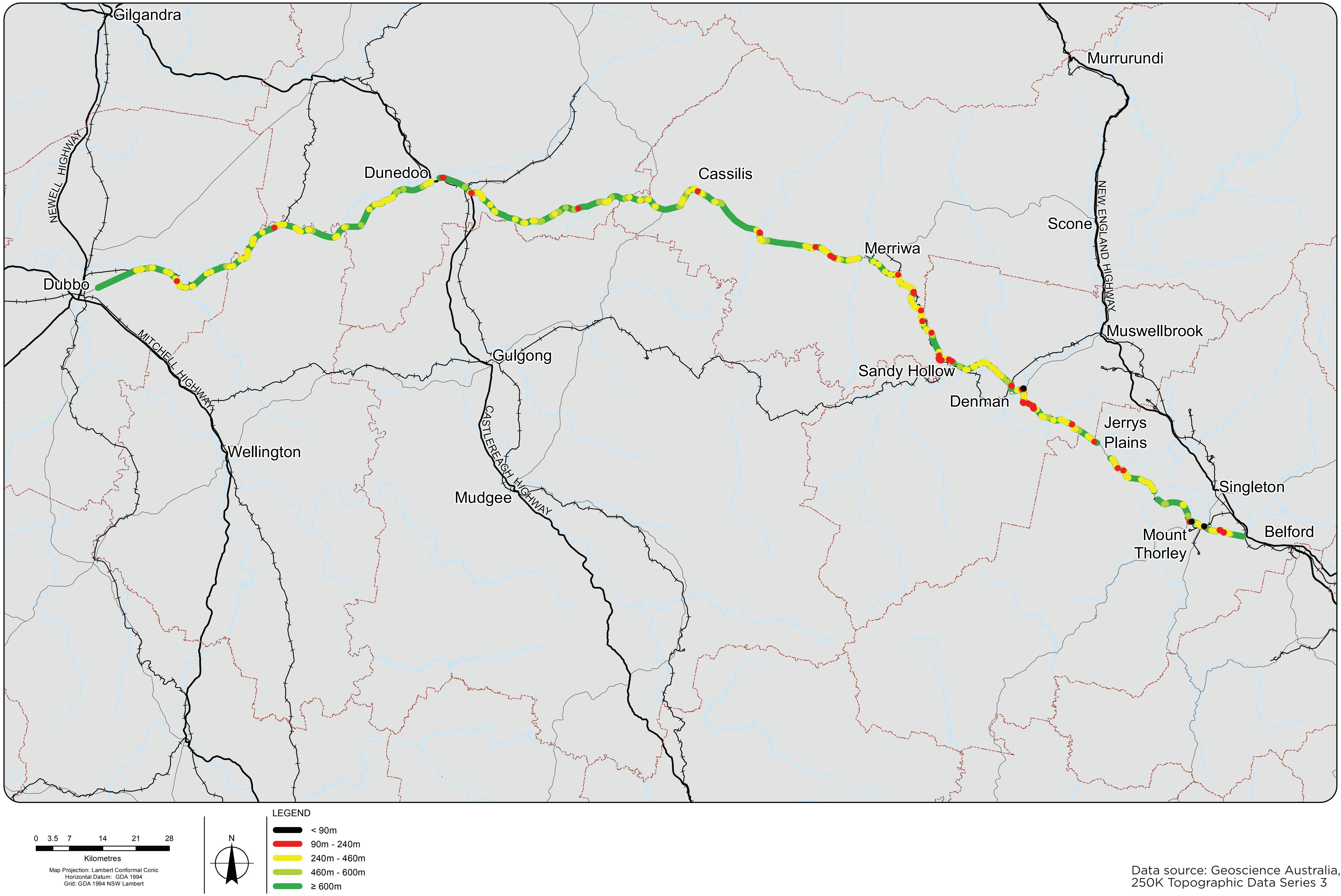
41 *AUSTROADS* 2010, *Guide to Road Design: Part 3: Geometric Design*, *AUSTROADS*, Sydney

Golden Highway near Rosemount Road

The percentage of the corridor comprising radii less than the target is 10 percent. This is favourable compared to the NSW average for rural roads of 13 percent[42]. There are a larger number of tight curves between Jerrys Plains and Merriwa and through Dunedoo. The highway is straightest in the rural sections between Merriwa and Dunedoo and between Dunedoo and Dubbo. Preliminary analysis of the road geometry has identified several sub-standard road sections including the eastern approach to Jerrys Plains. The eastern approach to the Krui River bridge (only 6.0 m in width) has a small radius curve of 315m, preceded by a long downward grade. A review of sections of poor horizontal geometry is recommended. Options for sub-standard curves may include enhanced delineation, additional shoulder sealing on the outside of sub-standard curves, vehicle activated signs on the approaches to sub-standard curves and curve realignment.

42 Levett, S 2010, *Curves, clear zones, shoulder widths on rural roads, Centre for Road Safety Internal Presentation*, RMS, Sydney

Figure 5.11 Curve Radii for 100km/h speed zone



Data source: Geoscience Australia, 250K Topographic Data Series 3

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Grades

Travel efficiency and road safety can be directly influenced by the grade of a road. Sections of road with steep uphill grades over long distances often experience 'bunches' of traffic and in turn perform less efficiently than roads without grade constraints. This is particularly relevant for roads with higher traffic volumes and with a high proportion of heavy vehicles.

In addition, roads with steep grades offer limited opportunities for overtaking, which may increase the incidence of crashes due to driver frustration. Steeper grades are particularly significant on roads where there are many heavy vehicles, because freight costs increase with fuel consumption and slower speeds. From an environmental perspective, steeper grades result in high vehicle emissions. Steeper grades may also impede motorists' ability to see any hazards ahead on the road.

As a guide, Roads and Maritime Services' Network Performance Measures and Planning Targets recommend maximum grades of 6 percent for Class 4R roads and for Class 3R roads 6 percent in flat to rolling terrain and 10 percent in steep to very steep terrain[43]. The Golden Highway achieves these targets along 96.5 percent of the corridor (Table 5.18).

There are steep grades between Jerrys Plains and Denman where the highway passes through Ogilvies Hill and Winery Hill. Heavy vehicles frequently slide on Ogilvies Hill due to the grades which are in excess of 10 percent at the steepest points. In the rural sections between Denman and Merriwa and Merriwa and Dunedoo there are also some hills with steeper grades including Pikes Gap (9%), east and west of Merriwa (9%), east of the Krui River (7%), west of Cassilis Road (7%), and near Ulan Road. Through towns and west of Dunedoo the highway is relatively flat and grades are not a major concern.

Table 5.18 Target Maximum Grade

Hierarchy Class	Flat (plains)	Rolling (slopes)	Steep (tableland or coastal range)	Very Steep (pass, escarpment or ravine)
4R	6%	6%	6%	6%
3R	6%	6%	10%	10%

Table 5.19 Vertical grades total length km

Corridor Planning Sections	≤ 6% grade	> 6% grade	Total Section length (km)
1. Belford to Mt Thorley	13.17	0.23	13.4
2. Mt Thorley to Jerrys Plains	23.4	Nil	23.4
3. Jerrys Plains	10.1	Nil	10.1
4. Jerrys Plains to Denman	17.69	0.91	18.6
5. Denman	5	Nil	5
6. Denman to Merriwa	44.82	1.48	46.3
7. Merriwa	2.8	Nil	2.8
8. Merriwa to Dunedoo	100.06	2.14	102.2
9. Dunedoo	4	Nil	4
10. Dunedoo to Dubbo	85	Nil	85
11. Dubbo	4.5	Nil	4.5
Total (by length km)	**302.3**	**11**	**313.3**

Roads and Maritime will explore opportunities to provide climbing lanes on sections of steep grade such as Winery Hill and Ogilvies Hill which impact on vehicle operating speeds.

43 Roads and Maritime Services 2010, *Network Performance Measures and Network Planning Targets*, RMS, Sydney, p. 40

Golden Highway looking west towards Ogilvies Hill

Steep grades on curves

Steep grades and tight road curves can combine to increase the risk to motorists travelling on the road. This combination can obstruct how far motorists can see ahead – reducing their capability to assess potential conflict.

Table 5.20 summarises the proportions of each section of the Golden Highway corridor which have vertical grades of more than 6 percent combined with a horizontal curvature.

Steeper grades are generally on curves greater than 600 m radius with the exception of the section between Jerrys Plains and Denman where steep grades and tight curves are brought together on Ogilvies Hill.

In the long term road realignments will be considered should the impact of these sections on traffic and/or road safety become unacceptable and should projects be economically justifiable.

Table 5.20 Proportion of corridor planning sections with vertical grades exceeding 6% (by curve radii)

Corridor Planning Sections	Total length of curve radii km				Section length (km)
	90–240	240–460	460–600	> 600	
1. Belford to Mt Thorley		0.08	-	0.21	13.4
2. Mt Thorley to Jerrys Plains	0.03	-	-	0.03	23.4
4. Jerrys Plains to Denman	0.18	0.28	0.01	0.62	18.6
6. Denman to Merriwa	-	0.28	0.29	1.64	46.3
8. Merriwa to Dunedoo	-	0.16	-	2.6	102.2

Speed on curves

Run off road on curve crashes are overrepresented in NSW crash statistics on the rural network. To improve road safety a road with a 100km/h speed zone should have large radius curves to accommodate the speeds. There are some isolated tighter curves on the Golden Highway, in particular near Range Road at Whittingham and in the vicinity of Sandy Hollow and Gungal. The only section with a large number of tight curves located close together is the section between the town of Jerrys Plains and Denman Road, Denman. The highest proportion of small curve radii in high speed zones is between Jerrys Plains and Merriwa, including the small radius curve immediately east of the Krui River bridge.

Further work is required to investigate the suitability of existing delineation such as advisory speed and curve warning signage along the corridor. Where pavement rehabilitation works take place, widening on curves should also occur if shoulder widths are below the target for the curve radii and class of road. *AUSTROADS* design guides, Australian Standards along with Roads and Maritime Services supplements will be followed for guidance. The focus should be on curves with a radius between 200 metres and 600 metres. The majority of run off road casualty crashes occur within this radii range. It is recommended that sealed shoulders on the outside of curves are 2.5 metres, with a minimum 6 metre clear zones on straight sections and 10 metres on the outside of curves. These measures would make a significant impact in terms of reducing the number and severity of run off road crashes[44]. Where there are a large number of crashes related to a number of tight curves in specific locations, road realignments will be investigated. However, the benefits of realigning the road would need to justify the costs.

Those sections east of Merriwa where the road alignment is poorer generally have a higher number of off road crashes. Reduced travel speeds are experienced on Ogilvies Hill and in other areas west of Jerrys Plains as well as at Whittingham (west of the New England Highway) where the alignment is poorer.

Lane and bridge widths

Lane widths influence road capacity, comfort and safety. The desirable lane width on rural roads is 3.5 m, which allows large vehicles to be overtaken or overtake without the overtaking vehicle needing to move sideways towards the lane's outer edge. Wider lane widths also increase clearance between opposing vehicles and therefore have potential to reduce the incidence of head-on and 'run off road' crashes. Where lane widths are narrower, the ability of heavy vehicles to access a route can also be affected.

Roads and Maritime Services' Network Performance Measures and Planning Targets guideline recommends a minimum lane width of 3.5 m should be maintained for all sections of the Golden Highway, as it is a Class 4R road asset east of Denman Road and a Class 3R road asset with AADT exceeding 1,000 west of Denman Road.[45]

Around 46 percent of the Golden Highway has lane widths of 3.5 m or greater. Through towns, lane widths generally meet the target width, with the exception of Denman and a short section in the Dubbo urban centre. The rural sections with narrower lane widths are between the New England Highway at Belford and Mount Thorley, between Jerrys Plains and Merriwa, between Dunedoo and Mugga Downs, and to a lesser extent between Merriwa and Dunedoo (Table 5.21).

The locations and lengths of lane widths which do not meet network performance targets (see Table 5.22 and Figure 5.12) include:

- 1 km west of the Castlereagh Highway (west), Dunedoo to 1.6 km west of Muronbung Road, Gollan (48.4 km).
- Bowmans Crossing of Hunter River, Jerrys Plains to 1.4 km west of Giants Creek Road, Sandy Hollow (37.9 km of 40.4 km).
- 2.6 km west of Idaville Road, Merriwa to 1 km west of Pembroke Road, Cassilis (14.3 km).
- 500m west of Merotherie Road to 500m west of Black Stump Way, Leadville (11.1 km).

44 Levett, S. 2007, *Retro-Fitting Incremental Clear zone Widths to Existing Rural Roads*, NSW Centre for Road Safety, Sydney

45 Roads and Maritime Services 2010, Network Performance and Network Planning Targets, RMS, Sydney, p.43

- Worondi Road, Gungal to 1.3 km east of Dunblane Road, Merriwa (10.9 km).

While lane widths less than 3.5 m do not meet the performance targets, particular attention should be focused on road sections which have lane widths significantly below the performance targets – that is, less than 3.25 m road widths.

These are located at:

- 1.3 km west of Saddlers Creek, Jerrys Plains to Palace Street, Denman (35.0 km of 38.3 km).
- 24.2% of the Golden Highway between Dunedoo and Dubbo currently has lane widths of between 3.0 and 3.25 m, below the desirable lane width of 3.5 m.

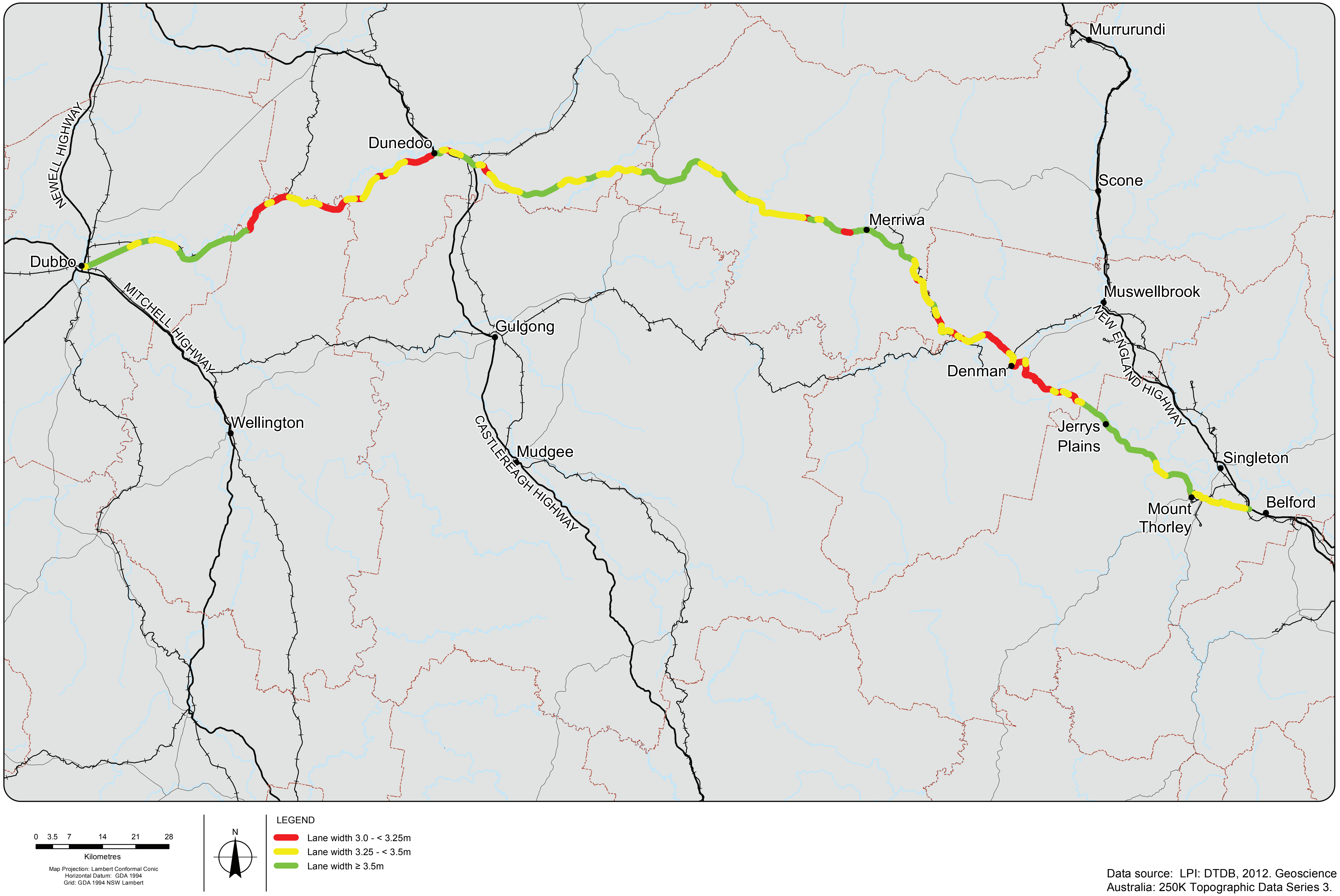
There is one short section of the Golden Highway with lane widths of only 3 m located 2.6km west of Idaville Road to 2.3 km east of Glenroy Road, Merriwa (1.4 km).

The locations where the lane width is significantly below the target are detailed in Table 5.21 and Figure 5.12.

Table 5.21 Lane widths total length km

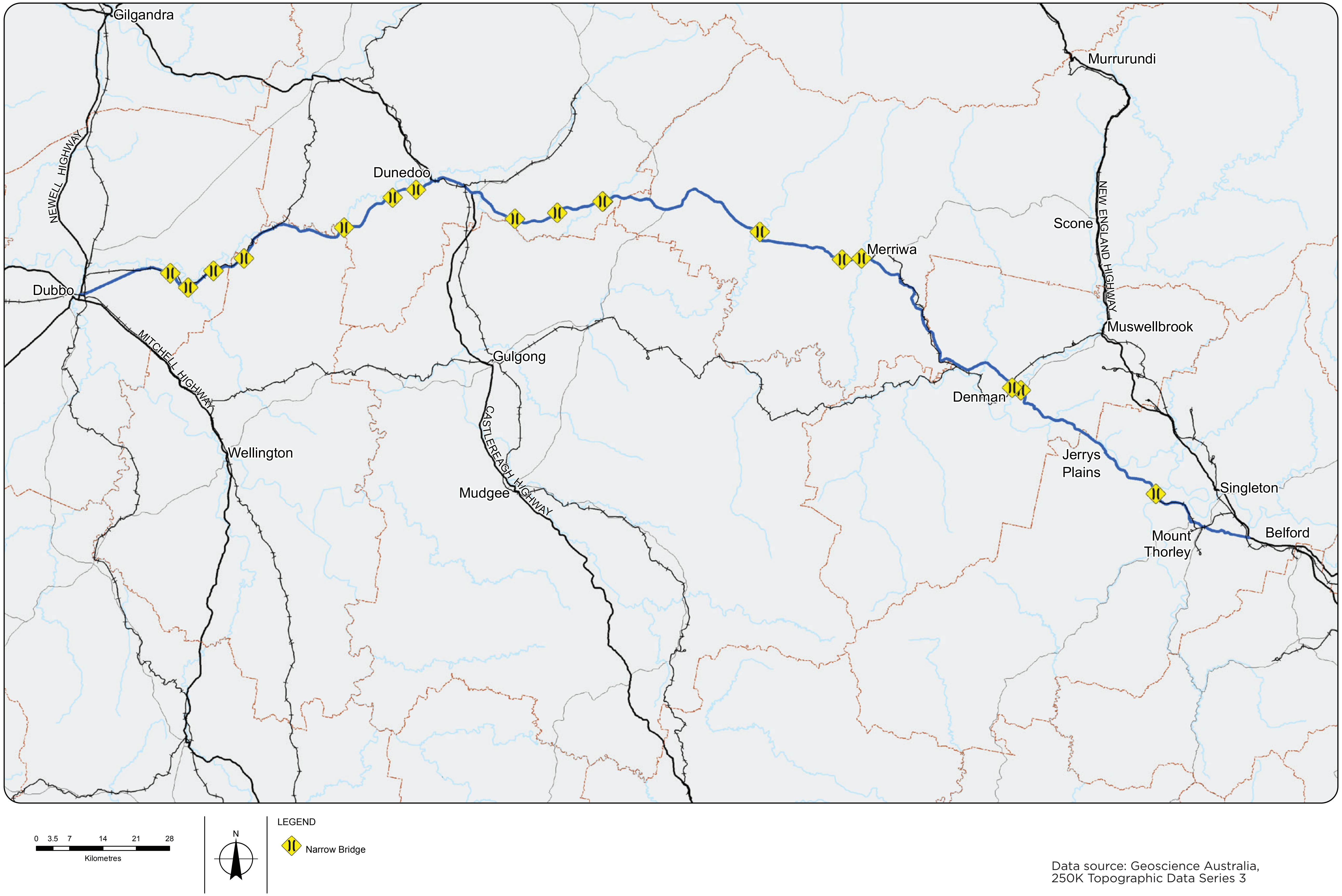
Corridor Planning Sections	Performance target	3.0 –<3.25 m	3.25 – <3.5 m	≥ 3.5 m	Section Length (km)
1. Belford to Mt Thorley	≥ 3.5 m	0.1	9.7	3.6	13.4
2. Mt Thorley to Jerrys Plains	≥ 3.5 m	0.1	3.7	19.7	23.4
3. Jerrys Plains	≥ 3.5 m	-	-	10.1	10.1
4. Jerrys Plains to Denman	≥ 3.5 m	13.9	3.8	30.9	18.6
5. Denman	≥ 3.5 m	2.6	1.8	0.7	5.0
6. Denman to Merriwa	≥ 3.5 m	13.3	18.3	14.6	46.3
7. Merriwa	≥ 3.5 m	-	-	2.8	2.8
8. Merriwa to Dunedoo	≥ 3.5 m	4.8	44.2	53.2	102.2
9. Dunedoo	≥ 3.5 m	0.4	0.8	2.8	4.0
10. Dunedoo to Dubbo	≥ 3.5 m	20.1	34.8	28.1	83
11. Dubbo	≥ 3.5 m	-	0.4	4.1	4.5
Total (by length km)	**≥ 3.5 m**	**55.1**	**117.5**	**140.7**	**313.3**

Figure 5.12 Locations where lane widths are less than 3.5 metres



Data source: LPI: DTDB, 2012. Geoscience Australia: 250K Topographic Data Series 3.

Figure 5.13 Locations of narrow bridge and bridge sized culverts



Data source: Geoscience Australia, 250K Topographic Data Series 3

Bridge widths are also a significant factor, because they are generally the narrowest point along any route. The *Performance Based Standards Scheme Network Guidelines*[46] recommend a minimum width of 8.4 metres for bridges when the AADT is greater than 500 vehicles. There are 16 bridges and three bridge sized culverts that are below the minimum width recommended (see Table 5.22 and Figure 5.13).

The PBS Guidelines recommend that:

"A visual inspection and risk assessment should be undertaken for bridges not providing the recommended widths considering:

- *Bridge approach sight distance*
- *Ability of drivers on a bridge approach to see vehicles on the opposing approach*
- *Willingness of drivers to adjust trajectory or entry onto a bridge to accommodate the width needs of large vehicles."*[47]

Appropriate bridge widths need to be increased on curved approaches. These assessments will guide access provided to PBS Class 2B vehicles. Where access cannot be provided narrow bridges may need to be widened.

Table 5.22 Narrow Bridges and Culverts less than 8.4 metres wide

Bridge Number	Description	Width
1585	Cockfighter Bridge over Wollombi Brook – 1.24 km west of Wallaby Scrub Road, Warkworth	7.8 m
1575	Steel truss bridge over Hunter River – 2.57 km east of Denman	7.9 m
10256	Culvert across unnamed creek – 0.03 km west of Denman	7.0 m
3629	Bridge over Merriwa River (Smith's Rivulet) - 0.85 km west of Merriwa	8.0 m
3630	Culvert across Farm Springs Creek – 5.14 km west of Merriwa	8.0 m
3637	Collaroy Bridge over Krui River – 25.08 km west of Merriwa	6.0 m
6852	Bridge over Talbragar River, Uarbry – 40.48 km east of Dunedoo	7.4 m
6853	Piper Bridge over Talbragar River, Uarbry – 40.35 km east of Dunedoo	7.4 m
1115	Denis McGrath Bridge over Cainbil Creek, Leadville – 29.98 km east of Dunedoo	7.4 m
1144	Bridge over Limestone Creek – 4.78 km west of Dunedoo	7.4 m
1147	Bridge over Tucklan Creek – 10.40 km west of Dunedoo	7.4 m
4397	Bridge over Sandy Creek, Dunedoo – 16.60 km east of Elong Elong	7.7 m
4402	Bridge over Spicers Creek, Gollan – 41.03 km east of Dubbo	7.4 m
4405	Bridge over Ballimore Creek, Ballimore – 33.84 km east of Dubbo	7.4 m
4407	Bridge over Mitchells Creek, Ballimore – 27.36 km east of Dubbo	7.4 m
4409	Bridge over Plain Creek, Beni – 22.12 km east of Dubbo	8.3 m

46 National Transport Commission 2007, *http://www.ntc.gov.au/filemedia/Reports/PBSSchemeNetwkClassifGLinesOct07.pdf*

47 National Transport Commission 2007, *Performance Based Standards Scheme Network Classification Guidelines*, NTC, p. 8

It is likely that replacing narrow bridges would be more economically feasible than incrementally widening them. However this would be costly and may be difficult to justify in many instances. The delineation of many of these bridges could be improved significantly to help improve their visibility and safety.

Road narrowing at the Halls Creek bridge on the Golden Highway

The bridge over the Krui River is 6 m wide, providing 2.8 m travel lanes in each direction, narrower than the recommended minimum width of 8.4 m. In the short-term improvements such as enhanced delineation (including vehicle activated signs), and a reduced heavy vehicle speed limit should be undertaken. It is also recommended that a separate investigation commence to assess potential improvements such as bridge widening or replacement.

Sealed shoulder widths

Sealed shoulder widths are the portion of the road that extend outside the marked traffic lanes. Pavements with shoulder treatments last longer than road sections without it. Sealed shoulder treatments improve the pavement structure and reduce moisture levels. Sealed shoulders also provide road safety benefits, providing room which can allow a driver to correct an errant vehicle. A sealed shoulder can assist in reducing the potential likelihood and severity of a crash, and provide additional width for the provision of cyclists.

As a guide the network planning targets recommend a minimum sealed shoulder width of 2.0 metres for rural Class 4R roads and Class 3R roads with an AADT of more than 3000. However, 1.0 m wide sealed shoulders are appropriate where an auxiliary lane such as an overtaking lane or climbing lane is present. For Class 3R roads with an AADT of less than 3000 the recommended sealed shoulder width is 1.0 metre.[48] Extra shoulder width is required on the outside of curves. Currently around 58.9 percent of the total length of Class 4R roads across the State (for Fringe Urban, Rural and Vegetation Conservation land uses) has sealed shoulder width less than the desirable minimum. The rate of sealed shoulder for Class 3R roads with adjacent Fringe Urban, Rural and Vegetation Conservation land uses is 46.4 percent and the rate for Class 3R roads with adjacent Urban and Urban Commercial land uses is 35.0 percent.[49]

As illustrated in Table 5.23, 15.4 percent of the Golden Highway has sealed shoulders of two or more metres in width. The percentage of road with sealed shoulders between 1 m and 2 m is 43.6 percent. The remainder of the corridor has sealed shoulders less than 1 m in width (41.0 percent).

None of the individual sections fully meet the target for width of sealed shoulders. The best performing sections for their target width are Dunedoo (99.8 percent), Merriwa (87.9 percent), Dubbo (79.4 percent) and east of Dunedoo (77.7 percent). The worst performing sections are Jerrys Plains, west of Dunedoo and Mugga Downs.

In the case of Jerrys Plains, the narrow sealed shoulders are also accompanied with a narrow clearzone, with major trees and power poles located close to the road edge line. The widening of this section and removal of hazards within the clear zone is a priority.

Although wider sealed shoulders are being provided where possible, a number of constraints, including the location of road cuttings, the width of the road corridor, environmental issues and general constructibility issues makes achieving the recommended minimum sealed shoulder widths a significant challenge.

Those sections with larger proportions of shoulder below the target width will be progressively widened. The target sections will be those with higher traffic volumes and higher crash rates. Where possible such widening will also occur as pavement rehabilitation is undertaken.


Golden Highway near Cobbora Road

48 Roads and Maritime Services 2010, *Network Performance Measures and Network Planning Targets*, RMS, Sydney, p. 45

49 TfNSW update September 2014, *Network and Corridor Planning Practice Notes*, RMS, Sydney, p. 3

Table 5.23 Sealed shoulder width total length km

Corridor Planning Sections	Target minimum width	Shoulder Widths (metres)			Section length (km)
		<1 m	≥1 & <2 m	≥2.0 m	
1. Belford to Mt Thorley	2.0 m	7.5	3.2	2.7	13.4
2. Mt Thorley to Jerrys Plains	2.0 m	1.9	8.9	12.6	23.4
3. Jerrys Plains	2.0 m	7	3.1	-	10.1
4. Jerrys Plains to Denman	2.0 m	11.8	6.4	0.3	18.6
5. Denman	2.0 m	3.9	-	1.1	5.0
6. Denman to Merriwa	1.0 m	18.4	14.8	13.1	46.3
7. Merriwa	2.0 m	0.3	-	2.5	2.8
8. Merriwa to Dunedoo	1.0 m	40.2	52.4	9.6	102.2
9. Dunedoo	2.0 m	1.3	1.5	1.2	4.0
10. Dunedoo to Dubbo	1.0 m	35.7	44.5	2.8	83
11. Dubbo	2.0 m	0.5	1.6	1.6	4.5
Total (by length km)		**128.5**	**136.6**	**48.2**	**313.3**

Clear zone and safety barriers

A clear zone is a width of roadside available without any obstructions available for drivers to take corrective action in an emergency. The minimum desirable width of a clear zone depends on traffic speeds and road class.

Roads and Maritime Services *Network Performance Measures and Network Planning Targets*[50] state that for Class 3R and 4R roads, the minimum width of the clear zone should be 3 to 5 m depending on the speed limit (see Table 5.24).

Where these clear zone widths cannot be achieved (such as due to sensitive roadside vegetation), the need for a barrier should be assessed. A roadside safety barrier is a longitudinal system that prevents vehicle access to a particular area. Barriers must meet specific requirements related to the segment of road.[51]

Table 5.24 Clear zone Network Planning Targets

Class	Speed	(m)
1-4R	<60 kph	3
	60-80 kph	4
	80-110 kph	5

Clear zones generally do not meet the targets on the Golden Highway. Some of the narrowest clear zones for the respective speed environments are located west of the village of Jerrys Plains, east of Denman, near Rosemount Road, east of Westwood Road, near Redwell Road, east of Ulan Road, east of Elong Elong village, east of Ballimore and through Muronbung. These sections will be addressed progressively with vegetation clearing and/or barriers. Locations with higher traffic volumes, higher crash rates and higher speed limits will be addressed first. In some locations trees intended to provide improved amenity have been planted within required clear zone areas.

Some of the widest clear zones are located west of the Mount Thorley interchange, east of Cassilis Road, through Leadville, west of Dunedoo township, west of Elong Elong village, west of Ballimore and through Mugga Downs.

50 Roads and Maritime Services 2010, *Network Performance Measures and Network Planning Targets*, RMS, Sydney, p. 51

51 Roads and Maritime Services 2010, *Network Performance Measures and Network Planning Targets*, RMS, Sydney, p. 53

Section of the Golden Highway west of Jerrys Plains with narrow sealed shoulders and a hazardous clear zone (trees and power poles)

Ideally, clear zones should be designed in accordance with the *AUSTROADS* Guide to Road Design. However, there are many existing roads that were developed prior to implementing minimum requirements for clear zones. *AUSTROADS* guidelines recommend clear zones along both sides of the Golden Highway along its full length – including sections with challenging topography such as cut and fill batter constraints.

Any increase in the width of the corridor's clear zones would improve safety compared to the existing situation. This would, however, involve trade-offs with environmental objectives, high expenditure and potentially stringent environmental mitigation works.

The long term target is to provide roadside safety barriers where needed in instances where clear zone targets cannot be met.

Edge lines and retro-reflective raised pavement markers

Edge lines provide a continuous, visual guide for drivers by delineating the edge of the roadway. They are designed to make driving safer and more comfortable, particularly at night. Edge lines provide important markings for motorists and in areas with high rates of run off-road crashes, audio tactile edge lines can be effective.

Network planning targets recommend that edge lines be provided for the full length of Class 3R and 4R roads[52]. The Golden Highway meets this target.

Retro-reflective raised pavement markers (RRPMs) provide improved visibility in times of low light and adverse weather. These are provided on edge lines, centre line and lane lines in the eastern sections of the corridor. From Cassilis to Dubbo there are no RRPMs on rural sections of the Golden Highway. RRPMs on the western sections of the Golden Highway should be provided to improve road safety by improving the visibility of travel lanes in low light and adverse weather events, but also provide more consistent driving conditions along the full length of the Golden Highway.

Intersections

The network planning targets identify required intersection treatments based on volumes of through-traffic and turning traffic. Minimum intersection treatments relevant to the Golden Highway include[53]:

- BAR and BAL: 'basic treatment right' and 'basic treatment left'.
- AUL: 'auxiliary lane treatment left'.
- CHR(s): 'short channelised treatment right'.
- CHR and CHL: 'channelised treatment right' and 'channelised treatment left'.
- GS: 'grade separation'.

The Golden Highway has 174 intersections excluding private driveways between Belford and Dubbo. The standard of intersections along the Golden Highway includes T-junctions (three-way), four-way junctions (including a grade separation at Mount Thorley) and one five-way junction at Dunedoo (intersection with the Castlereagh Highway west). A preliminary assessment of intersection standards has been undertaken along the Golden Highway to assess the existing intersection standards against current standards and is shown in Table 5.25.

52 Roads and Maritime Services 2010, *Network Performance Measures and Network Planning Targets*, RMS, Sydney, p. 48

53 Roads and Maritime Services 2010, *Network Performance Measures and Network Planning Targets*, RMS, Sydney, p. 49

Table 5.25 Intersection types and standard

Corridor Planning Sections	Intersection Standard	To current standard	Requiring upgrade to standard	Total Intersections
Section 1: Belford to Mount Thorley	BAR/BAL	-	1	1
	CHR/AUL	3	2	5
	Grade Separation	1	1	2
	Total	4	4	8
Section 2: Mt Thorley to Jerrys Plains	BAR/BAL	1	2	3
	CHR/AUL	3	8	11
	Total	4	10	14
Section 3: Jerrys Plains	BAR/BAL	3	5	8
	CHR/AUL	-	-	-
	Total	3	5	8
Section 4: Jerrys Plains to Denman	BAR/BAL	-	1	1
	CHR/AUL	-	6	6
	Total	-	7	7
Section 5: Denman	BAR/BAL	-	2	2
	CHR/AUL	-	5	5
	Total	-	7	7
Section 6: Denman to Merriwa	BAR/BAL	-	9	9
	CHR/AUL	-	9	9
	Total	-	18	18
Section 7: Merriwa	BAR/BAL	2	2	4
	CHR/AUL	-	5	5
	Total	2	7	9
Section 8: Merriwa to Dunedoo	BAR/BAL	1	24	25
	CHR/AUL	5	6	11
	Total	6	30	36
Section 9: Dunedoo	BAR/BAL	-	1	1
	CHR/AUL	-	11	11
	Total	-	12	12
Section 10: Dunedoo to Dubbo	BAR/BAL	1	25	26
	CHR/AUL	1	9	10
	Total	-	34	36
Section 11: Dubbo	BAR/BAL	0	1	1
	CHR/AUL	2	11	13
	Roundabout	2	1	3
	Signals	1	0	1
	Total	5	13	18
Total	**BAR/BAL**	**8**	**72**	**80**
	CHR/AUL	**12**	**72**	**80**
	Roundabout	**2**	**1**	**3**
	Signals	**1**	**1**	**2**
	Grade Separation	**1**	**1**	**2**
	Total	**26**	**139**	**174**

From Table 5.25, only 15 percent (or 26) intersections are to current standards. Most intersections are not provided with turn lanes of a sufficient length for the expected turning traffic volumes.

In addition to the standard of intersections, there are numerous intersections with drainage issues, loose gravel (from side streets), poor sight distance, poor pavement condition and inadequate signage.

Intersection upgrades along the Golden Highway will be undertaken on a priority basis, with intersections that have a poorer crash history, pose the greatest risk, and are more highly trafficked being addressed first.

There are four intersections with the Golden Highway which experience delays in peak periods. These include the New England Highway, Putty Road (East), Denman Road and the Newell Highway within Dubbo.

There are six intersections where three or more injury crashes have occurred over the last five year period (July 2009 to June 2014). These include:

- New England Highway, Belford (currently in planning for grade separation).
- Wallaby Scrub Road, Warkworth.
- Denman Road, Denman.
- Wheelers Lane/Yarrandale Rd, Dubbo.
- Fitzroy Street, Dubbo.
- Pozieres Street, Dubbo.

These should be further investigated to determine if upgrade works are required and what those works will involve.

A fatal crash has also occurred at the intersection of Muronbung Road, Gollan in June 2012 however there have only been two crashes at or near the intersection in the five years between June 2009 and July 2014.

The intersection of Palace/Crinoline Street at Denman has recently been completed. The upgraded intersection will provide more efficient through movements on the Golden Highway, and improved turn facilities into Denman.

Intersection of the Golden Highway and Cobbora Road

The intersection of the Golden Highway with Lydes Lane is recommended for closure, as it is located on a merge taper north of the Mount Thorley interchange, which increases crash risk between turning and merging traffic. Alternate access to Lydes Lane can be provided from Putty Road to the south.

Intersection upgrades are also recommended to be undertaken in conjunction with all future pavement rehabilitation and widening works along the Golden Highway, particularly where widening works bisect existing intersections which are not currently to standard. These intersections could be upgraded at low incremental cost.

Future intersection upgrades should also consider the accommodation of school bus stops where appropriate along the Golden Highway.

Flooding

The Golden Highway crosses a number of floodplains as well as waterways subject to flooding.

Flooding can result in corridor closures at multiple locations for hours at a time, or up to several days.

The impacts of flooding on the Golden Highway can be measured in terms of:

- Flood volume – This contributes to flood duration and level.
- Speed the water moves – Faster flowing water causes a greater risk to human life, erosion and infrastructure damage.
- Flood duration – Flood events can isolate people and communities, increase travel times and reduce productivity for industry and other road users.
- Extent of flooding – Flooding that affects a larger area often causes greater impact.

There are a range of flood types. These include:

- Nuisance flooding - Causes public inconvenience, but little or no property damage. Water is typically not deep, is stagnant and generally localised. Nuisance flooding events may last several hours and may slow or prevent access along the corridor.
- Flooding caused by rising waterways - This type of flooding restricts access. To manage it, water is either directed under the road through culverts and pipes, or over the road through causeways and floodways, or in the case of defined waterways, road structures such as bridges, are specifically built over the water way. During flooding, approaches to these bridges can be cut off even though the bridge is still above water. Flooding may also be localised, but the scale and volume of water may cause damage to property and infrastructure.
- Sheet flooding where landscape is flat - In places such as western NSW, sheet flooding can occur when large volumes of water travel across the landscape gradually, causing significant damage to embankments, culverts and other infrastructure. This damage can occur even if the water is not particularly deep.

There are two locations on the Golden Highway that are subject to flooding caused by rising waterways (see Figure 5.14).

Key locations subject to flooding are:

- Talbragar River, Uarbry. This has a 1:5 average recurrence interval (ARI). Water crossing the road closes the highway for two days at a time.
- Mudies Creek, Whittingham. This has a 1:1.5 ARI, with water closing the road for 24 hours at a time. There have also been several crashes related to water on the road.

The objective for Talbragar River is to provide consistent 1:100 ARI flood immunity across the floodplain, matching the immunity of the existing bridges. This is in line with Roads and Maritime Services' supplement to the *AUSTROADS* Guide to Road Design, Part 5 – Drainage Design[54], which recommends a 1:100 ARI flood immunity for major

54 Roads and Maritime Services 2011, *RTA Supplement to AUSTROADS Guide to Road Design – Part 5 (2008): Drainage Design*, Roads and Maritime Services, Sydney, p. 17

Talbragar River floodplain near Uarbry

structures. At Mudies Creek, the highway should be provided with a minimum 1:20 ARI flood immunity, consistent with the surrounding highway sections and *AUSTROADS* standards[55]. The target flood immunity at Mudies Creek should also consider the Golden Highway's role as an alternate route to the New England Highway at Singleton in times of flooding.

A section of the Golden Highway approximately 20 km east of Dubbo is affected by sheet flooding due to poor drainage and alignment. This section overtops the highway by more than 30 mm. It is recommended that this section be upgraded to minimise the impact of sheet flooding across the highway.

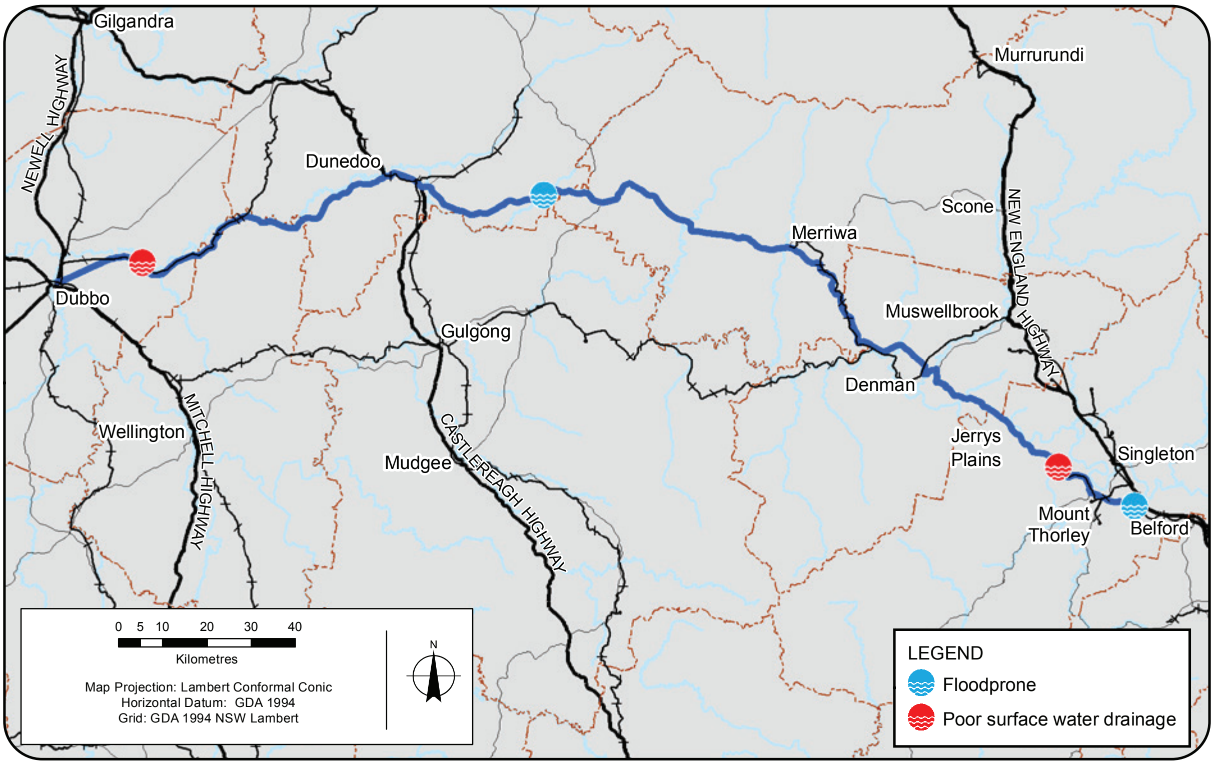
The corridor crosses a number of other major waterways where flooding is not a major issue. These are:

- Wollombi Brook (Cockfighter Bridge), Warkworth.
- Hunter River (Bowmans Crossing), Jerrys Plains.
- Hunter River, Denman.
- Talbragar River (Pipers Bridge and unnamed bridge), Uarbry.
- Talbragar River (Denison Town Bridge and unnamed bridge), Leadville / Dunedoo.

The flood immunity of existing bridges along the route is sufficient, however surface drainage is inadequate at Cockfighter Bridge over Wollombi Brook at Warkworth. This presents an aqua planning risk to drivers during periods of heavy rain.

55 *AUSTROADS* 2013, *AUSTROADS Guide to Road Design Part 5: Drainage – General and Hydrology Considerations*, *AUSTROADS*, Sydney, p. 79

Figure 5.14 Location of flood prone sites



G:\22\17815\GIS\Maps\Deliverables\Report\2217815_R029_Flooding_2.mxd

Data source: Geoscience Australia, 250K Topographic Data Series 3.

Road slope risk rating

Earth embankments and cuttings are constructed to connect the road corridor to the existing terrain. These embankments and cuttings are designed and built in accordance with design standards. Part of managing these embankments and cuttings involves assessing measures necessary to mitigate against possible risk of slope instability. A road slope risk rating systematically analyses risks associated with potential slope instability on roads across the State.

Slope stability is measured and assessed using Roads and Maritime Services' Guide to Slope Risk Analysis. The risk posed by a slope is measured in terms of an Assessed Risk Level (ARL). Slopes considered to have a high risk of instability are rated ARL 1 and 2, while slopes with low perceived risk are rated ARL 4 and 5. Slopes rated as ARL 3 are considered to have a medium risk of instability. Generally, the target rating for all existing slopes in a corridor should be ARL 3 or better.

There are 28 slopes on the Golden Highway that have been assessed. There are no ARL 1 slopes along the Golden Highway. Four slopes are rated as high risk. One of these is located at Whittingham, two at Warkworth and one on Ogilvies Hill west of Jerrys Plains. There are nine slopes rated as medium risk. These slopes have specific management plans. Should climbing lanes be constructed on Ogilvies Hill the cutting will need to be carefully managed.

Golden Highway at the summit of Ogilvies Hill

Road culvert risk rating

A culvert is one or more adjacent pipes or enclosed channels that allow water to flow under a road. There are 77 bridge size culverts and 741 non-bridge size culverts on the Golden Highway. This equates to a total of 818 culverts. Of the non-bridge size culverts, there are 609 steel reinforced concrete pipe barrels, 49 precast arch box barrels, 38 steel reinforced concrete box barrels, and one each of spiral wound steel barrel, fibre reinforced concrete pipe barrel, fibre reinforced concrete box barrel, stone box barrel and pipe barrel of another type.

A road culvert risk rating is a systematic analysis of the risks associated with culvert condition on the State road network. If a culvert fails, under extreme conditions, the road surface above the culverts may collapse or be washed away.

There are no assessed risk levels or specific management plans for bridge size culverts, instead they are inspected regularly and maintenance works are programmed as part of the bridge inspection program.

All non-bridge sized culverts under active management are scheduled for inspection on a rolling cycle within Roads and Maritime Services asset management program. Inspected culverts are assessed for risk by calculating the culvert's Assessed Risk Level (ARL). Culverts rated as 'High Risk' are those with a rating of ARL 1 or 2. Culverts rated 'Low Risk' are those with a rating of ARL 3, 4 or 5. Each year a sample of culverts are inspected such that over the course of ten years all culverts will have received an initial inspection. Following this initial inspection follow up re-inspections are scheduled based on the ARL assigned; steel culverts, larger culverts, culverts that serve to accommodate catchment water and culverts with known problems are given re-inspection priority. Culverts are also inspected when road works take place.

Additional resources are required to enable the initial assessment of outstanding culverts to avoid more costly repairs in future years and to prevent damage to the road above.

The overall number of culverts assessed according to low and high priority is provided in Table 5.26. There are 12 high priority and 102 low priority culverts. The balance of culverts flagged as Null have not been inspected for the first time.

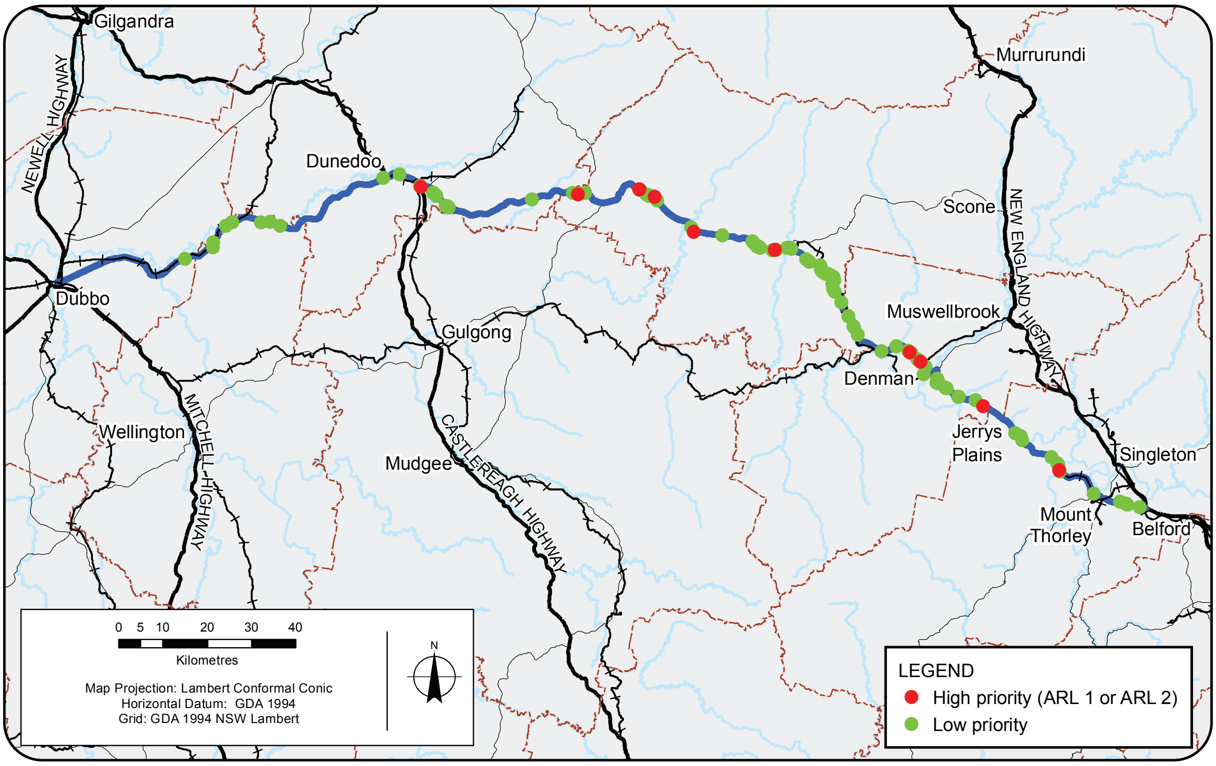
There are three culverts rated as ARL 1, nine culverts rated ARL 2, 88 culverts rated ARL 3, nine culverts rated ARL 4, and five culverts rated ARL 5. The vast majority of higher risk culverts are in the eastern sections of the corridor. Additional funding is required to address culvert issues before they are identified as ARL 1 culverts. Culverts with an ARL of 1 and 2 are located at:

- Warkworth – 1.70 km west of Long Point Road, Warkworth - ARL 2.
- Warkworth – 0.72 km west of Wallaby Scrub Road – ARL 2.
- Jerrys Plains – 0.95 km east of Edderton Road – ARL 2.
- Denman – 0.26 km east of Pine Ridge R.O.W. – ARL 2.
- Denman – 0.76 km east of Rosemount Road – ARL 2.
- Merriwa – 1.29 km west of Cullingral Road – ARL 2.
- Merriwa – 3.67 km west of Redwell Road – ARL 2.
- Cassilis – 1.73 km west of Wyoming Road – ARL 1.
- Cassilis – 2.32 km east of Cassilis Road – ARL 2.
- Cassilis – 2.06 km east of Cassilis Road, Cassilis (x2) – ARL 1.
- Dunedoo – 0.47 km west of Castlereagh Highway (E) – ARL 2.

Table 5.26 Culvert conditions

Culvert type	Low priority	High priority	Null	Total
Pipe	86	11	521	616
Box	16	1	108	125
Composite	0	0	0	
Total	**102**	**12**	**629**	**741**

Figure 5.15 Culvert locations and condition



Bridge load performance

The network planning target for bridge load performance states that all bridges on State and regional roads should be able to carry Higher Mass Limits (HML) loads.[56]

HML is a nationally agreed scheme that permits approved heavy vehicles to operate with additional mass on certain types of axle groups, on a restricted road network and subject to specified conditions.[57]

The Australian Government has approved the following axle mass limit increases for vehicles fitted with road friendly suspensions:

- 0.5 tonne increase on tandem axle groups to 17 tonnes.
- 2.5 tonne increase on tri-axle groups to 22.5 tonnes.
- 1 tonne increase on single drive axles on buses to 10 tonnes.
- 1 tonne increase on six-tyred tandem axles to 14 tonnes.
- 0.7 tonne increase on steering axles of long combination vehicle prime movers - such as road trains – fitted with wide single tyres, regardless of suspension type.

The Golden Highway is a HML 25/26 m B-Double route. A recent assessment has identified that bridges on the Golden Highway are able to accommodate PBS Class 2B A-Double and Super B-Double vehicles operating at up to 91 tonne following enhanced delineation works to narrow bridges to improve their visibility to approaching drivers (see Appendix B for vehicle configurations).Road trains up to 36.5 metres in length are permitted between the Newell Highway and Fitzroy Street in Dubbo.

56 Roads and Maritime Services 2010, *Network Performance Measures and Network Planning Targets*, RMS, Sydney, p. 56

57 National Transport Commission 2014, *http://www.ntc.gov.au/viewpage.aspx?AreaId=37&DocumentId=1806*


Cockfighter Bridge over Wollombi Brook on the Golden Highway undergoing an inspection.

Bridge structural health

Bridge health is measured using the Roads and Maritime Services Bridge Health Index (BHI). The BHI measures a bridge's condition in terms of 'poor', 'fair', 'good' or 'as built'.

The network planning target for the rural road network is that less than 2.5 percent of all bridges across the route should have a BHI rating of 'poor'[58].

There are 104 bridges and bridge size culverts along the Golden Highway. The condition of all of these bridges has been assessed. A total of 18 bridges are in 'as built' condition and 34 bridges are in good condition, with 50 bridges in fair condition and two bridges in poor condition.

The two bridges with a 'poor' BHI are:

- Warkworth: Cockfighter Bridge over Wollombi Brook – Steel girder bridge constructed in 1956.
- Gungal: Unnamed bridge over Halls Creek – Pre-stressed plank bridge constructed in 1997.

Remediation works should be undertaken on these bridges in the short term. The ongoing serviceability and performance of the Cockfighter Bridge should also be closely monitored given its narrow width and age.

58 Roads and Maritime Services 2010, *Network Performance Measures and Network Planning Targets*, RMS, Sydney, p. 34

5.5 Road pavement condition

Road pavement is a layer of crushed rock which sits above the ground the road is built on. This rock can be either in a natural state or modified into materials such as concrete or asphalt.

The surface of a road experiences very high stress under the tyres of passing vehicles, especially heavy vehicles. The natural earth material is too weak to withstand these tyre loadings and therefore a pavement material is overlayed that has sufficient strength. The pavement material is also stiff and thus spreads the concentrated tyre load over a wider area and passes the load through to the natural earth.

Effectively managing the Golden Highway's pavement condition for the long term is a key task that involves estimating the pavements remaining service life to ensure adequate rates of pavement replacement.

Without adequate rates of replacement the network will deteriorate until eventually the road will be compromised. Alternatively, if the pavement replacement rate is too high, resources are spent unnecessarily and inefficiently.

A sustainable level of preventative maintenance also reduces the long term ongoing maintenance costs, whereby significant maintenance costs such as full depth reconstruction can be avoided. A well maintained pavement also reduces wear and tear on vehicles, reducing vehicle operating costs.

Measuring the remaining structural life of the pavement is therefore a critical role of asset maintenance.

To understand how pavement is performing and to forecast future pavement condition, a number of measures are considered. These include:

- Road pavement structural remaining life.
- Intensity of pavement rebuilding.
- Pavement age.
- Pavement types and seals.
- Road surface cracking.
- Roughness.
- Road smoothness.
- Rutting.
- Deflection.

Pavement replacement rate

The Golden Highway is currently being reconstructed or rehabilitated at a rate of 0.4 percent per year, based on works undertaken in the last ten years. This replacement rate is not sustainable and more maintenance funding is needed for the Golden Highway.

Pavement types and seals

Pavements provide structural support for vehicles travelling along a route. Weaker or older pavements may become uneven, rutted or rough, leading to inferior travel conditions.

Road pavements are classified as either flexible or rigid. Flexible pavements generally consist of a number of layers of gravel, unbound granular materials, with a bitumen surface. Some flexible pavements incorporate cement-bound or asphalt layers, referred to as composite pavements.

Rigid pavements are Portland-cement concrete pavements. They may or may not be surfaced with asphalt over the concrete base.

Pavement types also differ in their expected useful life. Pavements may be referred to as '10 year pavements', '20 year pavements' or '40 year pavements'. Pavements with a shorter expected life may be used when funds are very limited and rehabilitation is urgently needed. They may also be used when a road is not needed in the medium term, for example when a realignment of the existing road is planned.

The factors that are considered in selecting a pavement type include:

- Anticipated traffic loadings, including likely heavy vehicle use.
- Environmental and construction constraints.
- Material availability and cost.
- The need to optimise life-cycle costs.

The majority of the corridor consists of granular sealed pavements. There are short sections of bound pavement, with or without asphalt. There are sections with poor sub-grade between Jerrys Plains and Denman.

There is no material available in the vicinity of the corridor that meets engineering specifications for use as road pavement. Materials are transported to the corridor primarily from the Muswellbrook, Murrurundi and Cessnock areas in the east and from quarries also outside of the corridor in the west.

Pavement design aims to maximise whole-of-life benefits by selecting the most economical thickness and composition to provide a satisfactory level of service for anticipated traffic. Different pavement configurations are used in NSW, depending on how heavy the traffic is along particular routes. Thicker, stronger and more expensive pavements are used on heavy traffic routes.

Heavy duty pavements should be used on roads with a design traffic loading of one $x10^7$ Design Equivalent Standard Axles (DESA) or greater for the first 20 years of service.[59]

Typical forms of heavy duty pavements include:

Rigid:

- Plain concrete
- Joint reinforced concrete
- Continually reinforced concrete

Flexible:

- Full depth asphalt
- Thick asphalt over cemented sub-base
- Asphalt over blast furnace slag
- Thick asphalt over lean mix concrete
- Granular based pavements with bitumen seals.

At the eastern end of the corridor with traffic volumes in excess of 3,000 vehicles per day and around 12 percent of traffic consisting of heavy vehicles there is a requirement for heavy duty pavements such as bound granular pavement and asphalt. Heavy duty pavements have been constructed in this area for many years. West of Cassilis the pavements are largely unbound granular sealed pavements.

Table 5.27 summarises the pavement types along the Golden Highway. The main pavement type along the corridor is granular sealed flexible pavement. This pavement type is used on 89.2 percent of the corridor. Bound granular pavement with a seal is used on 8.3 percent of the corridor. The other two pavement types used on the corridor are bound granular with asphalt (1.7 percent) and granular with asphalt (0.7 percent). Through Denman 40.7 percent of the section is bound granular with sealed pavement and in the urban section of Dubbo 32.5 percent is granular with asphalt pavement.

59 *AUSTROADS* 2012, *Guide to Pavement Technology: Part 2: Pavement Structural Design*, *AUSTROADS*, Sydney

Table 5.27 Pavement types total length km

Corridor Planning Sections		Flexible granular sealed	Bound granular with seal	Composite Granular with asphalt	Bound granular with asphalt	Section length (km)
1.	Belford to Mt Thorley	10.5	1.8	-	1.1	13.4
2.	Mt Thorley to Jerrys Plains	19.6	2	-	1.8	23.4
3.	Jerrys Plains	7.7	1.6	0.8	-	10.1
4.	Jerrys Plains to Denman	15.9	-	-	2.5	18.6
5.	Denman	3	2	-	-	5.0
6.	Denman to Merriwa	35.5	10.8	-	-	46.3
7.	Merriwa	2.2	0.5	-	-	2.8
8.	Merriwa to Dunedoo	98.5	3.4	-	-	102.2
9.	Dunedoo	100	-	-	-	4.0
10.	Dunedoo to Dubbo	83	-	-	-	83
11.	Dubbo	4.5	-	-	-	4.5
Total (by length km)		**279.5**	**26**	**0.8**	**5.3**	**313.3**

As pavements deteriorate they are often resealed to protect the underlying pavement from water damage and general wear and tear, particularly from heavy vehicles, and to provide a more consistent road surface. Reseals are far less costly than rehabilitation where the pavement is rebuilt, and involve resealing over the existing seal. Reseals are not effective in reducing any significant unevenness in the road.

Pavement age

Road pavement is designed to provide satisfactory service over a specified period, typically 20 years for flexible pavements and 40 years for rigid pavements. The age of the pavement is a further indicator of its remaining life. While pavement can continue to operate beyond its design life, it will experience increasing failures and require regular repair. Eventually the pavement will require full reconstruction to continue to support traffic.

Roads and Maritime Services faces considerable challenges in maintaining and renewing its infrastructure to ensure it is serviceable and sustainable now and in the future.

With the objective of enabling access for PBS Class 2B vehicles there is a heightened need to monitor pavement condition and ensure durable pavements are used due to changes in the loadings on the pavement along the corridor. There is also a greater need for older pavements in poor condition to be replaced as they may fail more quickly with increased vehicle loadings.

Table 5.28 summarises the age of pavements along the Golden Highway. A large proportion of the corridor, 38.7 percent, has pavement greater than 40 years in age. The oldest sections of pavement where the majority is greater than 40 years of age are:

- Within and either side of Dunedoo
- Jerrys Plains and between Jerrys Plains and Denman

Immediately to the east of Dunedoo the full length of pavement is greater than 40 years old. West of Dunedoo to Avonside North Road 86.5% of the pavement is more than 40 years old.

The current replacement rate of pavement is not sufficient to prevent sections deteriorating to a point where they require major rehabilitation. There are sections of pavement requiring major rehabilitation due to poor performance:

- Whittingham
- Jerrys Plains - East of Jerrys Plains village, near Winery Hill and west of Winery Hill
- Denman / Sandy Hollow – West of Ogilvies Hill, Denman township to west of Sandy Hollow
- Gungal – North of Gungal
- Merriwa – East of Merriwa
- Merriwa / Cassilis – East of Krui River crossing
- Cassilis - In the vicinity of Krui River and Borambil Creek crossings, around Vinegaroy Road.
- In the vicinity of Borambil Creek crossing
- Around Vinegaroy Road

Table 5.28 Pavement age total length km

Corridor Planning Sections	< 20 years	20-40 years	> 40 years	Section length (km)
1. Belford to Mt Thorley	1.2	10.1	2.1	13.4
2. Mt Thorley to Jerrys Plains	3.3	11.2	8.9	23.4
3. Jerrys Plains	-	5	5.1	10.1
4. Jerrys Plains to Denman	4.6	2.1	11.9	18.6
5. Denman	1.3	3.7	-	5.0
6. Denman to Merriwa	3.5	24	18.8	46.3
7. Merriwa	0.5	1.3	0.9	2.8
8. Merriwa to Dunedoo	24.2	34.7	43.3	102.2
9. Dunedoo	-	-	4	4.0
10. Dunedoo to Dubbo	35.3	21.1	26.6	83
11. Dubbo	2.6	1.4	0.5	4.5
Total (by length km)	**76.8**	**115.3**	**121.2**	**313.3**

Section of poor pavement on the Golden Highway east of Dunedoo

Road surface cracking

Road surface cracking results primarily from water erosion and is wearing of the surface that protects the pavement's structure.

The prevalence of cracking in a road surface is a key performance measure determining the rate of pavement deterioration. Although an increase in untreated cracking of the surface material does not affect traffic efficiency or road safety, it can lead to deterioration of the underlying pavement in the longer term, thereby increasing asset maintenance and bringing forward the need for pavement replacement.

In addition, if full pavement rehabilitation becomes necessary as a result, this produces longer delays to traffic, with fewer available lanes during the construction phase than repairs involving the resurfacing of the existing road surface undertaken at earlier times.

As a guide, the network planning targets for all state roads indicate that[60]:

- For asphalt roads, on average, at least 67 percent of the road lengths should exhibit cracking of less than 5 percent, and no more than 2.6 percent of these road lengths should exhibit cracking of more than 30 percent.
- For spray seal surface roads, on average, at least 80.2 percent of road lengths should exhibit cracking of less than one percent, and no more than 4.3 percent of these road lengths should exhibit cracking of more than 10 percent.

Table 5.29 and Table 5.30 summarise pavement cracking along asphaltic concrete and spray sealed pavements on the Golden Highway.

Four of the six planning sections that are comprised of asphalt meet the target of at least 67 percent of pavement with less than 5 percent cracking whilst all six sections meet the target of no more than 2.6 percent of pavement with more than 30 percent cracking. In between Mount Thorley and Jerrys Plains the whole road length has cracking of between 5 and 30 percent. This section may require rehabilitation in the future should routine maintenance work fail in addressing any major cracking. The majority of the Golden Highway corridor has spray sealed surfaces. Of these sections, those that do not meet the target of 80.2 percent of road lengths with less than one percent cracking are Dubbo (none), Merriwa (12.1 percent), Dunedoo (62.2 percent), Jerrys Plains to Denman (64.4 percent), east of Dubbo central business district (67.2 percent), Denman to

60 Roads and Maritime Services 2010, *Network Performance Measures and Network Planning Targets*, RMS, Sydney, p. 29

Merriwa (74.1 percent), Mount Thorley to Jerrys Plains (76.6 percent), and Merriwa to east of Dunedoo (80.0 percent). The road pavement between Mount Thorley and Merriwa and in the towns of Merriwa, Dunedoo and Dubbo may require rehabilitation if more serious cracking cannot be treated through routine maintenance activities. All sections meet the target of no more than 4.3 percent of road lengths exhibiting cracking of more than 10 percent.

Pavement cracking should continue to be monitored as it can be a precursor to more severe distress.

Table 5.29 Pavement cracking for asphaltic concrete total length km

Corridor Planning Section		% of asphaltic concrete within cracking category		Section length (km)
		< 5%	5-30%	
1.	Belford to Mt Thorley	2.3	-	2.3
2.	Mt Thorley to Jerrys Plains	-	3.62	3.6
3.	Jerrys Plains	-	0.8	0.8
4.	Jerrys Plains to Denman	2.5	-	2.5
10.	Dunedoo to Dubbo	0.6	-	0.6
11.	Dubbo	0.5	0.1	0.6
Total (by length km)		**6.5**	**3.9**	**10.4**

Table 5.30 Pavement cracking for spray sealed total length km

Corridor Planning Section		Km of spray seal in corridor planning section within cracking category		Section length (km)
		< 1%	1-10%	
1.	Belford to Mt Thorley	1.2	10.1	13.4
2.	Mt Thorley to Jerrys Plains	3.3	11.2	23.4
3.	Jerrys Plains	-	5	10.1
4.	Jerrys Plains to Denman	4.6	2.1	18.6
5.	Denman	1.3	3.7	5.0
6.	Denman to Merriwa	3.5	24	46.3
7.	Merriwa	0.5	1.3	2.8
8.	Merriwa to Dunedoo	24.2	34.7	102.2
9.	Dunedoo	-	-	4.0
10.	Dunedoo to Dubbo	35.3	21.1	83
11.	Dubbo	2.6	1.4	4.5
Performance (by length km)		**73**	**90.7**	**163.7**

Roughness and smoothness

Roughness measures the undulations in the road and therefore provides an indication of ride comfort experienced by the driver and passengers. Smoother roads also decrease the wear and tear on vehicles and are a significant factor in reducing heavy vehicle operating costs.

The ride quality, or longitudinal profile of the road surface, is measured using vehicle mounted laser technology. A 'roughness' score, measured using International Roughness Index (IRI), below 4.2 metres per kilometre indicates a generally smooth and comfortable ride.

In noting these targets however, higher levels of roughness are more acceptable in lower speed environments as the impact on the traveller is less at lower speeds.

The worst non-urban performing sections relative to the network target of IRI of less than 4.2m per kilometre are between Jerrys Plains and Denman (16 per cent or 3 km greater than IRI 4.2), and between Dunedoo and Dubbo (16 per cent or 13.4 km greater than IRI 4.2).

Table 5.31 Roughness counts per km (toal length km)

	Corridor Planning Sections	Section length (km)	Km corridor planning section within roughness category (%)	
			< 4.2	≥ 4.2
1.	Belford to Mt Thorley	13.4	12.7 (95%)	0.7 (5%)
2.	Mt Thorley to Jerrys Plains	23.4	23 (98%)	0.4 (2%)
3.	Jerrys Plains	10.1	9.4 (93%)	0.7 (7%)
4.	Jerrys Plains to Denman	18.6	15.6 (84%)	3 (16%)
5.	Denman	5.0	4.3 (86%)	0.7 (14%)
6.	Denman to Merriwa	46.3	42.5 (92%)	3.8 (8%)
7.	Merriwa	2.8	1.8 (64%)	1 (36%)
8.	Merriwa to Dunedoo	102.2	96.4 (94%)	5.8 (6%)
9.	Dunedoo	4.0	3.2 (80%)	0.8 (20%)
10.	Dunedoo to Dubbo	83	69.6 (84%)	13.4 (16%)
11.	Dubbo	4.5	3.4 (76%)	1.1 (24%)
Total (by length km)		**313.3**	**281.9 (90%)**	**31.4 (10%)**

Rutting

Rutting measures the extent of permanent pavement deformation in the wheel paths. Rutting is a longitudinal distress that generally does not influence roughness. Rutting represents a potential road safety concern due to water ponding (or in cold areas ice formations) that can form in the depressions along the wheel paths, increase in aquaplaning risk and subsequent loss of skid resistance.[61]

Rutting is regarded as a key distress mode and has a strong influence on Roads and Maritime's maintenance and rehabilitation programs for future pavement rehabilitation or reconstruction works. Rutting may indicate structural instability in flexible pavements or excessive plastic deformation in asphalt pavements.

High levels of rutting require investigation to ascertain the structural integrity of the pavement and potential risk to safety. The deformation may occur in the wearing or base courses (upper thickness), which indicates material instability, or sub-base and subgrade (deeper level), which indicates material breakdown and loss of bearing strength. The remedial treatment will depend on the cause (resurface if asphalt instability, heavy patch or rebuild if deeper).

The performance of the Golden Highway overall with regard to rutting is relatively good, with 28.7 percent of the corridor 'good', 68.5 percent with 'slight' rutting, and 2.8 percent with 'moderate' rutting. There are no sections of 'extreme' rutting on the Golden Highway (Table 5.32).

There are two sections of the corridor with 'moderate' rutting, Merriwa to east of Dunedoo (6.6 percent) and west of Dunedoo to Mugga Downs (2.5 percent). These sections will need to be addressed through rehabilitation works.

Poorer quality sub-grade may have contributed to the larger portion of rutting in the western sections of the corridor.

Table 5.32 Rutting deficiencies total length km

Corridor Planning Sections	Good (< 5mm)	Slight (5 - 10mm)	Moderate (10 - 20mm)	Section Length (km)
1. Belford to Mt Thorley	3.8	9.6	-	13.4
2. Mt Thorley to Jerrys Plains	6	17.4	-	23.4
3. Jerrys Plains	2.4	7.7	-	10.1
4. Jerrys Plains to Denman	6.8	11.8	-	18.6
5. Denman	2.2	2.8	-	5.0
6. Denman to Merriwa	14.1	32.2	-	46.3
7. Merriwa	1	2.8	-	2.8
8. Merriwa to Dunedoo	30	65.4	6.7	102.2
9. Dunedoo	1.5	2.5	-	4.0
10. Dunedoo to Dubbo	20	61.1	2	83
11. Dubbo	2.3	2.2	-	4.5
Total (by length km)	**89.9**	**214.6**	**8.8**	**313.3**

61 *AUSTROADS* 2007, *Guide to Asset Management: Part 5C: Rutting*, *AUSTROADS*, Sydney

Skid Resistance

The Golden Highway east of the Great Dividing Range experiences greater rainfall and higher traffic volumes and as a result the pavement deteriorates more quickly.

On asphaltic concrete and flexible granular sealed pavements water blasting can provide a temporary roughing of the surface until such time as funding is available to mill and re-sheet the road surface, generally with a high friction aggregate. However, water blasting should only occur on flexible granular sealed pavements where it is determined that the surface will not be damaged and deteriorate as a result of the blasting.

Remediation works are undertaken across the state regularly on a priority basis.

Around 1.5 kilometres west of Jerrys Plains village there is a stock crossing for cattle which results in mud being left on the highway that is walked on to the road by the cattle as they move across the road. As a result of this crossing, the 80 km/hr zone west of Jerrys Plains has been extended an additional 2 km. In the short-term shoulder widening near the stock crossings and enhanced delineation (such as vehicle activated signs), may improve the safety at these stock crossings. Roads and Maritime will continuously monitor the performance of these stock crossings in consultation with the respective landholders.


Rutting on the Golden Highway east of Dunedoo

5.6 Environment

The corridor passes through three main land use zones – coal mining, agricultural and urban.

East of Jerrys Plains, land use types are dominated by coal mines and related industries, the Singleton military base and some small acreages. Between Jerrys Plains and Sandy Hollow the land use is characterised by horse studs, viticulture and small acreages. West of Sandy Hollow to Mugga Downs (east of Dubbo) is characterised by a mix of broad acre crop farming including wheat, sorghum, barley, sunflowers, canola and lucerne as well as beef cattle and sheep. The approaches to Dubbo are characterised by rural residential and small acreages, before residential subdivisions, commercial and industrial development within the urban centre of Dubbo.

Flora

A large proportion of the Golden Highway corridor is disturbed land that is largely devoid of native vegetation. There are however natural grasslands. Open fields are the dominant landscape type. There is a relatively large amount of native vegetation at Warkworth, between Denman and Sandy Hollow and on the western side of Cassilis.

At the eastern end of the corridor between Belford and Denman there is a large prevalence of Bull Oak and Narrow-leaved Ironbark trees. Also scattered along the roadsides are Water Bush and a few other species common to the Western Plains. There are Banksia Integrifolias on the sand dune formations near Warkworth.

The section between Denman and Merriwa has various native trees, grasses and shrubs including Bull Oak, Eucalyptus 'Box' trees, Narrow-leaved Ironbark, Barbed Wire Grass and various Wattles.

West of Merriwa to Cassilis there are grasslands with little tree cover. The tree species White Box is common, with native grasses, herbs and only scattered shrubs. Trees do not cope well with dry conditions that lead to soil cracking and wetter conditions creating waterlogged soils.

At Cassilis the drier, rocky ridgelines are dominated by Narrow-leaved Ironbark trees whilst the lower lying valley has a number of White Box woodland species. In the vicinity of Ulan Road the bushland may be used as a feeding area for Glossy Black Cockatoos and Regent Honeyeaters.

Between Cassilis and Dunedoo the altitude starts to fall on the approach to the Western Plains. The most common tree species are Yellow Box, Blakely's Red Gum and Rough-barked Apple. There are a variety of shrubs on the lighter soils.

In the western section of the corridor between Dunedoo and Dubbo there is a transition between plant species of the Central Tablelands, including Yellow Box, Blakely's Red Gum and Rough-barked Apple, and Western Plains species including Grey Box, Rosewood and Weeping Pittosporum, to name a few. There is a variety of shrub species in less disturbed sections.

The Slaty Red Gum (Eucalyptus Glaucina) is listed in the *Environment Protection and Biodiversity Conservation Act 1999*[62] (Federal legislation) as 'vulnerable' flora and has been recorded in the Singleton Military Area at Whittingham near the eastern end of the corridor. The Acacia Pendula is listed in the *Threatened Species Conservation Act 1995*[63] (State legislation) as an 'endangered population' and occurs in the road reserve in the eastern sections of the corridor.

There are a number of sections considered to be of high conservation value. These are listed below. Maintenance activities and road upgrades should be particularly sensitive to these areas:

- Mount Thorley – Mount Thorley Road overpass to Lydes Lane.
- Warkworth – Hunter Valley Operations Southern Facility access to Wollombi Brook (Cockfighter Bridge).

  Also contains a Significant Roadside Environment Area.

62 *Federal Environmental Protection and Biodiversity Act* 1999 (Cth)

63 *Threatened Species Conservation Act*, 1995 (NSW)

- Hollydeen – Pine Ridge R.O.W. turnoff to 1.3 kilometres east of Reedy Creek Road.

  Also contains a Significant Roadside Environment Area.

- Hollydeen to Sandy Hollow – Reedy Creek Road to 650 metres east of Bylong Valley Way.
- Gungal – 1.1 kilometres east of Westwood Road to Battery Rock rest area.

  Also contains a Significant Roadside Environment Area.

- Merriwa – Dunblane Road to 0.9 kilometres west of Dunblane Road.
- Cassilis – Eastern entrance to Cassilis Park Rest Area to 1.4 kilometres west of Ulan Road.
- Cassilis – 1.2 kilometres to 1.55 kilometres west of Vinegaroy Road.
- Cassilis – 2.4 kilometres to 1.55 kilometres east of Stotts Lane (W).
- Cassilis – 1.6 kilometres to 2.5 kilometres west of Stotts Lane (W).
- Uarbry to Leadville – 2 kilometres east of Birkalla Road to Cainbil Creek (Denis McGrath Bridge).
- Dunedoo – 1.3 kilometres east of Spring Ridge Road to 1.35km east of Sandy Creek Road.
- Muronbung to Elong Elong – 1.85 kilometres west of Wattle Road to 2.5km east of Muronbung Road.

  Also contains a Significant Roadside Environment Area.

- Gollan to Ballimore – 1.85 kilometres to 2.85 kilometres west of Muronbung Road.
- Beni – Railway Level Crossing to Old Mendooran Road.
- Mugga Downs to Dubbo – 750 metres west of Harefield Road to Buninyong Road, Dubbo.

There are various weed species growing along the Golden Highway corridor. Common types include (but are not limited to) Fennel, Paspalum, Purple-top, Pepper Tree, Prickly Pear, Balloon Cotton and Rhodes Grass and Coolatai Grass.

Fauna

There are no threatened fauna species along the Golden Highway corridor, although koalas (Phascolarctos cinerus) have been recorded in Goonoo State Forest north of Ballimore. Koalas are a vulnerable mammal listed in

Golden Highway west of the New England Highway intersection the *Environment Protection and Biodiversity Conservation Act 1999* and *Threatened Species Conservation Act 1995*.

Animals are frequently hit by motor vehicles on the Golden Highway, with kangaroos being the most commonly hit animal. East of Tongy Lane at Uarbry animals are often hit and killed by cars as they move between hillside bushland on the southern side of the highway to grassed flats on the opposite side of the highway. There is also a large amount of animal casualties around one km west of Tongy Lane where animals move between open reserves. To the north of Battery Rock rest area there is a vegetated ridgeline on the northern side of the highway and Worondi Creek on the southern side. Echidnas, wombats and kangaroos are often killed in this area as they cross cleared farmland in the corridor.

It is Roads and Maritime Services' responsibility to manage the road reserve in a way that balances the needs of road users with the needs of the environment. This can be achieved by planting native species and improving habitat conditions outside the clear zone, through re-establishing groundcover and understory species.

Aboriginal and Non-Aboriginal history

Roads and Maritime Services procedures developed in consultation with local Aboriginal communities, ensure the identification and ongoing protection of sensitive cultural sites within the road corridor.

The Golden Highway corridor holds special significance for Aboriginal people, with the corridor following a songline. Within the animist[64] belief system of Aboriginal people, songlines mark the route that local 'creator-beings' followed during the Dreaming period. Songlines are recorded in traditional stories, songs, dance and painting.

There are a number of possible locations of Aboriginal scarred trees, which have had their bark removed by Aboriginal people for the making of useful items:

- Gungal – Grassy Box Woodland area adjoining the Battery Rock rest area north of Gungal.
- Cassilis – East of the village on the northern roadside near the road edge (may have been used to take bark for a coolamon / carrying vessel).
- Leadville – Near Melrose Road there is a large tree remains.
- Dunedoo – West of Cobbora Road (E) trees have been recorded.
- Elong Elong – Near Cobbora Road (W) trees may be present in the road reserve, especially on the southern side.
- Gollan – Near Muronbung Road trees may be present in the road reserve.

There may also be numerous sites of Aboriginal significance west of Lettybrook Road at Borambil.

Jerrys Plains, Merriwa and Elong Elong are listed as indigenous places on the Register of the National Estate, a non-statutory archive of significant items.

In terms of European heritage, there are a number of items of significance in the Golden Highway corridor listed on various registers that should be protected from future development. These are shown in the table below, along with Bow Palaeontological site, a natural item of significance listed on the Register of the National Estate west of Bow River at Merriwa. In a road cutting here fossilised remains of marsupials that are now extinct have been recorded. Such remains have also been recorded in exposed banks of the Krui River at Merriwa / Cassilis.

Those items of national and state significance in particular require special protection. The items listed as being of national significance are listed on the Register of the National Estate, a list discontinued in 2007 and now non-statutory. There are no items in the Golden Highway corridor listed on the Commonwealth, National or World Heritage Lists.

64 Meaning spirituality contained in non-human entities.

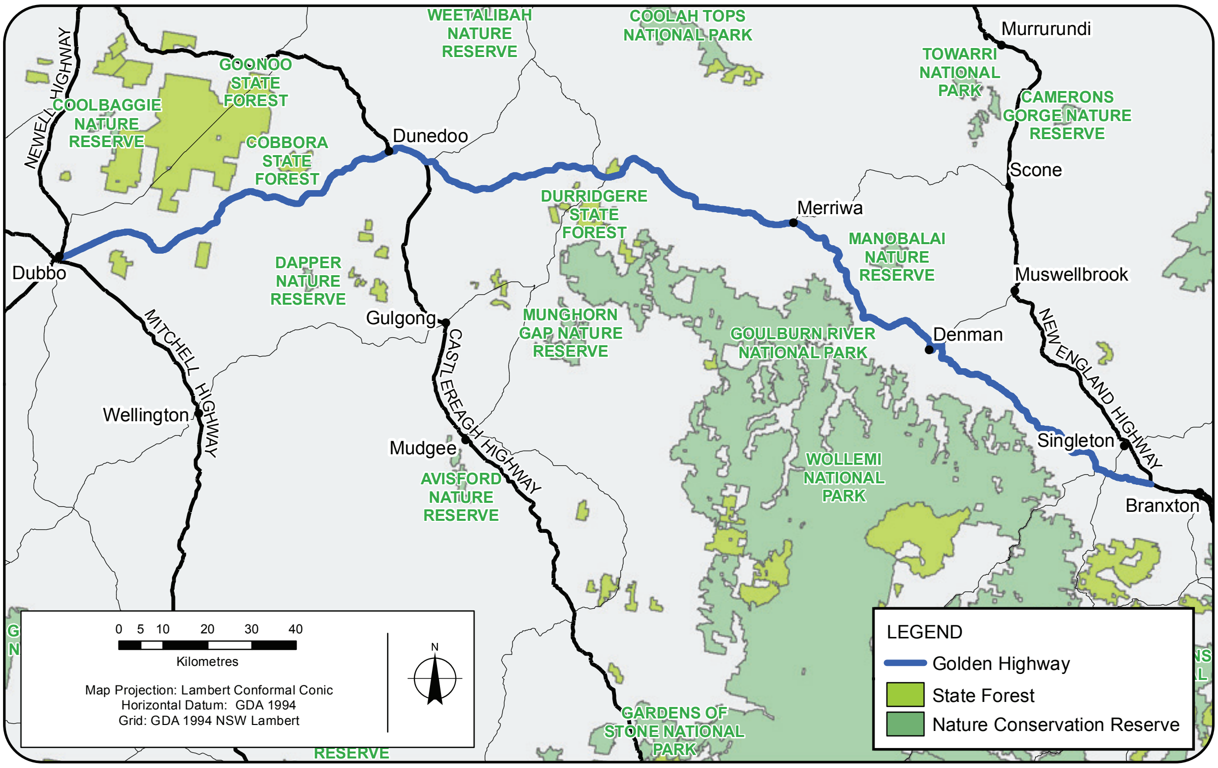
Table 5.33 Heritage items on the Golden Highway

Item	Location	Register of the National Estate	State Heritage Register	NSW State agency Heritage Register	Regional Environmental Plan	Local Environmental Plan
Brick Farm House	Mount Thorley					Yes
Church, School and Police Station Group	Jerrys Plains	Yes				
St James Anglican Church	Jerrys Plains	Yes				Yes
St Matthew's Catholic Church	Jerrys Plains					Yes
Post Office and Store	Jerrys Plains					Yes
Strowan (House)	Jerrys Plains	Yes				Yes
Bridge over Hunter River	Denman			Yes		
Merton Cottage	Denman	Yes	Yes		Yes	
Merton Cemetery	Denman				Yes	
St Matthias Anglican Church	Denman	Yes			Yes	
St Bernard's School and Residence	Denman				Yes	
St Joseph's Hall	Denman				Yes	
Olinda (House)	Denman				Yes	
Former Giants Creek School and Residence	Sandy Hollow				Yes	
St John's Anglican Church	Sandy Hollow				Yes	
Ellamara (Homestead)	Sandy Hollow				Yes	
Grave of Peter George	Gungal				Yes	
Brindley Park	Merriwa				Yes	
CBC Bank (former)	Merriwa					Yes
Campbells Store	Merriwa					Yes
Cottage Museum (Colonial)	Merriwa		Yes		Yes	Yes
Fitzroy Hotel	Merriwa				Yes	Yes
Royal Hotel and Outbuildings	Merriwa				Yes	Yes
Terragong (House)	Merriwa				Yes	
Astros Theatre Facade	Merriwa				Yes	Yes
Merriwa Urban Conservation Area	Merriwa	Yes			Yes	
Merriwa Showground	Merriwa	Yes				
Bow Palaeontological Site	Merriwa				Yes	
Old Cassilis Woolshed	Cassilis	Yes				
Village of Cassilis	Cassilis	Yes				
Dunedoo Railway Station and Yard Group	Dunedoo	Yes	Yes	Yes		Yes
Barbigal Homestead	Barbigal					Yes
Barbigal Woolshed	Barbigal					Yes
House (Californian Bungalow) at 169 Fitzroy Street	Dubbo					Yes
Dubbo Base Hospital	Dubbo					Yes
Total		**10**	**3**	**2**	**18**	**16**

The NSW EPA has not identified any contaminated land in the Golden Highway corridor[65].

The map below shows forest reserves, waterways and other protected areas surrounding the Golden Highway corridor.

Figure 5.16 National parks, State forests and other protected areas[66]



65 NSW Department of Environment, Climate Change and Water 2014, NSW EPA Contaminated Land Record available at: *www.environment.nsw.gov.au/prclmapp/searchregister.aspx*

66 Australian Government 2014, Protected Matters Search Tool Map, Department of the Environment, available at: *http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf*

6 FUTURE CORRIDOR CHANGES

6.1 Population and demographics

Population forecast

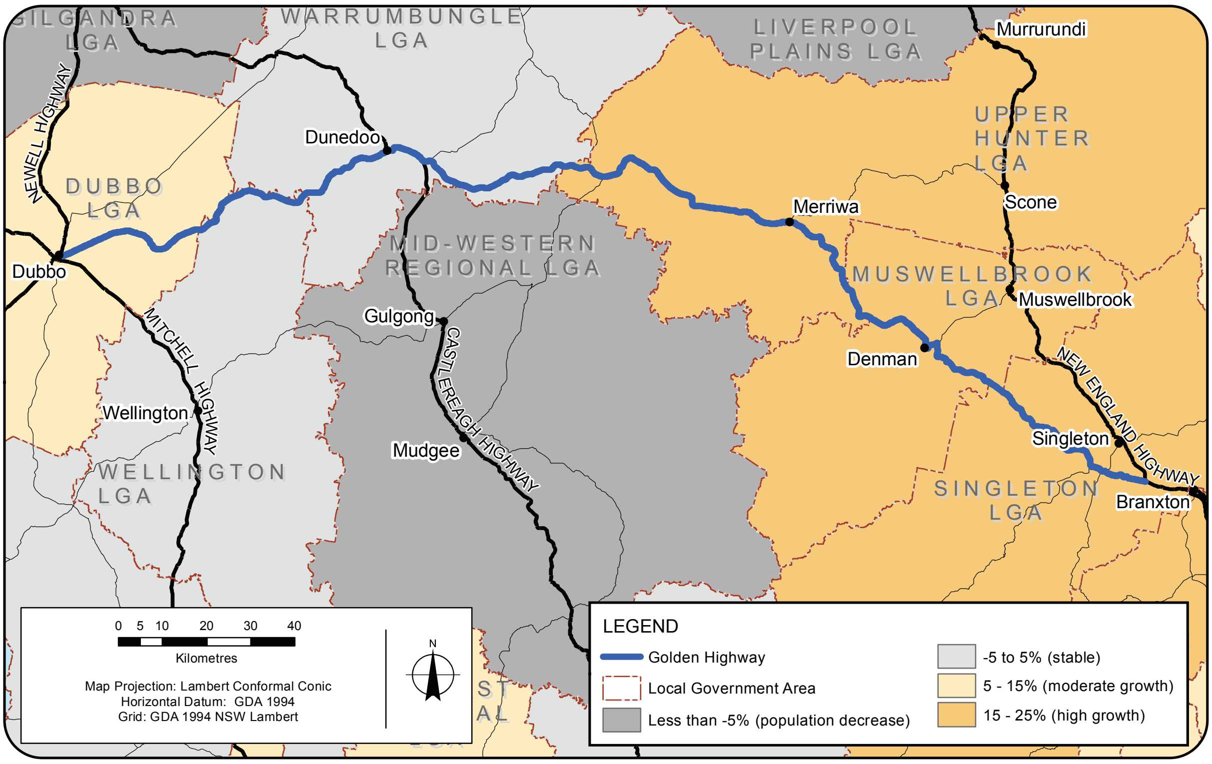
The combined population of LGAs along the corridor was 113,350 people in 2011. However, with the exception of Dubbo there are no large towns within the corridor. Dubbo is at the western end of the corridor and the Golden Highway is not significantly affected by Dubbo traffic. The population of Dubbo (urban centre) was recorded as 32,327 in 2011. Other towns along the corridor are much smaller:

- Denman: 1,403
- Merriwa: 973
- Dunedoo: 802[67]

The Department of Planning and Environment has prepared population projections and growth rates for regional NSW in the *NSW Long Term Transport Master Plan*.

As shown in Figure 6.1, along the Golden Highway corridor, the highest population increase is expected in the Singleton LGA, which is set to grow from 23,450 in 2011 to 27,700 people in the year 2031, an annual average change of 0.9 percent (linear) between 2011 and 2031[68]. This is closely followed by the Muswellbrook LGA which is expected to grow from 16,300 in 2011 to 19,250 people in the year 2031. The population growth in these LGAs is expected to increase general traffic in mining areas east of Denman. The Dubbo and Upper Hunter LGAs are expected to continue to grow steadily in population, with the populations of the Warrumbungle and Wellington LGAs expected to decline marginally.

Figure 6.1 Forecast NSW population growth 2011-2031[69]



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Data source: Geoscience Australia, 250K Topographic Data Series 3.

67 Australian Bureau of Statistics, Census Data 2011.

68 Department of Planning and Infrastructure 2013, *New South Wales in the future: Preliminary 2013 population projections*, Preliminary release of NSW state and local government area population projections, DPI, Sydney. *http://www.planning.nsw.gov.au/Portals/0/HousingDelivery*

69 Transport for NSW 2013, *NSW Freight and Ports Strategy*, TfNSW, Sydney, p. 100

Table 6.1 Population LGA and urban centre demographics (2011 to 2031)

LGA	2011 LGA Population	Urban centres	Forecast 2031 LGA Population	% Change
Singleton	23,450	None in corridor	27,700	+18.2%
Muswellbrook	16,300	Denman	19,250	+18.0%
Upper Hunter	14,200	Merriwa	16,550	+16.4%
Warrumbungle	9,950	Dunedoo	9,500	-4.5%
Wellington	8,950	None in corridor	8,600	-4.0%
Dubbo	40,500	Dubbo	45,400	+12.2%
Total	**113,350**		**127,000**	**+12.0%**
NSW State average				**+27.5%**

Demographic changes and trends

The average age of the population in all urban centres along the corridor is increasing, with the exception of Merriwa where the median age has remained constant between 2006 and 2011, however the percentage of the population 65 years of age and over has decreased and the population aged 0-14 years has increased.[70] The town of Dunedoo was most affected by aging between 2006 and 2011 with the median age of the population increasing from 43 to 49 years of age. As the population ages, demand for public and community transport connections between towns and larger regional centres will grow.

The percentage of the labour force employed full time has increased in all urban centres with the exception of Denman where it has been fairly stable. The largest increase was in Dunedoo where the percentage of the labour force employed full time increased from 49.7 percent to 53.3 percent.

The main industries of employment for LGAs within the corridor changed between 2006 and 2011. In Singleton and Muswellbrook, cafés, restaurants and takeaway food services replaced school education as the second largest employment industry in the LGAs. In Upper Hunter LGA, coal mining replaced 'other' livestock farming as the second largest employment industry in the LGA.

Table 6.2 Car Ownership for LGAs within Golden Highway corridor (2011)

LGA	No cars in household	One car in household	Two cars in household	Three or more cars in household	Not stated
Singleton	4.4%	26.3%	42.2%	24.4%	2.7%
Muswellbrook	7.0%	32.6%	38.4%	18.7%	3.4%
Upper Hunter	6.4%	32.5%	38.6%	19.3%	3.3%
Warrumbungle	6.9%	36.3%	33.8%	18.7%	4.3%
Wellington	11.5%	35.0%	33.0%	16.5%	4.0%
Dubbo	7.8%	35.3%	36.8%	16.8%	3.4%
AUSTRALIA	**8.6%**	**35.8%**	**36.1%**	**16.5%**	**3.0%**

70 Australian Bureau of Statistics, Census Data, 2006 and 2011.

The majority of trips to work in the LGAs within the Golden Highway corridor are made by car with very few trips made by any other mode of transport.[71]

The level of car ownership is higher than the Australian average in the LGAs of Singleton, Muswellbrook and Upper Hunter, similar to the average in Warrumbungle and Dubbo and lower than the average in Wellington[72]. It should be noted that a very small proportion of the population of the Wellington LGA resides in the Golden Highway corridor, with the majority of the population further south.

6.2 Land use changes

The Department of Planning and Environment's (DoPE) Draft Hunter Regional Plan outlines a vision, goals and actions for the sustainable growth of the Hunter region through to 2036. This draft plan supersedes the Lower Hunter Regional Strategy, Mid North Coast Regional Strategy and Upper Hunter Strategic Land Use Plan.

The Hunter region is identified as the most populous region in NSW outside of Sydney and the largest regional economy in Australia (Deloitte, 2013). This region is expected to grow by 117,850 residents, requiring an additional 60,000 homes by 2036. The four main goals of the strategy are to:

- Grow Australia's next major city – "Hunter City"
- Grow the largest regional economy in Australia
- Protect and connect natural environments
- Support robust regional communities
-

In April 2016, the DP&E also released the *Draft Central West* and *Orana Regional Plan* also outlines a vision, goals and actions for the sustainable growth of the region through to 2036. The plan aims to grow and diversify the economy over by creating more jobs, strengthening the region's cities, centres, towns and villages, and sustainably managing its agricultural, mining and natural resources. This region is expected to grow by 18,750, requiring an additional 13,600 homes. The four main goals of the strategy are for:

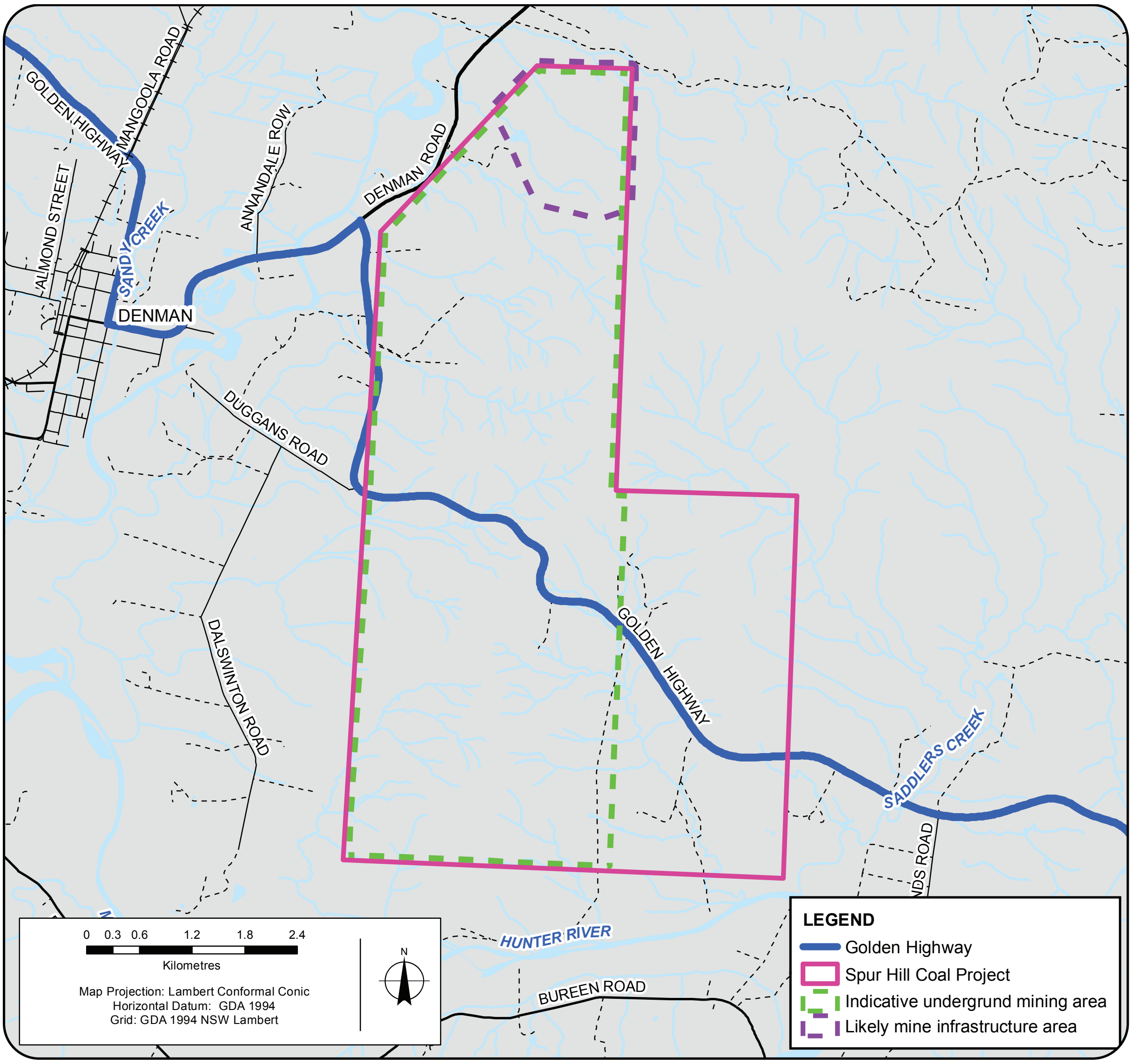
- A growing and diverse regional economy
- A regional with strong freight transport and utility infrastructure networks that support economic growth
- A region that protects and enhances its productive agricultural land, natural resources and environmental assets
- Strong communities and liveable places that cater for the region's changing population.

Of particular relevance to the Golden Highway is the Spur Hill Underground Coking Coal Project (see Figure 6.2). A proposal to undertake longwall mining underneath the Golden Highway in the vicinity of Ogilvies Hill, the proposed project has a recoverable resource of approximately 154 million tonnes over a 25 year life, with extraction rates of approximately 8 million tonnes per year.

71 Australian Bureau of Statistics, Census Data 2011.

72 Australian Bureau of Statistics, Census Data 2011.

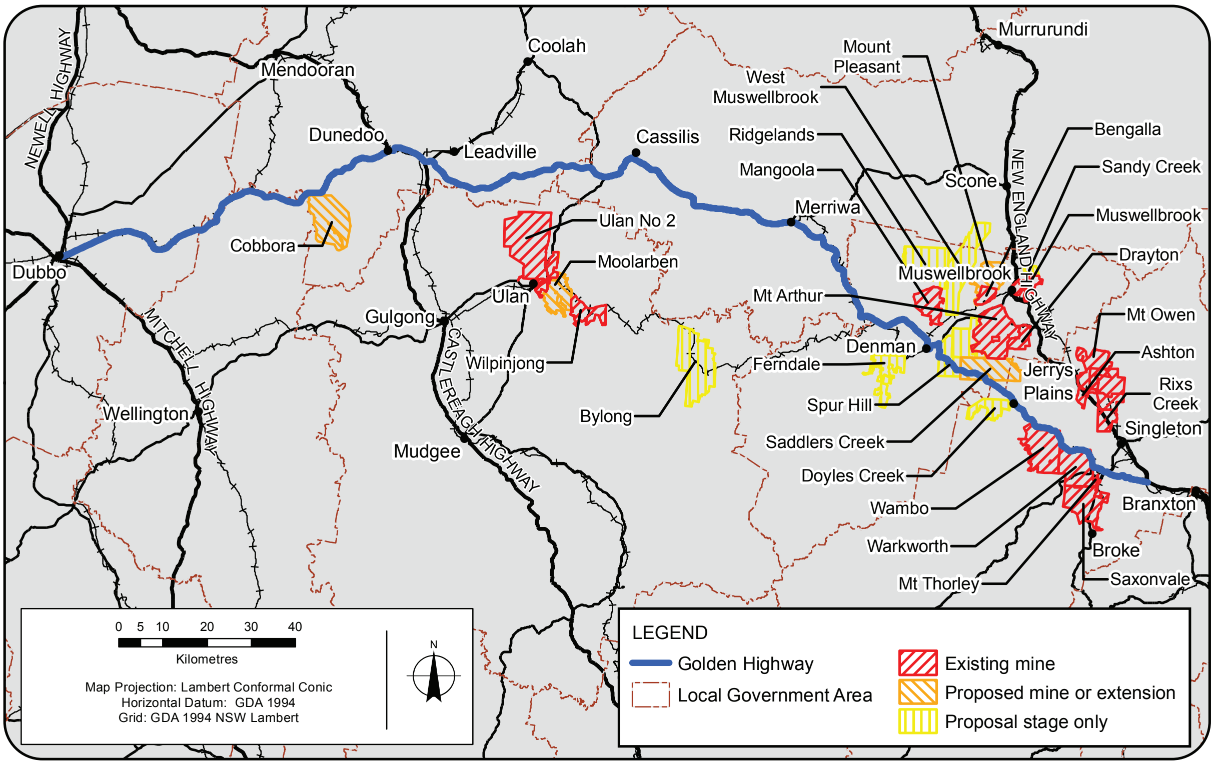
Figure 6.2 Locality plan for Spur Hill Underground mine[73]



The proposed management of subsidence as a result of this proposal needs to be carefully assessed to ensure the safety, efficiency and integrity of the Golden Highway is not compromised, particularly in areas of steep and mountainous terrain such as Ogilvies Hill. Given the strategic importance of the Golden Highway as a freight corridor including as an essential OSOM route, its closure (including any detours) for the purposes of mining will need to be carefully considered, given the lack of alternate OSOM routes in the immediate area. This is particularly relevant to the mining industry, as most OSOM loads on the Golden Highway are in some way attributed to the mining industry. Roads and Maritime will

73 Spur Hill Underground Coking Coal Project – Application for a Gateway Certificate – Technical Overview, p4, available at *https://majorprojects.affinitylive.com/public/5c271d713ebb9dca4baecdce34e7eee4/1.%20Technical%20Overview.pdf*

Figure 6.3 Coal mines in the vicinity of Denman[74]



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Data source: Geoscience Australia, 250K Topographic Data Series 3

be working closely with Spur Hill, Muswellbrook Shire Council and the Department of Planning and Environment to ensure that any proposed management measures for subsidence do not unduly compromise the safety and efficiency of the Golden Highway, and other local and state roads in the event of managed closures on the Golden Highway.

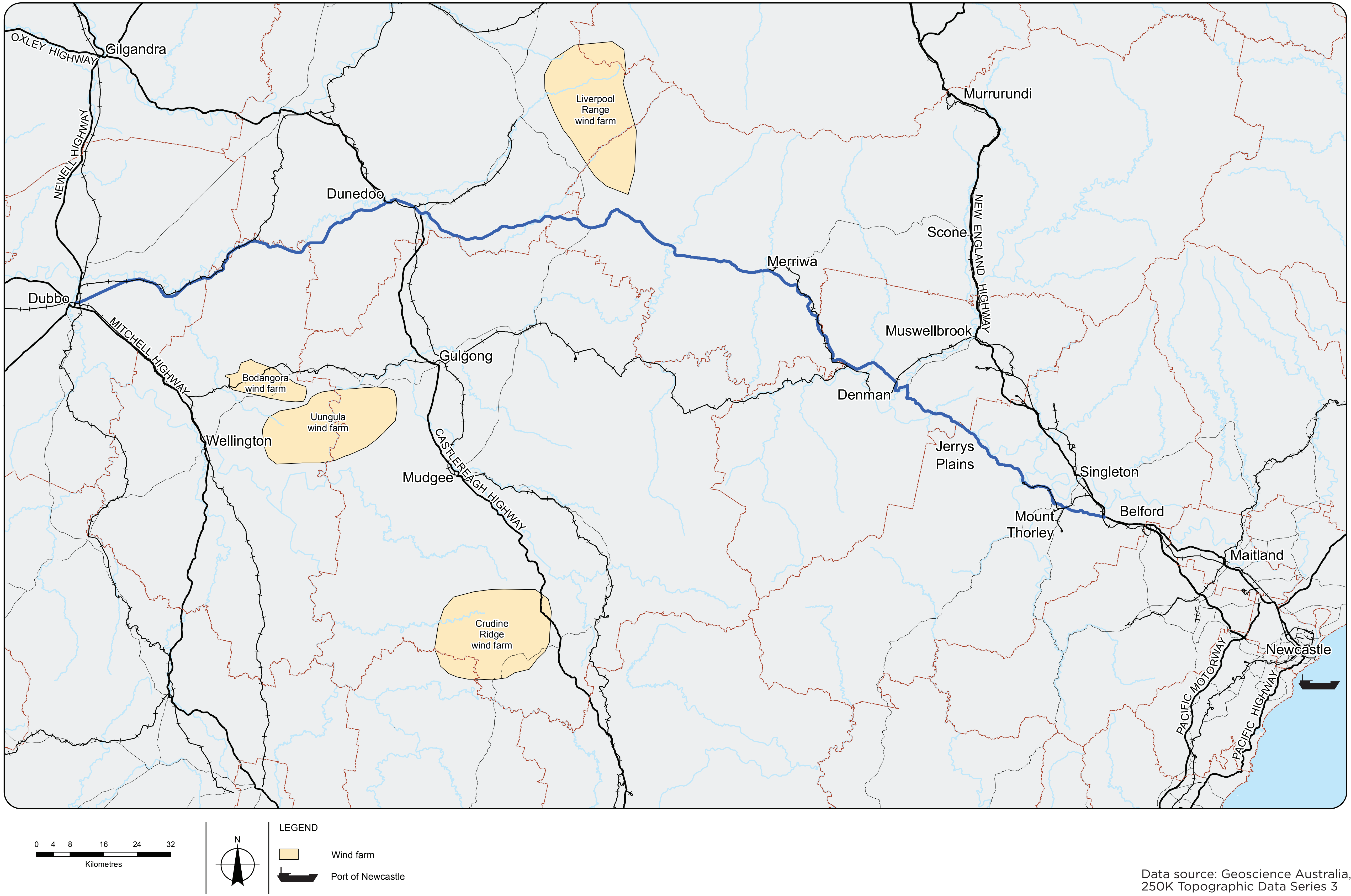
The *Muswellbrook Shire Council (Draft Muswellbrook Mine Affected Roads – Road Network Plan 2014)* has also been investigating the cumulative impacts of mining east of the Denman township.

The report recommends that Muswellbrook Shire Council, Roads and Maritime, Department of Planning and Environment and individual mine companies continue to liaise to identify and confirm the long term aspirations of the immediate road network, with a particular focus on the long term safety and efficiency of the Golden Highway as the principal road corridor.

Immediately north-west of Wollombi Brook, Glencore are proposing a joint venture, the *United Wambo JV Project* which would increase the life of the existing Wambo and United mines to 2031. As part of this proposal, Glencore are proposing to realign the Golden Highway over a 2 km length to get access to

74 Muswellbrook Shire Council, 2014, Draft Muswellbrook Mine Affected Roads Road Network Plan, p5

Figure 6.4 Wind farms along the Golden Highway corridor



Data source: Geoscience Australia, 250K Topographic Data Series 3

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the coal reserves below the Golden Highway. The planning for this project is in its preliminary stages. Roads and Maritime will continue to liaise with Glencore as they further develop this planning proposal and ensure the function and integrity of the highway is not impacted during the realignment, or the operational phases of the *United Wambo JV Project*.

There is expected to be continued growth in coal mining activities north and east of Denman as well as in the Ulan area south of Cassilis and at Cobbora, 22 kilometres south-west of the town of Dunedoo. There are new mines planned in these areas. At Cobbora the Cobbora Coal Project has been approved by the State and Federal Governments and will provide up to 12 million tonnes of coal per annum for domestic and export markets[75]. At Ulan, Glencore Coal/Mitsubishi have commenced operations of the Ulan West project in 2014, a new underground longwall mining operation. Ulan West is expected to produce 6.7 million tonnes of export thermal coal per annum[76]. Wilipinjong mine has also had approval to increase production from 12.5 million tonnes per year to 16 million tonnes per year. To the south-east, Yancoal at its Moolarben Coal facility has recently had approval for Stage 2 of mining incorporating one open cut and two underground mines, which will extract an additional 16 million tonnes of coal per annum[77, 78]. An additional coal mine is also being proposed for the Bylong Valley. The Bylong Coal Project is proposing to extract 6.5 million tonnes per year with an expected life of 25 years. Construction of the project is expected to commence in 2017. All of these coal mines rely on the Golden Highway for the supply of materials which includes OSOM movements.

Mining activity grew significantly between 2007 and 2012 and is expected to continue to grow until 2020[79]. In Muswellbrook Shire alone, coal extraction grew from four million tonnes in 2001 to 43 million tonnes in 2011[80]. Significant employment growth over the period to 2036 will be driven by the growth of the coal and coal seam gas industries, particularly in the Singleton, Muswellbrook and Upper Hunter LGAs.

There are four wind farms (see Figure 6.4) along the Golden Highway corridor in various stages of planning. These include the Bodangra wind farm which has received consent (33 turbines), Uungala wind farm which has received Director General's Requirements (330 turbines), Crudine Ridge wind farm currently under assessment (106 turbines) and the Liverpool Range wind farm which is currently reviewing submissions (288 turbines). These four wind farms will transport all wind turbine components by road along the Golden Highway from the Port of Newcastle. Each turbine requires a minimum of seven OSOM movements. As such, these turbines will generate in excess of 5,000 OSOM movements along the Golden Highway during construction, should they proceed. The transport of these wind turbines (over and above existing OSOM movements) is expected to have a significant

75 Cobbora Holding Company 2014, *Cobbora Coal Project Website Home Page*, website accessed on 21 October 2014 *http://www.cobbora.com/*

76 Glencore Coal 2014, *Glencore Coal – About Us – Developments*, website accessed on 21 October 2014 *http://www.xstratacoal.com/en/aboutus/pages/developments.aspx*

77 Yancoal 2014, *Moolarben (Fact Sheet)*, website accessed on 21 October 2014, *http://www.yancoal.com.au/icms_docs/187639_Moolarben_Factsheet_May_2014.pdf*

78 Yancoal 2014, *Yancoal – Mines – Moolarben*, website accessed on 21 October 2014, *http://www.yancoal.com.au/page/key-assets/mines/moolarben/*

79 NSW Department of Planning and Infrastructure 2012, *Upper Hunter Strategic Regional Land Use Plan*.

80 Muswellbrook Shire Council 2013, *Muswellbrook Shire's coal industry*, website accessed on 23 October 2014 *http://www.muswellbrook.nsw.gov.au/index.php/about-muswellbrook-shire/industry-profile/434-coal-industry*

operational impact on the Golden Highway. It is recommended that options to provide additional lay-by areas be investigated, to allow these OSOM movements to be temporarily stored, to allow trailing vehicles to pass.

Other major developments along the Golden Highway corridor which are in various stages of planning include a feedlot and abattoir west of Denman (near Yarrawa estate), and a proposal for a storage area for Orica along Rosemount Road to service the mining industry. Roads and Maritime will continue to liaise with Muswellbrook Council and project proponents to continue to assess the impact of these proposals on the Golden Highway.

ARTC has also for some time being considering a rail bypass of Denman. The rail bypass would significantly reduce the length of the track to Ulan, and would also provide a practical doubling of capacity along this section of track. In the July 2015 update to the Hunter Valley Corridor Capacity Strategy, the need for the Denman Bypass is no longer required under the current prospective volume scenario. Roads and Maritime will continue to liaise with ARTC on any future changes to the Ulan line near the Golden Highway corridor. In the short-term, Roads and Maritime is coordinating the upgrade of the existing Denman rail level crossing of the Golden Highway with ARTC, to provide boom gates, as well as an upgrade to the adjacent Mangoola Road intersection.

More housing will be required to accommodate population growth particularly in the Singleton, Muswellbrook and Upper Hunter LGAs, and a larger number of smaller dwellings will be needed in the region to accommodate smaller household sizes. In terms of urban release areas, there are proposed developments immediately west of the town of Singleton and investigation areas further to the west, north and north-east of town[81]. The Singleton Heights area has sufficient land zoned for around 2,000 new dwellings[82]. Muswellbrook Shire has around 133 hectares of land immediately to the west of Denman township zoned RU5 – Village Zone in the Local Environmental Plan (LEP)[83]. There is potential at South Muswellbrook for a further 1,300 new dwellings in zoned residential land[84] and there are urban release areas on the eastern side of the town of Muswellbrook[85]. On balance however these residential developments are expected to have only minor impacts on the Golden Highway.

The NSW Government is committed to protecting strategic agricultural lands and critical industry clusters from any development that would unsatisfactorily impact upon these lands through planning processes.

West of Denman residential development is expected to be much slower. Merriwa is only growing very slowly to the south-east of the town (Oxley View Estate)[86]. Proposed rural residential development to the south and west of Dunedoo comprises a total area of 336.5 hectares[87]. There are no residential release areas proposed within close proximity to the Golden Highway corridor in the Wellington LGA.[88]

81 Planning Workshop Australia 2008, Singleton Land Use Strategy

82 NSW Department of Planning and Infrastructure 2012, *Upper Hunter Strategic Regional Land Use Plan*.

83 Muswellbrook Shire Development Control Plan Section 27 – West Denman Urban Release Area

84 NSW Department of Planning and Infrastructure 2012, *Upper Hunter Strategic Regional Land Use Plan*.

85 SGS Economics and Planning 2014, Muswellbrook Residential and Rural Residential Strategy, February 2014

86 Upper Hunter Shire Council 2014, Oxley View Estate, Merriwa at: *http://upperhunter.nsw.gov.au/our-shire/economic-development/oxley-view-estate-merriwa.aspx*

87 Warrumbungle Shire Council & GHD 2013, Warrumbungle Shire Council Land Use Strategy March 2013, available at: *http://www.warrumbungle.nsw.gov.au/planning---development/lep-and-dcp/lep-and-dcp/default.aspx*

88 Wellington Council 2012, Wellington Council (Draft) Settlement Strategy, January 2012, available at: *http://www.wellington.nsw.gov.au/building-a-development/100-supporting-strategies*

Dubbo is expected to grow at a steady rate, and Dubbo City Council has urban release areas on the fringes of the urban centre, with the largest being west of the city and to the south-east of the city[89]. The Golden Highway is not expected to be significantly impacted by these developments due to their location and high prevalence of trips within town.

6.3 Traffic growth

Traffic growth can be forecast by considering historical annual daily traffic (ADT) data and projecting population, land use and freight changes in the future.

Average linear growth rates based on 10 years of data (2004 to 2014) for the different sections of the corridor vary, with the highest growth occurring immediately west of the New England Highway, of up to 2 percent annual linear growth. The rural sections within and adjacent to Merriwa were lower at between 1.1 to 1.5 percent. To ensure continued accurate traffic growth projections, regular traffic surveys will be conducted along the Golden Highway. Historic growth rates are shown on Table 6.3.

Table 6.3 ADT volumes and historical growth rates (2004 to 2014)

Corridor Planning Sections	ADT (vehicles per day)	Growth rate	Section Length (km)
1. Belford to Mt Thorley	4,975 - 11,370[1]	2% - 1.9%	13.4
2. Mt Thorley to Jerrys Plains	3,748	1.2%	23.4
3. Jerrys Plains	3,042	1.9%	10.1
4. Jerrys Plains to Denman	3,042	1.9%	18.6
5. Denman	N/A	N/A	5.0
6. Denman to Merriwa	2,089	1.5%	46.3
7. Merriwa	3,522	1.1%	2.8
8. Merriwa to Dunedoo	1,644 - 2223[2]	1.6% - 1.5%[2]	102.2
9. Dunedoo	N/A	N/A	4.0
10. Dunedoo to Dubbo	1507	1.6%	83
11. Dubbo	20,800[3]	N/A	4.5

Notes:

1 – Between Putty Road and Mount Thorley overpass

2 – Between Castlereagh Highway junction and Dunedoo

3 – Estimated from a weekday 6am – 6pm count.

N/A – Growth rate not available due to lack of traffic survey data.

89 Dubbo City Council 2014, Dubbo Local Environmental Plan 2011 (updated 15 August 2014), available at: *http://www.legislation.nsw.gov.au/maintop/view/inforce/epi+580+2011+cd+0+N*


Warkworth Mine

6.4 Future freight task and heavy vehicle volumes

The *NSW Freight and Ports Strategy* identifies the freight task in NSW is projected to nearly double to 794 million tonnes by 2031. Mining represents almost half of the current task and is expected to remain the single largest freight task in NSW. All outputs from coal mines in the Golden Highway corridor are transported by rail however mine inputs and oversize loads carrying equipment are mostly transported by road.

The forecast daily truck movements and freight task on the Golden Highway for 2031 is shown in Table 6.4. The volume of freight moved along the corridor is expected to increase significantly over the next twenty years. The highest growth is expected at the eastern end of the corridor. East of Putty Road (East) freight volumes are expected to nearly double between 2011 and 2031. At the western end of the corridor freight volumes will increase by a much smaller but still significant 60 percent.

Table 6.4 Forecast year daily truck annual tonnage (2031)[90]

From	To	Daily trucks (2031)			Annual kilotonnes			% Increase from 2011
		Forward	Reverse	Total	Forward	Reverse	Total	
New England Hwy	Putty Rd (E)	840	840	1680	7,450	700	8,150	+99%
Putty Rd (E)	Denman Rd	310	310	620	2,450	550	3,000	+82%
Denman Rd	Castlereagh Hwy (E)	310	310	620	2,500	550	3,050	+79%
Castlereagh Hwy (E)	Castlereagh Hwy (W)	360	360	720	360	360	720	+64%
Castlereagh Hwy (W)	Buninyong Rd	130	130	260	1,000	200	1,200	+60%

90 Transport for NSW Strategic Freight Model (SFM) 2013

Westbound road freight movements at the eastern end of the corridor are primarily to the mines, including a significant amount of dangerous goods by road, whilst eastbound freight from Dubbo is a mix of grains. Although traded grain volumes across NSW are expected to increase if production can grow according to growing demand in the northern hemisphere, surplus grain exported in bulk via the rail served terminal at Newcastle has fallen. This is due to the development of an alternative chain, containerised exports travelling via rail and road through Port Botany[91].

Rail transport is far more significant than road transport in terms of total freight movement and in particular freight travelling in an easterly direction (by weight) between the Central West and Upper Hunter. In 2011 it was estimated that 7,650 kilotonnes of freight (including 7,150 kilotonnes of coal), moved in an easterly direction between Ulan, around 30 kilometres south of the Ulan Road intersection at Cassilis, and Bengalla Junction, around 25 kilometres north-east of Denman. West of Ulan rail freight volumes fall to 550 kilotonnes per annum and commodities carried are varied. West of Dunedoo total freight volumes are around 800 kilotonnes per annum. Rail freight east of Ulan is expected to more than double between 2011 and 2031 and increase by around 82 percent between Ulan and Dunedoo and by 75 percent west of Dunedoo.

Use of higher productivity vehicles will improve productivity along the Golden Highway. Roads and Maritime Services has undertaken a preliminary assessment which identifies that PBS Class 2B vehicles of up to 30 metres in length, including Super B-Doubles and A-Doubles are suitable following completion of enabling works including overtaking lanes, heavy vehicle inspection sites, flood immunity works, truck parking bays, upgrade of the Denman level crossing, enhanced delineation of narrow bridges, and the grade seperation of the New England Highway.

6.5 Future public transport

In regional NSW, the provision of good public transport services requires careful planning to take account of long travel distances and dispersed demand.

Regional Transport Plans will be integrated with land use planning and other NSW Government initiatives, such as Department of Planning Regional Plans. This will ensure transport services and infrastructure are provided in a timely way, particularly in regions and centres with strong growth.

Regional cycling, walking and public transport initiatives are addressed in the Hunter and Central West Regional Transport Plans to help reduce reliance on cars in the region.

For example, active transport actions include:

- Roll out the Walking Communities Program.
- Connecting Centres Cycling Program.
- Roll out the Cycling Towns Program.
- Improve information about walking and cycling routes and facilities.

The Hunter Regional Transport Plan also identifies an action to improve the frequency and hours of bus operation for inter-regional routes, whilst the Central West Regional Transport Plan also includes an action to identify opportunities to improve the infrastructure that supports public transport services, such as bus stops and shelters, terminal facilities and customer information.

6.6 Climate change

The expected impacts of climate change in Australia vary across the continent and include changing rainfall patterns, reduced water availability and an increased frequency of severe weather events.

91 Hyder Consulting Pty Ltd 2012, *Grain Case Study – NSW Road Freight Model (Draft Report)*, Chapter 4, p. 5

The NSW Office of Environment and Heritage (OEH) has developed a new, fine-scale climate projections for New South Wales and the Australian Capital Territory using a regional climate model called the NSW and ACT Regional Climate Model or NARCliM. This includes the Hunter and Central West regions and Golden Highway corridor.

The impacts of climate change in the Hunter Region are expected to include rising sea levels, increased rainfall (with the exception of winter), increased run-off particularly in summer, higher temperatures, more frequent flooding, increased erosion on the steeper slopes of the upper catchments, and impacts on ecosystems particularly highly cleared and fragmented forests and woodlands.

In Western NSW the expectation is for temperatures to increase, rainfall to increase in summer and decrease in winter, run-off to increase in summer and autumn, the intensity of flood producing rainfall to increase and erosion to increase due to more frequent and intense storm events and reduced vegetation. Some surface soils on alluvial plains will be particularly vulnerable to erosion, as will gullies on the slopes and plains. Hotter and drier conditions are likely to affect all natural ecosystems, with riverine and wetland ecosystems to be the worst affected[92].

Increased rainfall and run-off at certain times of the year would increase the rate of road surface deterioration without changes to pavement types. It would also increase erosion and affect slope stability. More frequent and intense storm events and more frequent flooding would lead to more frequent short and long term highway closures. The expected impact of climate change on ecosystems would necessitate a greater awareness of road corridor changes and their impacts on vulnerable species of flora and fauna. Climatic conditions will continue to be monitored for potential road impacts.

6.7 Road corridor changes

There is one significant project currently in planning on the Golden Highway in addition to various asset improvement projects and small signage and delineation projects.

Belford to Golden Highway Upgrade (New England Highway)

In March 2015, the NSW Government committed $85 million to build an interchange and extend the duplication of the New England Highway from Belford to the Golden Highway.

92 NSW Department of Environment and Heritage 2011, *NSW Climate Impact Profile Interactive Map* – Hunter and Western NSW regions, available at: *http://www.environment.nsw.gov.au/climateChange/impactprofile.htm*

7 CORRIDOR CHALLENGES AND PRIORITIES

7.1 Overview of road corridor challenges and priorities

Corridor challenges are the main issues that need to be overcome to maintain or improve transport roles and services that the Golden Highway provides for the community. They include challenges already evident and others that are expected to emerge as a result of future changes in land use and demographics. These challenges have been identified over the short (Table 7.1), medium (Table 7.2) and long-term (Table 7.3) against broader *NSW Long Term Transport Master Plan* objectives.

NSW Government priorities for responding to the Golden Highway corridor challenges are set out below. The priorities are divided into short, medium and long term investment priorities proposed to address these challenges over the next 20 years.

The benefits of the proposed actions include:

- Improved road safety by providing wider lanes, sealed shoulders and wide clear zones.
- Upgraded intersections to provide left and right turn bays, and acceleration lanes at major intersections.
- Improved overtaking opportunities with new overtaking lanes and climbing lanes in sections of steep terrain.
- Accelerated pavement rehabilitation to reduce ongoing maintenance liability, and provide smoother road surfaces.
- Improved rail level crossing safety with upgrades to boom gates and reduced speed limits on level crossing approaches.
- New and upgraded heavy vehicle parking bays and rest areas.
- Improved heavy vehicle enforcement through three new heavy vehicle enforcement sites.
- Enable access to the Golden Highway by higher productivity vehicles (HPVs) of up to PBS Class 2B (30 m in length) in the short term.
- Improved route reliability by providing flood immunity works at Mudies Creek and the Talbragar River floodplain, Uarbry.

Regular monitoring of this corridor strategy will be undertaken, with a progress report being prepared every three years to review progress and to identify any issues that require addressing. Monitoring will also help to identify new actions or tasks that may be required to ensure ongoing opportunities along the Golden Highway are being considered.

The Strategy will be targeted for review every five years. Implementation of the final strategy will be a shared responsibility with the NSW Government and Councils in collaboration with other state agencies. The NSW Government will also liaise with the Federal Government, particularly where funding may be provided under various Federal programs.

Table 7.1 Key challenges and short-term priorities (0 - 5 years)

Key challenges and short-term priorities		
Specific challenge	**Specific actions**	**Strategic response reference**
Improve liveability / Reduce social disadvantage		
• Pedestrian facilities across the Golden Highway at Dunedoo are limited.	• Work with the Warrumbungle Shire Council to prepare a Pedestrian Access and Mobility Plan for Dunedoo to identify the warrant and location of a pedestrian crossing of the Golden Highway. If the warrant for a pedestrian crossing is met, provide a crossing.	4.7 Walking and cycling in the corridor.
• Along the eastern approach of the Golden Highway to Dubbo, the standard and consistency of pedestrian and cycling facilities are variable.	• Work with Western Plains Regional Council to provide a safe, consistent and connected pedestrian and cycling network along the Golden Highway corridor from Buninyong Road (particularly the university and hospital precinct) to the central business district.	4.7 Walking and cycling in the corridor.
Economic growth / productivity		
• The lack of overtaking opportunities in the sections of the corridor east of Denman increases travel times and increases the risk of crashes, as motorists increasingly accept smaller gaps to undertake an overtaking manoeuvre.	• Construct eastbound and westbound overtaking lanes between the New England Highway and Putty Road (*east*).	5.2 Traffic *Overtaking opportunities and level of service*
• Insufficient heavy vehicle inspection sites, poor flood immunity at discrete locations restrict the ability of the Golden Highway to operate as a reliable and efficient freight corridor to accommodate higher productivity vehicles (HPVs).	• Construct three new heavy vehicle inspection sites of a sufficient size to accommodate HPVs and over-dimensional and over-mass vehicles. Two sites are proposed east of Mt Thorley, with a bi-directional site proposed east of Dunedoo. • Undertake flood immunity works at Mudies Creek near Belford, and Uarbry near Dunedoo.	5.3 Heavy vehicles on the Golden Highway
• Heavy vehicles slow other traffic on Ogilvies Hill, Winery Hill and on other inclines. On Ogilvies Hill truck breakdowns regularly occur, closing the highway for up to six hours at a time.	• Construct a westbound climbing lane at Winery Hill and an eastbound climbing lane near Woodlands Road. • Construct eastbound and westbound climbing lanes at Ogilvies Hill.	5.4 Road design and geometry *Grades*

Key challenges and short-term priorities		
Specific challenge	**Specific actions**	**Strategic response reference**
Economic growth / productivity		
• The intersection of the Golden Highway with the New England Highway has a poor crash history and experiences delays in peak periods.	• Grade separate the intersection of the Golden and New England highways.	5.4 Road design and geometry *Intersections*
• The layout of the intersections of Putty Road (east) and Denman Road do not facilitate efficient turning movements. These intersections also exhibit a poor crash history.	• Upgrade the intersections of Putty Road (east) and Denman Road to provide westbound slip lanes, protected right turn bays and lighting.	5.4 Road design and geometry *Intersections*
• HPVs larger than B-Doubles operating at HML are not able to travel on the Golden Highway.	• Enable access to PBS Class 2B (30 metres in length), following completion of enabling works including overtaking lanes, heavy vehicle inspection sites, flood immunity works, truck parking bays, upgrade of the Denman level crossing, enhanced delineation of narrow bridges, and the grade seperation of the New England Highway.	5.3 Heavy vehicles on the Golden Highway
Regional development / accessibility		
• School buses which serve rural areas are provided with limited facilities to pick up and drop off school children.	• Work with councils and school bus operators to identify opportunities to improve school bus stops with programmed road or maintenance works.	4.6 Public transport in the corridor. *School bus routes*
• Flood immunity at Mudies Creek (Whittingham) and Uarbry (part of the Talbragar River system) is poor, and closes the highway for up to two days at a time.	• Provide improved flood immunity at Mudies Creek and Uarbry to improve route reliability.	5.4 Road design and geometry *Flooding*

Key challenges and short-term priorities

Specific challenge	Specific actions	Strategic response reference
Improve sustainability		
• Wollombi Brook and Halls Creek bridges have a 'poor' Bridge Health Index (BHI).	• Repair and upgrade Wollombi Brook and Halls Creek bridges to return them to an appropriate condition.	5.4 Road design and geometry *Bridge structural health*
• There are four slopes which have an Assessed Risk Level (ARL) of 2.	• Ensure management plans for each of the four ARL 2 slopes are maintained. • Remediate these higher risk slopes to reduce their risk rating.	5.4 Road design and geometry *Road slope risk rating*
• There are three road culverts with an Assessed Risk Level (ARL) of 1, and nine culverts with an ARL of 2.	• Ensure management plans for all ARL 1 and 2 culverts are maintained. • Remediate or replace these higher risk culverts to reduce their risk rating.	5.4 Road design and geometry *Road culvert risk rating*
• There are a large number of culverts for which initial inspections have not yet been carried out to establish an Assessed Risk Level (ARL)	• Increase funding to accelerate inspection of outstanding culverts	5.4 Road design and geometry *Road culvert risk rating*
• The current program of limited road and pavement maintenance has resulted in an ageing pavement asset. Thirty nine percent (39%) of the length of the Golden Highway has a pavement age of in excess of 40 years. Increased pavement age increases the risk of pavement failure and maintenance liability.	• Undertake accelerated pavement rehabilitation (with lane and shoulder widening works) to minimise long term maintenance costs. Pavement rehabilitation will be prioritised between the New England Highway and Denman, and between Dunedoo and Dubbo.	5.5 Road pavement condition *Pavement age*
• Vegetation communities of significant value exist along the Golden Highway corridor.	• Identify and protect (where possible) vegetation communities of significant value along the Golden Highway. In instances where these occur within the clear zone, ensure a balanced approach is considered which may include limited clearing or roadside barriers.	5.6 Environment

Key challenges and short-term priorities		
Specific challenge	**Specific actions**	**Strategic response reference**
Safety and security		
• Narrow lane widths and shoulders, and hazardous clear zones have resulted in a high proportion of single vehicle run-off road crashes.	• Undertake lane and shoulder widening with clear zone works to reduce crash risk. Prioritise these works between the New England Highway and Denman, and west of the intersection of the Castlereagh Highway (east).	5.1 Road safety *Crash types* 5.4 Road design and geometry *Lane and bridge widths Sealed shoulder widths Clear zone and barriers*
• There are an insufficient number of heavy vehicle parking bays and rest areas along the highway to help manage driver fatigue. Current facilities also have access limitations.	• Provide regular heavy vehicle parking bays along the full length of the highway, and close to driver amenities such as at Jerrys Plains. • Provide a major heavy vehicle rest area at Sandy Hollow. • Improve access to the Dunedoo and Cassilis rest areas. • Provide a heavy vehicle rest area in the vicinity of Elong Elong. • Ensure parking bays and heavy vehicle rest areas can accommodate over-dimensional and over-mass vehicles as required.	5.3 Heavy vehicles on the Golden Highway *Heavy vehicle rest areas*
• Access into light vehicle rest areas are of a variable standard.	• Improve access to light vehicle rest areas such as at Gungal and Battery Rocks. • Work with the Muswellbrook Shire Council to relocate the Causey Park rest area.	5.3 Heavy vehicles on the Golden Highway *Heavy vehicle rest areas*

Key challenges and short-term priorities

Specific challenge	Specific actions	Strategic response reference
Safety and security		
• There are three high speed rail level crossings on the Golden Highway. The crossing at Denman exhibits a high number of train movements, and is located adjacent to a local road intersection which has no left or right turn bays. Crossings are currently only protected with signals.	• Upgrade the level crossing at Denman to provide boom gates and advanced warning signals, and upgrade the intersection of Mangoola Road. • Review the speed limit across all high speed level crossings against the *NSW Speed Zoning Guidelines* to identify the benefits of a reduced 80 km/hr regulatory speed limit at the Denman, Barbigal and Beni level crossings. • Continue to manage all rail level crossings in accordance with agreed management plans with the rail operator.	5.1 Road Safety *Rail Crossings*
• There are 12 bridges that are 7.8 metres in width or narrower that would benefit from enhanced delineation of the bridge and bridge approaches.	• Provide enhanced delineation of narrow bridges and approaches to improve driver awareness.	5.4 Road design and geometry *Lane and bridge widths*
• The bridge over the Krui River is only 6 m wide, with 2.8 m travel lanes (and no shoulders), and on a tight westbound approach curve.	• Install vehicle activated signs and provide a reduced truck and bus speed limit over this bridge. • Commence a planning study to assess options for the widening or replacement of this bridge. The planning study should also review the adequacy of the road alignment on the bridge approach.	5.4 Road design and geometry *Lane and bridge widths*
• Poor surface drainage over Wollombi Brook at Warkworth has resulted in a number of aqua planing crashes.	• Improve surface drainage at Wollombi Brook.	5.4 Road design and geometry *Flooding*

Key challenges and short-term priorities

Specific challenge	Specific actions	Strategic response reference
Safety and security		
• There are numerous intersections which do not meet current standards and do not provide left and and right turn bays, or experience a number of "near misses".	• Upgrade intersections on a priority basis to provide left and right turn bays. Upgrade the intersections with Cobbora Road (west), Muronbong Road and Durraween Lane. • Where shoulder widening works are programmed in the area, provide minimum BAL/BAR treatments to intersections. • Roads and Maritime have developed a Dubbo Traffic Model in consultation with Western Plains Regional Council (formally Dubbo City Council) for the purpose of testing options for a second high level crossing of the Macquarie River. That model will be used in future to investigate network expansion requests from Council on a priority basis. Safety performance will continue to be monitored and prioritised on an annual basis.	5.4 Road design and geometry *Intersections*
• There is a high proportion of fatigue related crashes between Belford and Jerrys Plains.	• Install audio tactile lines on edge and centre lines where fatigue crashes are prevalent. • Undertake lane and seal widening with clear zone works to reduce crash risk. • Install raised retro-reflective markers along the full length of the Golden Highway to provide route consistency.	5.4 Road design and geometry *Edge lines and retro-reflective pavement markers*
• There is an inconsistent application of speed limits along the Golden Highway, particularly on town approaches and through towns.	• Undertake a review of speed limits to ensure route consistency, but to also consider reducing speed limits on at-risk locations in accordance with the *NSW Speed Zoning Guidelines.*	5.1 Road safety *Speed zones*

Key challenges and short-term priorities		
Specific challenge	**Specific actions**	**Strategic response reference**
Improve transport integration process		
• Traffic survey data is limited along the Golden Highway which is a limitation to fully understanding the performance of the highway	• Undertake regular traffic surveys along the Golden Highway.	5.2 Traffic *Traffic volumes*
• Ensure value for money to the NSW community.	• Undertake works concurrently where economies of scale can be provided.	N/A
• Ensure positive community engagement.	• Engage with local government, road user and community groups along the Golden Highway to ensure concerns are identified and assessed.	3 Community involvement
• There are locations where the Golden Highway is not in a gazetted public road corridor	• Undertake survey of the Golden Highway corridor to determine where the road is not located in a gazetted public road corridor, and investigate options to address the issue.	N/A

Table 7.2 Key challenges and medium-term priorities (5 - 10 years)

Key challenges and medium-term priorities		
Specific challenge	**Specific actions**	**Strategic response reference**
Improve liveability / Reduce social disadvantage		
• Heavy vehicle volumes and/or vehicle sizes increase reducing amenity in towns and villages.	• Monitor the amenity impact of heavy vehicle volumes and types on towns. Undertake traffic calming or other works where warranted.	6.3 Traffic Growth
Economic growth / productivity		
• The lack of overtaking opportunities in the sections of the corridor east of Denman increases travel times and increases the risk of crashes, as motorists increasingly accept smaller gaps to undertake an overtaking manoeuvre.	• Construct additional overtaking lanes between the New England Highway and Denman.	5.2 Traffic *Overtaking opportunities and level of service*

Key challenges and medium-term priorities		
Specific challenge	**Specific actions**	**Strategic response reference**
Economic growth / productivity		
• Heavy vehicles slow other traffic on steep inclines.	• Progressively provide climbing lanes on all steep grades where heavy vehicle performance is affected, including the steeper grades east and west of Merriwa, east of the Krui River, west of Cassilis Road and near Ulan Road. Also undertake minor upgrades on the section of westbound climbing lane east of Merriwa to improve the safety of the eastbound lane, and the merge tapers on the climbing lanes at Pikes Gap (west of Denman).	5.4 Road design and geometry *Grades*
Regional development / accessibility		
• School buses which serve rural areas are provided with limited facilities to pick up and drop off school children.	• Work with councils and school bus operators to identify opportunities to improve school bus stops with programmed road or maintenance works.	4.6 Public transport in the corridor. *School bus routes*
• Intelligent transport systems (ITS) infrastructure such as variable message signs (VMSs) and other technologies have the potential to provide enhanced driver information to minimise the impacts from road closures.	• Continue to monitor the development of ITS to assess the feasibility and warrant for application on the Golden Highway.	5.2 Traffic *Incident management*
Improve sustainability		
• There are 28 slopes on the Golden Highway which require monitoring and management.	• Continue to monitor and manage slopes to ensure slopes with an ARL of 1 or 2 are addressed.	5.4 Road design and geometry *Road slope risk rating*
• There are 77 bridge sized culverts and 741 non-bridge sized culverts on the Golden Highway which require monitoring and management.	• Continue to monitor and manage culverts to ensure culverts with an ARL of 1 or 2 are addressed.	5.4 Road geometry *Road culvert risk rating*
• There are 104 bridges on the Golden Highway which require monitoring and management.	• Continue to monitor and manage bridges to ensure no bridge falls into a "poor" Bridge Health Index (BHI).	5.4 Road geometry *Bridge structural health.*
• The bridge over the Krui River is only 6 m wide, with 2.8 m travel lanes (and no shoulders), and on a tight westbound approach curve.	• Pending the outcomes of previous planning studies, either widen or replace the existing Krui River, including any road approach works.	5.4 Road geometry *Bridge structural health.*

Key challenges and medium-term priorities		
Specific challenge	**Specific actions**	**Strategic response reference**
Improve sustainability		
• The current program of limited road and pavement maintenance has resulted in an ageing pavement asset. Thirty nine per cent (39%) of the length of the Golden Highway has a pavement age of in excess of 40 years. Increased pavement age increases the risk of pavement failure and maintenance liability.	• Continue a program of accelerated pavement rehabilitation (with lane and shoulder widening works) to minimise long term maintenance costs. Pavement rehabilitation will be prioritised east and west of Jerrys Plains, and between Denman and Dunedoo.	5.5 Road pavement condition *Pavement age*
• Vegetation communities of significant value exist along the Golden Highway corridor. Such vegetation needs to be protected, with such protection balanced against the need to provide adequate clear zones to provide a forgiving roadside environment.	• Identify and protect (where possible) vegetation communities of significant value along the Golden Highway. In instances where these occur within the clear zone, ensure a balanced approach is considered which may include limited clearing or roadside barriers.	5.6 Environment
• Intelligent transport systems (ITS) have the potential to improve the efficiency of heavy vehicle enforcement, and minimise freight operator costs.	• Continue to monitor the development of ITS for heavy vehicle enforcement, and assess the feasibility and warrant for application on the Golden Highway.	5.3 Traffic *Heavy vehicle enforcement sites*
Safety and security		
• The adequacy and frequency of rest areas and parking bays is not sufficient as the number of heavy vehicles grow and the size of heavy vehicles increase.	• Continue to monitor the adequacy of rest area and stopping bay facilities. • Upgrade rest areas and parking bays where necessary.	5.3 Heavy vehicles on the Golden Highway *Heavy vehicle rest areas*
• Access into rest areas is of a variable standard, and rest area facilities are limited.	• Progressively upgrade accesses to all rest areas, and progressively upgrade facilities to meet National Guidelines.	5.3 Heavy vehicles on the Golden Highway *Heavy vehicle rest areas*
• Narrow lane widths and shoulders, and hazardous clear zones have resulted in a high proportion of single vehicle run-off road crashes.	• Complete lane and seal widening with clear zone works to reduce crash risk between the New England Highway and Denman. Commence a program of lane and shoulder widening east and west of Jerrys Plains, and between Denman and Dunedoo.	5.4 Road design and geometry *Lane and bridge widths* *Sealed shoulder widths* *Clear zone and barriers*
• There are three high speed rail level crossings on the Golden Highway	• Continue to monitor and manage all rail level crossings in accordance with agreed management plans with the rail operator.	5.1 Road Safety *Rail Crossings*

Key challenges and medium-term priorities		
Specific challenge	**Specific actions**	**Strategic response reference**
Safety and security		
• There are numerous intersections which do not meet current standards, such as for the provision of left and right turn bays. This increases the risk of crashes and traffic delays.	• Upgrade intersections on a priority basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash risk and road hierarchy (such as State and Regional roads). Intersections to be upgraded include Pagan Street, Reedy Creek Road, Bylong Valley Way, Wybong Road, Worondi Creek Road, Flaggs Road, Westwood Road, Vennacher Street, Ringwood Road, Idaville Road, Pembrooke Road, Ulan Road, Vinegaroy Road (Warrumbungle Way) and the Castlereagh Highway (east and west). • Where shoulder widening works are programmed in the area, provide minimum BAL/BAR treatments to intersections. • Rationalise and upgrade intersections in the Dubbo urban area from White Street to Tony McGrane Place.	5.4 Road design and geometry *Intersections*
Improve transport integration process		
• Traffic survey data is limited along the Golden Highway	• Continue to undertake regular traffic surveys to understand the performance of the Golden Highway.	5.2 Traffic *Traffic volumes*
• Ensure value for money is achieved for the NSW community.	• Undertake works concurrently where economies of scale can be provided.	N/A
• Ensure positive community engagement.	• Engage with local government, road user and community groups along the Golden Highway to ensure concerns are identified and assessed	3 Community involvement

Table 7.3 Key challenges and long-term priorities (10 - 20 years)

Key challenges and long-term priorities		
Specific challenge	**Specific actions**	**Strategic response reference**
Improve liveability / Reduce social disadvantage		
• Heavy vehicle volumes and/or heavy vehicle sizes increase reducing the amenity in towns and villages.	• Monitor the amenity impact of heavy vehicle volumes and types on towns. Undertake traffic calming or other works where warranted.	6.3 Traffic growth
Economic growth / productivity		
• The lack of overtaking opportunities in the sections of the corridor east of Denman increases travel times and increases the risk of crashes, as motorists increasingly accept smaller gaps to undertake an overtaking manoeuvre.	• Progressively provide overtaking lanes between the New England Highway and Denman to provide a three lane configuration with alternating overtaking lanes in each direction. Provide a flush median as part of these works for possible future upgrade to a median wire rope safety barrier. • Where warranted, increase capacity between Putty Road and Mount Thorley by providing two lanes in each direction.	5.2 Traffic *Overtaking opportunities and level of service*
• The limited number of overtaking lanes between Denman and Dubbo increases the risk of crashes as motorists accept smaller gaps to undertake an overtaking manoeuvre.	• Monitor the need to provide additional overtaking lanes between Denman and Dubbo.	5.2 Traffic *Overtaking opportunities and levels of service*
Economic growth / productivity		
• There is increased congestion on the eastern approach to Dubbo on the Golden Highway.	• Further monitoring of traffic in peak periods for the Dubbo urban area. • Duplicate the highway in Dubbo from the level crossing near White Street to Yarrandale Road, to provide improved access to the hospital and university precinct, and industrial areas on Yarrandale Road.	5.2 Traffic *Overtaking opportunities and levels of service*
• Heavy vehicles slow other traffic on steep inclines.	• Complete all climbing lanes on all steep grades where heavy vehicle performance is affected.	5.4 Road design and geometry *Grades*

Key challenges and long-term priorities		
Specific challenge	**Specific actions**	**Strategic response reference**
Regional development / accessibility		
• School buses which serve rural areas are provided with limited facilities to pick up and drop off school children.	• Work with councils and school bus operators to identify opportunities to improve school bus stops with programmed road or maintenance works.	4.6 Public transport in the corridor *School bus routes*
• Intelligent transport systems (ITS) infrastructure such as variable message signs (VMSs) and other technologies have the potential to provide enhanced driver information to minimise the impacts from road closures.	• Continue to monitor the development of ITS to assess the feasibility and warrant for application on the Golden Highway.	5.2 Traffic *Incident management*
Improve sustainability		
• There are 28 slopes on the Golden Highway which require monitoring and management.	• Continue to monitor and manage slopes to ensure slopes with an ARL of 1 or 2 are addressed.	5.4 Road design and geometry *Road slope risk rating*
• There are 77 bridge sized culverts and 741 non-bridge sized culverts on the Golden Highway which require monitoring and management.	• Continue to monitor and manage culverts to ensure culverts with an ARL of 1 or 2 are addressed.	5.4 Road geometry *Road culvert risk rating*
• There are 104 bridges on the Golden Highway which require monitoring and management.	• Continue to monitor and manage bridges to ensure no bridge falls into a "poor" Bridge Health Index (BHI). As traffic volumes increase (including for heavy vehicles), the long-term function of Cockfighter bridge should also be assessed for potential replacement.	5.4 Road geometry *Bridge structural health.*
• The current program of limited road and pavement maintenance has resulted in an ageing pavement asset. Thirty nine percent (39%) of the length of the Golden Highway has a pavement age of in excess of 40 years. Increased pavement age increases the risk pavement failure and maintenance liability.	• Continue a program of accelerated pavement rehabilitation (with lane and shoulder widening works) to minimise long term maintenance costs. Pavement rehabilitation will be prioritised between Denman and Dunedoo.	5.5 Road pavement condition *Pavement age*
• Vegetation communities of significant value exist along the Golden Highway corridor. Such vegetation needs to be protected, with such protection balanced against the need to provide adequate clear zones to provide a forgiving roadside environment.	• Identify and protect (where possible) vegetation communities of significant value along the Golden Highway. In instances where these occur within the clear zone, ensure a balanced approach is considered which may include limited clearing or roadside barriers.	5.6 Environment

Key challenges and long-term priorities		
Specific challenge	**Specific actions**	**Strategic response reference**
Safety and security		
• Intelligent transport systems (ITS) have the potential to improve the efficiency of heavy vehicle enforcement, and minimise freight operator costs.	• Continue to monitor the development of ITS for heavy vehicle enforcement, and assess the feasibility and warrant for application on the Golden Highway.	5.3 Heavy vehicles on the Golden Highway *Heavy vehicle enforcement sites*
• Narrow lane widths and shoulders, and hazardous clear zones have resulted in a high proportion of single vehicle run-off road crashes.	• Complete lane and seal widening with clear zone works to reduce crash risk between Denman and Dunedoo.	5.1 Road safety *Crash types* 5.4 Road design and geometry *Lane and bridge widths* *Sealed shoulder widths* *Clear zone and barriers*
• Heavy vehicle volumes and/or heavy vehicle sizes increase reducing the amenity in towns and villages.	• Continue to monitor the adequacy of rest area and stopping bay facilities. • Upgrade rest areas and parking bays where necessary.	5.3 Heavy vehicles on the Golden Highway *Heavy vehicle rest areas*
• Access into rest areas are of a variable standard, and rest area facilities are limited.	• Progressively upgrade accesses to all rest areas, and progressively upgrade facilities where warranted.	5.3 Heavy vehicles on the Golden Highway *Heavy vehicle rest areas*

Key challenges and long-term priorities		
Specific challenge	**Specific actions**	**Strategic response reference**
Safety and security		
• There are three high speed rail level crossings on the Golden Highway.	• Continue to monitor and manage all rail level crossings in accordance with agreed management plans with the rail operator. • Upgrade all high speed level crossings to boom gates.	5.1 Road Safety
• There are numerous intersections which do not meet current standards, such as for the provision of left and right turn bays. This increases the risk of crashes and traffic delays.	• Upgrade intersections on a priority basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash risk and road hierarchy (such as State and Regional roads). • Where shoulder widening works are programmed in the area, provide minimum BAL/BAR treatments to intersections.	5.4 Road design and geometry *Intersections*
Improve transport integration process		
• Traffic survey data is limited along the Golden Highway	• Continue to undertake regular traffic surveys to understand the performance of the Golden Highway.	5.2 Traffic *Traffic volumes*
• Ensure value of money is achieved for the NSW community.	• Undertake works concurrently where economies of scale can be provided.	N/A
• Ensure positive community engagement.	• Engage with local government, road user and community groups along the Golden Highway to ensure concerns are identified and assessed.	3 Community involvement

7.2 Corridor performance and priorities mapped by planning section

Current corridor performance and priorities that cover the short (0-5 years), medium (5-10 years) and long-term (10-20 years) have been provided in map form for each of the 11 corridor planning sections as follows:

Section 1: Belford to Mt Thorley (Figure 7.1)

Section 2: Mt Thorley to Jerrys Plains (Figure 7.2).

Section 3: Jerrys Plains (Figure 7.3).

Section 4: Jerrys Plains to Denman (Figure 7.4).

Section 5: Denman (township) (Figure 7.5).

Section 6: Denman to Merriwa (Figure 7.6).

Section 7: Merriwa (township) (Figure 7.7).

Section 8: Merriwa to Dunedoo (Figure 7.8).

Section 9: Dunedoo (township) (Figure 7.9).

Section 10: Dunedoo to Dubbo (Figure 7.10).

Section 11: Dubbo (urban area) (Figure 7.11).

Golden Highway corridor performance has been mapped using the following performance categories.

- **Road safety performance:** road safety performance has been summarised using casualty crash rate per kilometre and casualty crash rate per 100 million vehicular kilometres travelled (MVKT). Crash rates have been colour coded to differentiate the relative performance of the road corridor.

	Casualty crashes per km	Casualty crashes per 100 MVKT
Dark green	< 0.18	< 6.85
Light green	0.18 - 0.2	9.56 – 6.85
Yellow	0.2 – 1.14	9.56 – 12.34
Red	1.14 – 1.7	12.34 – 16.44
Black	> 1.7	> 16.44

- **Road pavement condition:** road pavement condition has been summarised using pavement age and pavement roughness (measured in International Roughness Index or IRI). Road pavement condition has been colour coded to differentiate the relative performance of the road corridor.

	Pavement Age	Pavement roughness (IRI)
	-	-
	< 20 years	< 4.2
	20 – 40 years	
	> 40 years	≥ 4.2
	-	-

- **Road design and geometry:** road design and geometry has been summarised by travel lane width, sealed shoulder width, curve radius and vertical grades. Road design and geometry have been colour coded to differentiate the relative performance of the road corridor.

	Lane Width	Sealed shoulder width	Curve radius	Grades
	-	-	> 600m	-
	≥ 3.5m	≥ 2	460 – 600 m	< 6%
	3.25 - < 3.5m	1 - < 2m	240- 460 m	-
	3.0 - < 3.25m	< 1m	90 - 240 m	>6%
	-	-	< 90 m	-

- **Traffic efficiency performance:** traffic efficiency has been measured using the modelled level of service (LoS) during peak hours (typically an AM peak hour) for both 2015 and 2035 (projected). For simplicity purposes, only the westbound direction is shown which is likely to be poorer due to the steeper westbound grades over the Great Dividing Range. Traffic efficiency has been colour coded to differentiate the relative performance of the road corridor.

	LoS 2015	LoS 2035
	A	A
	B	B
	C	C
	D	D
	E	E

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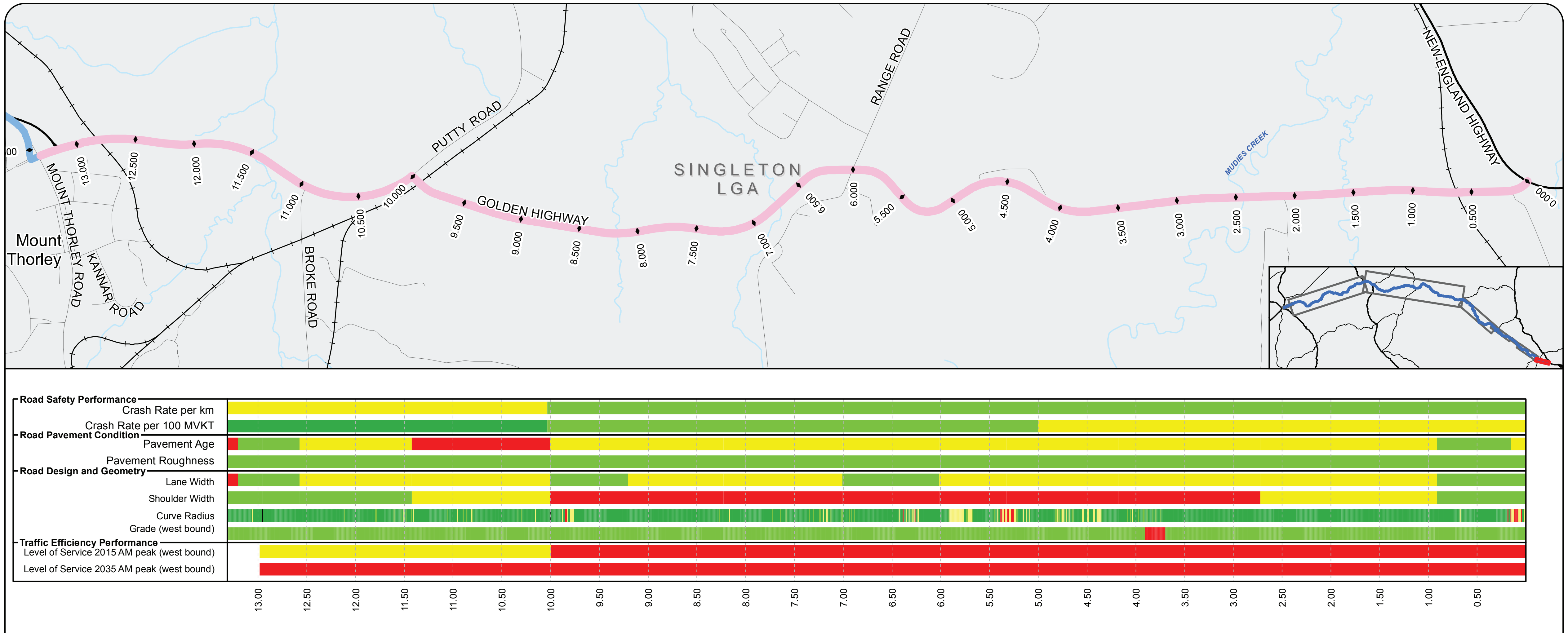
Figure 7.1 Section 1 Belford to Mt Thorley Road corridor performance and priorities.



Short term actions (0 - 5 years)	Medium term actions (5 - 10 years)	Long term actions (> 10 years)
Construct eastbound and westbound overtaking lanes between the New England Highway and Putty Road (east).	Construct additional overtaking lanes between the New England Highway and Denman.	Progressively provide overtaking lanes between the New England Highway and Denman to provide a three lane configuration with alternating overtaking lanes in each direction. Provide a flush median as part of these works for possible future upgrade to a median wire rope safety barrier.
Construct two (2) new heavy vehicle inspection sites of a sufficient size to accommodate Higher Productivity Vehicles and over-dimensional and over-mass vehicles east of Mt Thorley.		Where warranted, increase capacity between Putty Road and Mount Thorley by providing two lanes in each direction.
Ensure a management plan is maintained for the Assessed Risk Level 2 slope at Whittingham. Remediate this slope to reduce its risk rating.		
Undertake accelerated pavement rehabilitation between the New England Highway and Denman (with lane and shoulder widening works, and clearzone works) to minimise long term maintenance costs and reduce road safety risk.		
Grade separate the intersection of the Golden and New England Highways.		
Undertake flood immunity works at Mudies Creek near Belford.		
Upgrade the intersection of Putty Road (east) to provide a westbound slip lane, protected right turn bay and lighting.		
Enable access for Performance Based Standards (PBS) Class 2B heavy vehicles of up to 30m in length following completion of enabling works.		

0 0.1750.35 0.7 1.05 1.4
Kilometres

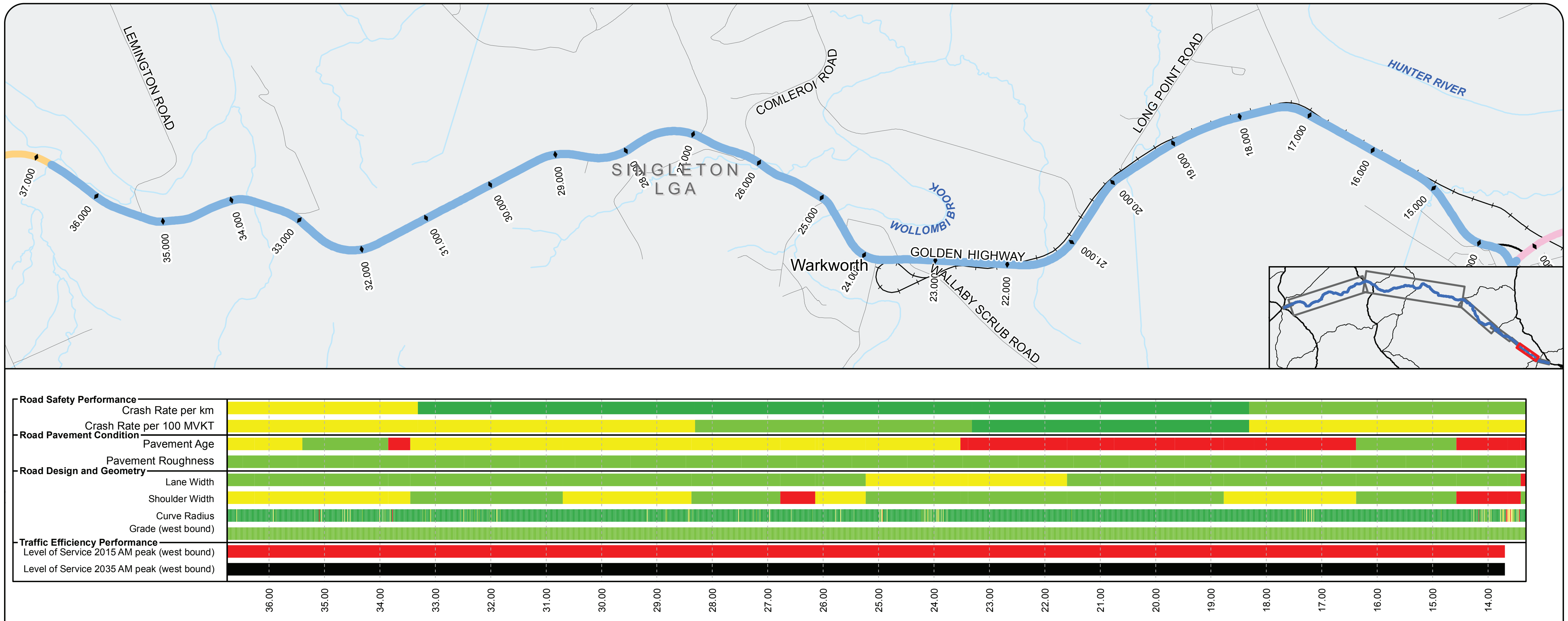
N

LEGEND
Section 1

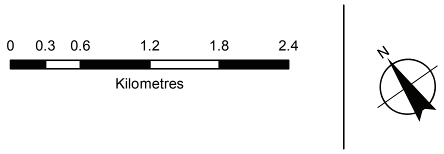
	Crashes per km	Crashes per MVKT	Pavement Age	Pavement Roughness	Lane Width	Sealed Shoulder Width	Curve Radius	Grade	LOS 2015	LOS 2035
	< 0.18	Low Risk (< 6.85)	——	——	——	——	> 600m	——	A	A
	0.18 - 0.2	Low - Medium Risk (6.85 - 9.56)	< 20 years	< 4.2	≥ 3.5m	≥ 2m	460m - 600m	< 6%	B	B
	0.2 - 1.14	Medium Risk (9.56 - 12.34)	20 - 40 years	——	3.25m - < 3.5m	1m - < 2m	240m - 460m	——	C	C
	1.14 - 1.7	Medium - High Risk (12.34 - 16.44)	> 40 years	≥ 4.2	3.0m - < 3.25m	< 1m	90m - 240m	> 6%	D	D
	> 1.7	High Risk (> 16.44)	——	——	——	——	< 90m	——	E	E

Data source: Geoscience Australia, 250K Topographic Data Series 3

Figure 7.2 Section 2 Mt Thorley to Jerrys Plains Road corridor performance and priorities.



Short term actions (0 - 5 years)	Medium term actions (5 - 10 years)	Long term actions (> 10 years)
Ensure management plans are maintained for the Assessed Risk Level 2 slopes at Warkworth. Remediate these slopes to reduce their risk rating.	Continue a program of accelerated pavement rehabilitation (with lane and shoulder widening works, and clearzone works) to minimise long term maintenance costs and road safety risk. Pavement rehabilitation will be prioritised between the New England Highway and Denman.	Progressively provide overtaking lanes between the New England Highway and Denman to provide a three lane configuration with alternating overtaking lanes in each direction. Provide a flush median as part of these works for possible future upgrade to a median wire rope safety barrier.
Improve surface drainage at Wollombi Brook.	Complete lane and seal widening with clearzone works to reduce crash risk between the New England Highway and Denman.	Where shoulder widening works are programmed in the area, provide minimum Basic Left-turn/Basic Right-turn treatments to intersections.
Repair and upgrade Wollombi Brook bridge to return it to an appropriate condition.	Upgrade intersections on a priority basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash risk and road hierarchy (such as State and Regional roads).	Upgrade intersections on a priority basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash risk and road hierarchy (such as State and Regional roads).
Ensure management plans are maintained for the two Assessed Risk Level 2 culverts near Warkworth. Remediate or replace these culverts to reduce their risk rating.	Where shoulder widening works are programmed in the area, provide minimum Basic Left-turn/Basic Right-turn treatments to intersections.	
Provide enhanced delineation of narrow bridges and bridge approaches at Wollombi Brook to improve driver awareness.		
Enable access for Performance Based Standards (PBS) Class 2B heavy vehicles of up to 30m in length following completion of enabling works.		

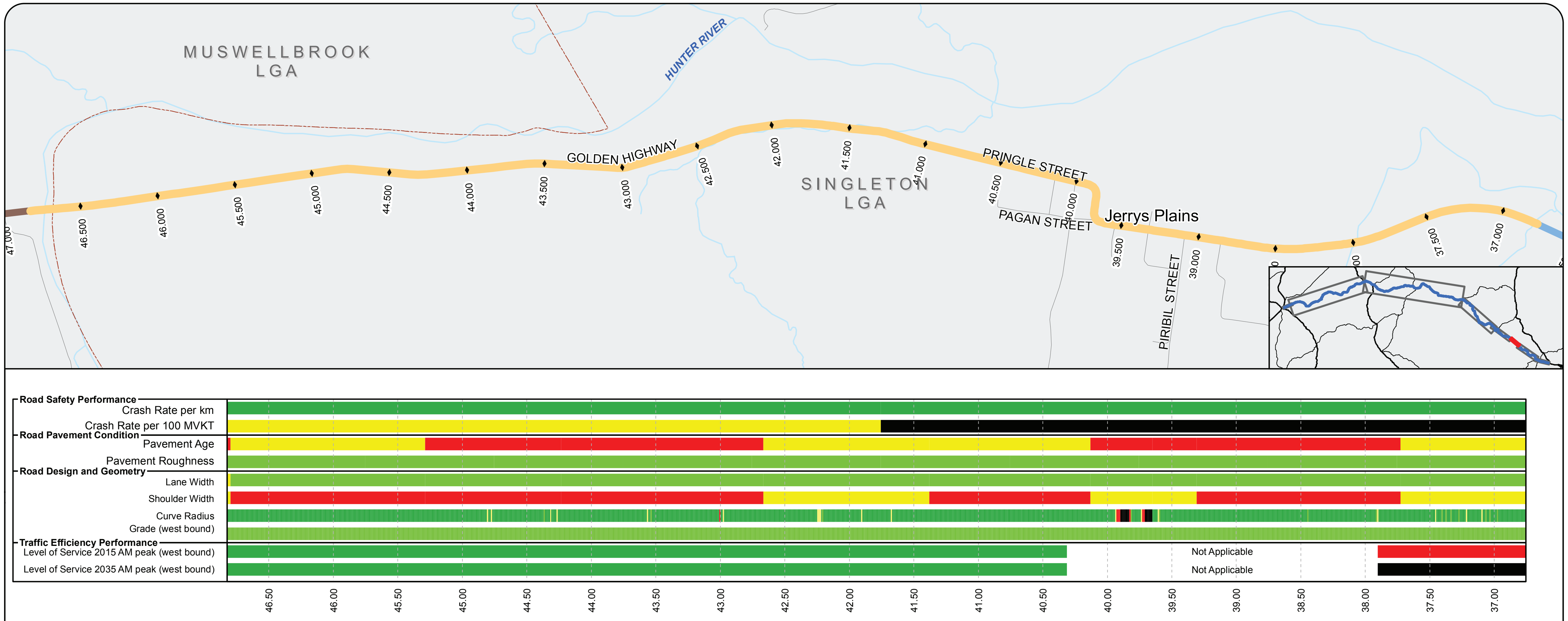


LEGEND
Section 2

	Crashes per km	Crashes per MVKT	Pavement Age	Pavement Roughness	Lane Width	Sealed Shoulder Width	Curve Radius	Grade	LOS 2015	LOS 2035
Dark green	< 0.18	Low Risk (< 6.85)	—	—	—	—	> 600m	—	A	A
Light green	0.18 - 0.2	Low - Medium Risk (6.85 - 9.56)	< 20 years	< 4.2	≥ 3.5m	≥ 2m	460m - 600m	< 6%	B	B
Yellow	0.2 - 1.14	Medium Risk (9.56 - 12.34)	20 - 40 years	—	3.25m - < 3.5m	1m - < 2m	240m - 460m	—	C	C
Red	1.14 - 1.7	Medium - High Risk (12.34 - 16.44)	> 40 years	≥ 4.2	3.0m - < 3.25m	< 1m	90m - 240m	> 6%	D	D
Black	> 1.7	High Risk (> 16.44)	—	—	—	—	< 90m	—	E	E

Data source: Geoscience Australia, 250K Topographic Data Series 3

Figure 7.3 Section 3 Jerrys Plains Road corridor performance and priorities.



Short term actions (0 - 5 years)	Medium term actions (5 - 10 years)	Long term actions (> 10 years)
Provide regular heavy vehicle parking bays along the full length of the highway, such as at the Jerrys Plains service station.	Monitor the amenity impact of heavy vehicle volumes and types on towns. Undertake traffic calming or other works where warranted.	Monitor the amenity impact of heavy vehicle volumes and types on towns. Undertake traffic calming or other works where warranted.
Enable access for Performance Based Standards (PBS) Class 2B heavy vehicles of up to 30 m in length following completion of enabling works.	Continue a program of accelerated pavement rehabilitation (with lane and shoulder widening works, and clearzone works) to minimise long term maintenance costs and road safety risk. Pavement rehabilitation will be prioritised between the New England Highway and Denman, and particularly east and west of Jerrys Plains. As part of these works, address the "s" curves on the westbound approach to Jerrys Plains.	Progressively provide overtaking lanes between the New England Highway and Denman to provide a three lane configuration with alternating overtaking lanes in each direction. Provide a flush median as part of these works for possible future upgrade to a median wire rope safety barrier.
Undertake a program of minor works near stock crossing west of Jerrys Plains including localised shoulder widening and vehicle activated signs to improve the safety and driver awareness of stock crossings.	Where shoulder widening works are programmed in the area, provide minimum Basic Left-turn/Basic Right-turn treatments to intersections.	Upgrade intersections on a priority basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash rish and road hierarchy (such as State and Regional roads).
Undertake a program of clear zone works west of Jerrys Plains including removal or protection of large trees between Jerrys Plains and the Hunter River.	Upgrade intersections on a priority basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash rish and road hierarchy (such as State and Regional roads). Intersections to be upgraded include Pagan Street. Intersections will also be progressively ugraded in towns including Jerrys Plain.	Where shoulder widening works are programmed in the area, provide minimum Basic Left-turn/Basic Right-turn treatments to intersections.
	Complete lane and seal widening with clearzone works to reduce crash risk between the New England Highway and Denman, and particularly east and west of Jerrys Plains.	

0 0.1250.25 0.5 0.75 1
Kilometres

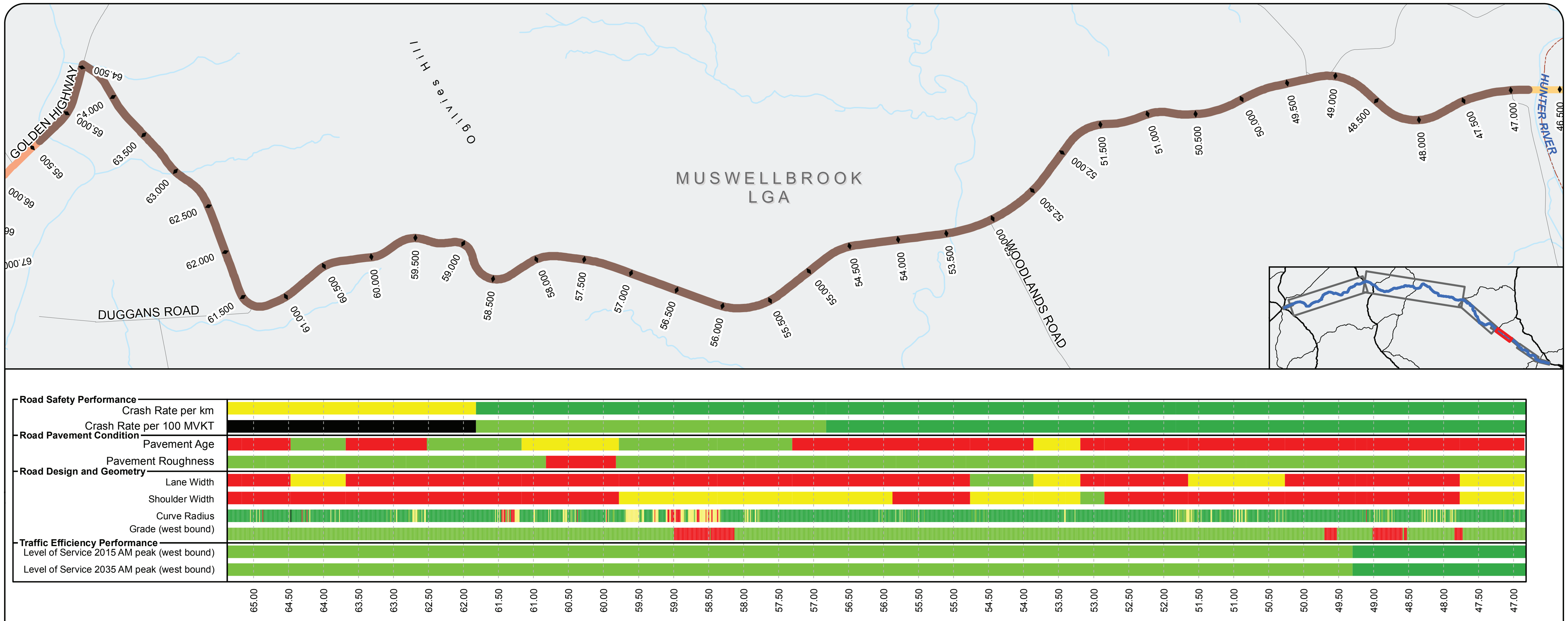
N

LEGEND
Section 3

	Crashes per km	Crashes per MVKT	Pavement Age	Pavement Roughness	Lane Width	Sealed Shoulder Width	Curve Radius	Grade	LOS 2015	LOS 2035
(green)	< 0.18	Low Risk (< 6.85)	——	——	——	——	> 600m	——	A	A
(light green)	0.18 - 0.2	Low - Medium Risk (6.85 - 9.56)	< 20 years	< 4.2	≥ 3.5m	≥ 2m	460m - 600m	< 6%	B	B
(yellow)	0.2 - 1.14	Medium Risk (9.56 - 12.34)	20 - 40 years	——	3.25m - < 3.5m	1m - < 2m	240m - 460m	——	C	C
(red)	1.14 - 1.7	Medium - High Risk (12.34 - 16.44)	> 40 years	≥ 4.2	3.0m - < 3.25m	< 1m	90m - 240m	> 6%	D	D
(black)	> 1.7	High Risk (> 16.44)	——	——	——	——	< 90m	——	E	E

Data source: Geoscience Australia, 250K Topographic Data Series 3

Figure 7.4 Section 4 Jerrys Plains to Denman Road corridor performance and priorities



Short term actions (0 - 5 years)	Medium term actions (5 - 10 years)	Long term actions (> 10 years)
Work with the Muswellbrook Shire Council and the Department of Planning and Environment to assess the impact of cumulative road closures from individual mine operations. This will ensure any remedial works (or funds) are directed in a manner which aligns with the future aspirations of Muswellbrook Shire Council, Transport for NSW, Roads and Maritime Services for the local and state road network.	Continue a program of accelerated pavement rehabilitation (with lane and shoulder widening works, and clearzone works) to minimise long term maintenance costs and road safety risk. Pavement rehabilitation will be prioritised between the New England Highway and Denman.	Progressively provide overtaking lanes between the New England Highway and Denman to provide a three lane configuration with alternating overtaking lanes in each direction. Provide a flush median as part of these works for possible future upgrade to a median wire rope safety barrier.
Construct a westbound climbing lane at Winery Hill and an eastbound climbing lane near Woodlands Rd, and eastbound and westbound climbing lanes on Ogilvies Hill.	Complete lane and seal widening with clearzone works to reduce crash risk between the New England Highway and Denman.	Upgrade intersections on a prioritised basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash risk and road hierarchy (such as State and Regional roads).
Where shoulder widening works are programmed in the area, provide minimum Basic Left-turn/Basic Right-turn treatments to intersections.	Upgrade intersections on a prioritised basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash risk and road hierarchy (such as State and Regional roads).	Where shoulder widening works are programmed in the area, provide minimum Basic Left-turn/Basic Right-turn treatments to intersections.
Ensure a management plan is maintained for the Assessed Risk Level 2 slope at Ogilvies Hill. Remediate this slope to reduce its risk rating.	Where shoulder widening works are programmed in the area, provide minimum Basic Left-turn/Basic Right-turn treatments to intersections.	
Ensure a management plan is maintained for the Assessed Risk Level 2 culvert near Edderton Road. Remediate or replace this culvert to reduce its risk rating.		
Enable access for Performance Based Standards (PBS) Class 2B heavy vehicles of up to 30m in length following completion of enabling works.		

0 0.225 0.45 0.9 1.35 1.8
Kilometres

N

LEGEND
Section 4

	Crashes per km	Crashes per MVKT	Pavement Age	Pavement Roughness	Lane Width	Sealed Shoulder Width	Curve Radius	Grade	LOS 2015	LOS 2035
(dark green)	< 0.18	Low Risk (< 6.85)	——	——	——	——	> 600m	——	A	A
(light green)	0.18 - 0.2	Low - Medium Risk (6.85 - 9.56)	< 20 years	< 4.2	≥ 3.5m	≥ 2m	460m - 600m	< 6%	B	B
(yellow)	0.2 - 1.14	Medium Risk (9.56 - 12.34)	20 - 40 years	——	3.25m - < 3.5m	1m - < 2m	240m - 460m	——	C	C
(red)	1.14 - 1.7	Medium - High Risk (12.34 - 16.44)	> 40 years	≥ 4.2	3.0m - < 3.25m	< 1m	90m - 240m	> 6%	D	D
(black)	> 1.7	High Risk (> 16.44)	——	——	——	——	< 90m	——	E	E

Data source: Geoscience Australia, 250K Topographic Data Series 3

Figure 7.5 Section 5 Denman Road corridor performance and priorities.

Short term actions (0 - 5 years)	Medium term actions (5 - 10 years)	Long term actions (> 10 years)
Work with the Muswellbrook Shire Council to relocate the Causey Park Rest area.	Monitor the amenity impact of heavy vehicle volumes and types on Denman. Undertake traffic calming or other works where warranted.	Monitor the amenity impact of heavy vehicle volumes and types on Denman. Undertake traffic calming or other works where warranted.
Undertake accelerated pavement rehabilitation (with lane and shoulder widening works, and clearzone works) to minimise long term maintenance costs and reduce road safety risk. Pavement rehabilitation will be prioritised between the New England Highway and Denman.	Where shoulder widening works are programmed in the area, provide minimum Basic Left-turn/Basic Right-turn treatments to intersections.	
Where shoulder widening works are programmed in the area, provide minimum Basic Left-turn/Basic Right-turn treatments to intersections.	Complete lane and seal widening with clearzone works to reduce crash risk between the New England Highway and Denman.	
Undertake a review of speed limits to ensure route consistency, but to also consider reducing speed limits at at-risk locations, such as the Denman level crossing, in accordance with the NSW Speed Zoning Guidelines.		
Upgrade the level crossing at Denman to provide boom gates and advanced warning signals, and upgrade the intersection of Mangoola Road.		
Enable access for Performance Based Standards (PBS) Class 2B heavy vehicles of up to 30m in length following completion of enabling works.		

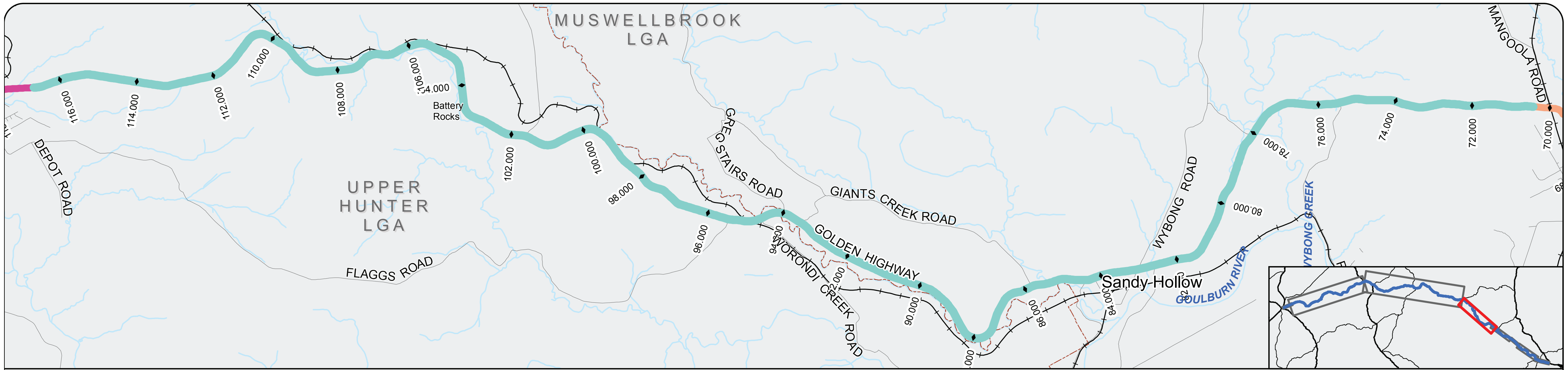
0 0.125 0.25 0.5 0.75 1
Kilometres

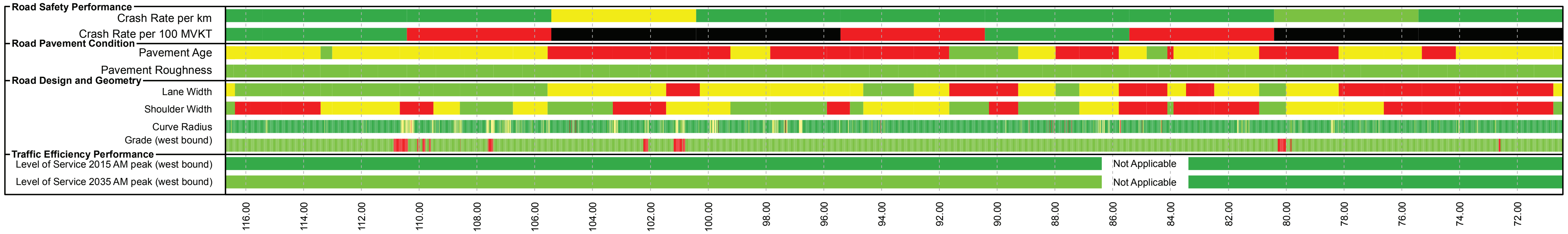
LEGEND
Section 5

	Crashes per km	Crashes per MVKT	Pavement Age	Pavement Roughness	Lane Width	Sealed Shoulder Width	Curve Radius	Grade	LOS 2015	LOS 2035
	< 0.18	Low Risk (< 6.85)	——	——	——	——	> 600m	——	A	A
	0.18 - 0.2	Low - Medium Risk (6.85 - 9.56)	< 20 years	< 4.2	≥ 3.5m	≥ 2m	460m - 600m	< 6%	B	B
	0.2 - 1.14	Medium Risk (9.56 - 12.34)	20 - 40 years	——	3.25m - < 3.5m	1m - < 2m	240m - 460m	——	C	C
	1.14 - 1.7	Medium - High Risk (12.34 - 16.44)	> 40 years	≥ 4.2	3.0m - < 3.25m	< 1m	90m - 240m	> 6%	D	D
	> 1.7	High Risk (> 16.44)	——	——	——	——	< 90m	——	E	E

Data source: Geoscience Australia, 250K Topographic Data Series 3

Figure 7.6 Section 6 Denman to Merriwa Road corridor performance and priorities.





Short term actions (0 - 5 years)	Medium term actions (5 - 10 years)	Long term actions (> 10 years)
Repair and upgrade Halls Creek bridge to return it to an appropriate condition.	Commence a program of lane and shoulder widening between Denman and Merriwa.	Monitor the need to provide additional overtaking lanes between Denman and Dubbo.
Provide a major heavy vehicle rest area at Sandy Hollow.	Progressively provide climbing lanes on all steep grades where heavy vehicle performance is affected including east of Merriwa. Extend the existing climbing lanes at Pikes Gap to ensure safer merging opportunities.	Progressively provide climbing lanes on all steep grades where heavy vehicle performance is affected.
Ensure management plans are maintained for the two (2) Assessed Risk Level 2 culverts west of Denman. Remediate or replace these culverts to reduce their risk rating.	Continue to monitor and manage all rail level crossings in accordance with agreed management plans with the rail operator.	Continue a program of accelerated pavement rehabilitation (with lane and shoulder widening works, and clearzone works) to minimise long term maintenance costs and road safety risk. Pavement rehabilitation will be prioritised between the Denman and Merriwa.
Undertake accelerated pavement rehabilitation near Gungal (with lane and shoulder widening works, and clearzone works) to minimise long term maintenance costs and reduce road safety risk.	Continue a program of accelerated pavement rehabilitation (with lane and shoulder widening works, and clearzone works) to minimise long term maintenance costs and road safety risk.	Complete lane and seal widening with clearzone works to reduce crash risk between the between Denman and Merriwa.
Improve access to light vehicle rest areas such as at Gungal and Battery Rocks.	Intersections to be upgraded include Reedy Creek Road, Bylong Valley Way, Wybong Road, Worondi Creek Road, Flaggs Road and Westwood Road. Intersections will also be progressively upgraded in towns including Sandy Hollow.	Where shoulder widening works are programmed in the area, provide minimum Basic Left-turn/Basic Right-turn treatments to intersections.
Continue to manage all rail level crossings in accordance with agreed management plans with the rail operator.	Where shoulder widening works are programmed in the area, provide minimum Basic Left-turn/Basic Right-turn treatments to intersections.	Continue to monitor and manage all rail level crossings in accordance with agreed management plans with the rail operator.
Provide enhanced delineation of narrow bridges and bridge approaches to improve driver awareness.	Monitor the amenity impact of heavy vehicle volumes and types on towns. Undertake traffic calming or other works where warranted.	Upgrade intersections on a priority basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash risk and road hierarchy (such as State and Regional roads).
Where shoulder widening works are programmed in the area, provide minimum Basic Left-turn/Basic Right-turn treatments to intersections.		
Enable access for Performance Based Standards (PBS) Class 2B heavy vehicles of up to 30m in length following completion of enabling works.		

0 0.5 1 2 3 4
Kilometres

LEGEND

Section 6

	Crashes per km	Crashes per MVKT	Pavement Age	Pavement Roughness	Lane Width	Sealed Shoulder Width	Curve Radius	Grade	LOS 2015	LOS 2035
	< 0.18	Low Risk (< 6.85)	——	——	——	——	> 600m	——	A	A
	0.18 - 0.2	Low - Medium Risk (6.85 - 9.56)	< 20 years	< 4.2	≥ 3.5m	≥ 2m	460m - 600m	< 6%	B	B
	0.2 - 1.14	Medium Risk (9.56 - 12.34)	20 - 40 years	——	3.25m - < 3.5m	1m - < 2m	240m - 460m	——	C	C
	1.14 - 1.7	Medium - High Risk (12.34 - 16.44)	> 40 years	≥ 4.2	3.0m - < 3.25m	< 1m	90m - 240m	> 6%	D	D
	> 1.7	High Risk (> 16.44)	——	——	——	——	< 90m	——	E	E

Data source: Geoscience Australia, 250K Topographic Data Series 3

Figure 7.7 Section 7 Merriwa Road corridor performance and priorities.

Short term actions (0 - 5 years)	Medium term actions (5 - 10 years)	Long term actions (> 10 years)
Monitor the amenity impact of heavy vehicle volumes and types on towns. Complete the pedestrian upgrades in Merriwa being undertaken as part of a road safety program.	Monitor the amenity impact of heavy vehicle volumes and types on Merriwa. Undertake traffic calming or other works where warranted.	Monitor the amenity impact of heavy vehicle volumes and types on Merriwa. Undertake traffic calming or other works where warranted.
Enable access for Performance Based Standards (PBS) Class 2B heavy vehicles of up to 30m in length following completion of enabling works.	Upgrade intersections on a priority basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash risk and road hierarchy (such as State and Regional roads). Intersections to be upgraded include Vennacher Street. Intersections will also be progressively upgraded in towns including Merriwa.	Continue to monitor the adequacy of rest area and stopping bay facilities. Upgrade rest area and parking bays where warranted.
		Upgrade intersections on a priority basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash risk and road hierarchy (such as State and Regional roads).

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Kilometres

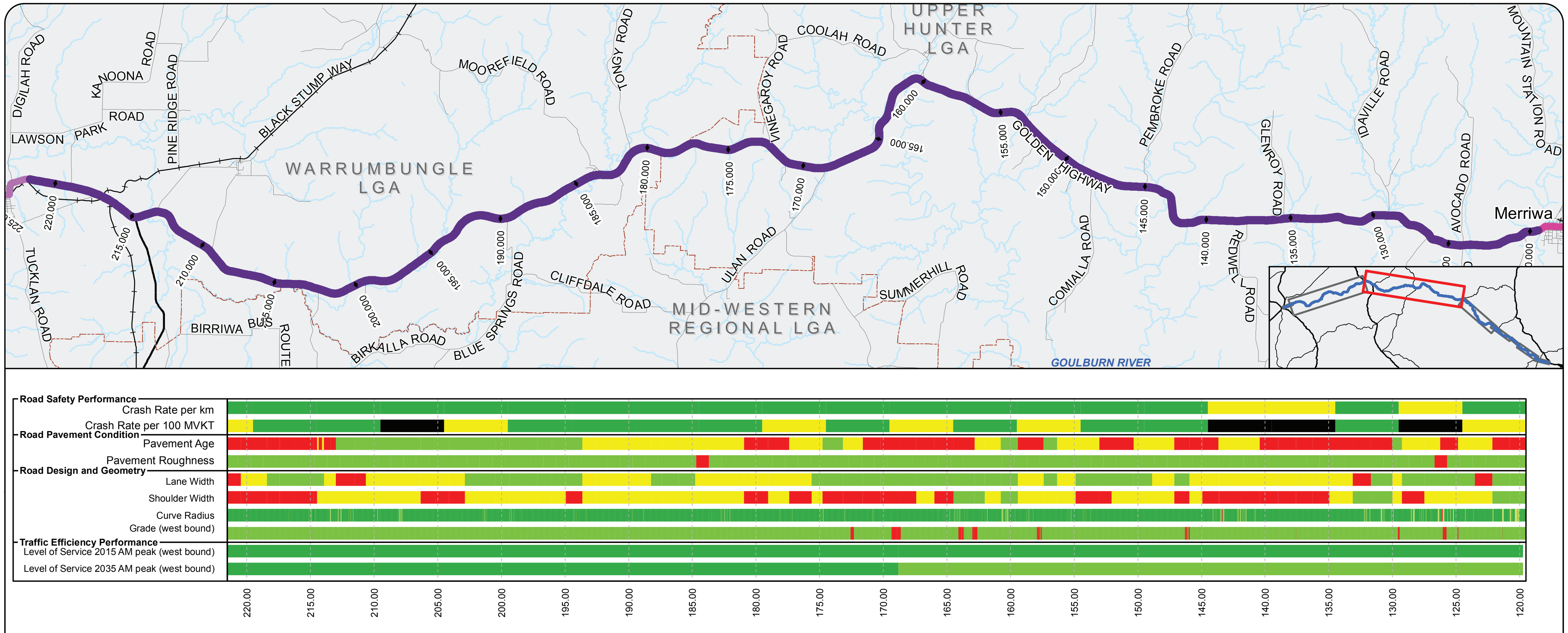
N

LEGEND
Section 7

	Crashes per km	Crashes per MVKT	Pavement Age	Pavement Roughness	Lane Width	Sealed Shoulder Width	Curve Radius	Grade	LOS 2015	LOS 2035
Dark green	< 0.18	Low Risk (< 6.85)	——	——	——	——	> 600m	——	A	A
Light green	0.18 - 0.2	Low - Medium Risk (6.85 - 9.56)	< 20 years	< 4.2	≥ 3.5m	≥ 2m	460m - 600m	< 6%	B	B
Yellow	0.2 - 1.14	Medium Risk (9.56 - 12.34)	20 - 40 years	——	3.25m - < 3.5m	1m - < 2m	240m - 460m	——	C	C
Red	1.14 - 1.7	Medium - High Risk (12.34 - 16.44)	> 40 years	≥ 4.2	3.0m - < 3.25m	< 1m	90m - 240m	> 6%	D	D
Black	> 1.7	High Risk (> 16.44)	——	——	——	——	< 90m	——	E	E

Data source: Geoscience Australia, 250K Topographic Data Series 3

Figure 7.8 Section 8 Merriwa to Dunedoo Road corridor performance and priorities.



Short term actions (0 - 5 years)	Medium term actions (5 - 10 years)	Long term actions (> 10 years)
Construct a new bi-directional heavy vehicle inspection site of a sufficient size to accommodate Higher Productivity Vehicles and over-dimensional and over-mass vehicles, east of Dunedoo.	Continue a program of accelerated pavement rehabilitation (with lane and shoulder widening works, and clearzone works) to minimise long term maintenance costs and road safety risk. Pavement rehabilitation will be prioritised between Merriwa and Dunedoo.	Monitor the need to provide additional overtaking lanes between Merriwa and Dunedoo.
Undertake flood immunity works near Uarbry, east of Dunedoo.		Progressively provide climbing lanes on all steep grades where heavy vehicle performance is affected.
Ensure managment plans are maintained for the six (6) Assessed Risk Level 2 and 1 culvert from Merriwa to Dunedoo. Remediate or replace these culverts to reduce risk rating.	Progressively provide climbing lanes on all steep grades where heavy vehicle performance is affected including west of Merriwa, east of the Krui River, west of Cassilis Road and near Ulan Road.	Continue a program of accelerated pavement rehabilitation between Denman and Dunedoo (with lane and shoulder widening works, and clearzone works) to minimise long term maintenance costs and road safety risk.
Provide enhanced delineation of narrow bridge and bridge approaches to improve driver awareness. Install raised retro-reflective markers along the full length of the Golden Highway to provide route consistency.	Upgrade intersections on a priority basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash risk and road hierarchy (such as State and Regional roads). Intersections to be upgraded include Ringwood Road, Idaville Road, Pembrooke Road, Ulan Road, Vinegaroy Road (Warrumbungle Way) and the Castlereagh Highway (east).	Prioritise lane and seal widening with clearzone works between Merriwa and Dunedoo.
Install vehicle activated signs and provide a reduced truck and bus speed limit over the Krui River Bridge. Also commence a planning study to assess options for the widening or replacement of this bridge. The planning study should also review the adequacy of the road alignment on the bridge approach.		Upgrade intersections on a priority basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash risk and road hierarchy (such as State and Regional roads).
Install raised retro-reflective markers along the full length of the Golden Highway to provide route consistency.	Where shoulder widening works are programmed in the area, provide minimum Basic Left-turn/Basic Right-turn treatments to intersections.	Where shoulder widening works are programmed in the area, provide minimum Basic Left-turn/Basic Right-turn treatments to intersections.
Undertake accelerated pavement rehabilitation between the intersection of Castlereagh Highway (east) and Dubbo (with lane and shoulder widening works, and clearzone works) to minimise long term maintenance costs and reduce road safety risk.	Pending the outcomes of previous planning studies, either widen or replace the existing Krui River Bridge, including any road approach works.	
Enable access for Performance Based Standards (PBS) Class 2B heavy vehicles of up to 30 m in length following completion of enabling works.		

0 1.25 2.5 5 7.5 10
Kilometres

N

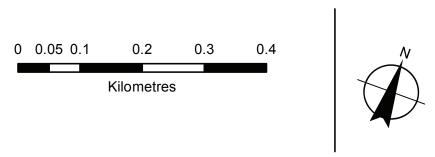
LEGEND
Section 8

	Crashes per km	Crashes per MVKT	Pavement Age	Pavement Roughness	Lane Width	Sealed Shoulder Width	Curve Radius	Grade	LOS 2015	LOS 2035
	< 0.18	Low Risk (< 6.85)	——	——	——	——	> 600m	——	A	A
	0.18 - 0.2	Low - Medium Risk (6.85 - 9.56)	< 20 years	< 4.2	≥ 3.5m	≥ 2m	460m - 600m	< 6%	B	B
	0.2 - 1.14	Medium Risk (9.56 - 12.34)	20 - 40 years	——	3.25m - < 3.5m	1m - < 2m	240m - 460m	——	C	C
	1.14 - 1.7	Medium - High Risk (12.34 - 16.44)	> 40 years	≥ 4.2	3.0m - < 3.25m	< 1m	90m - 240m	> 6%	D	D
	> 1.7	High Risk (> 16.44)	——	——	——	——	< 90m	——	E	E

Data source: Geoscience Australia, 250K Topographic Data Series 3

Figure 7.9 Section 9 Dunedoo Road corridor performance and priorities.

Short term actions (0 - 5 years)	Medium term actions (5 - 10 years)	Long term actions (> 10 years)
Work with the Warrumbungle Shire Council to develop a Pedestrian Access and Mobility Plan for Dunedoo to identify the warrant and location of a pedestrian crossing of the Golden Highway. If the warrant for a pedestrian crossing is met, provide a crossing.	Monitor the amenity impact of heavy vehicle volumes and types on Dunedoo. Undertake traffic calming or other works where warranted.	Monitor the amenity impact of heavy vehicle volumes and types on Dunedoo. Undertake traffic calming or other works where warranted.
Improve access to the Dunedoo rest area.	Continue to monitor and manage all rail level crossings in accordance with agreed management plans with the rail operator.	Continue to monitor and manage all rail level crossings in accordance with agreed management plans with the rail operator.
Continue to manage all rail level crossings in accordance with agreed management plans with the rail operator.	Upgrade intersections on a priority basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash risk and road hierarchy (such as State and Regional roads). Intersections to be upgraded include Castlereagh Highway (west). Intersections will also be progressively upgraded in towns including Dunedoo.	Upgrade intersections on a priority basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash risk and road hierarchy (such as State and Regional roads).
Install raised retro-reflective markers along the full length of the Golden Highway to provide route consistency.		
Enable access for Performance Based Standards (PBS) Class 2B heavy vehicles of up to 30m in length following completion of enabling works.		



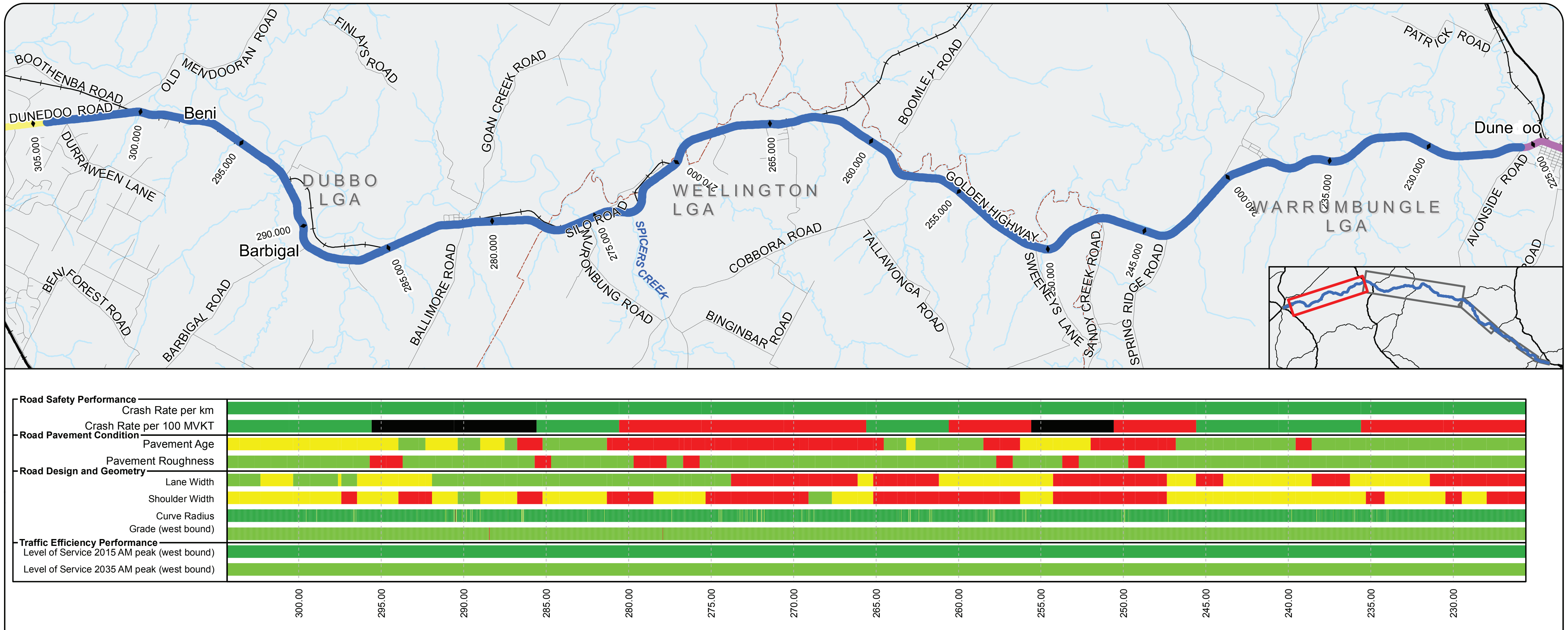
LEGEND

Section 9

	Crashes per km	Crashes per MVKT	Pavement Age	Pavement Roughness	Lane Width	Sealed Shoulder Width	Curve Radius	Grade	LOS 2015	LOS 2035
	< 0.18	Low Risk (< 6.85)	——	——	——	——	> 600m	——	A	A
	0.18 - 0.2	Low - Medium Risk (6.85 - 9.56)	< 20 years	< 4.2	≥ 3.5m	≥ 2m	460m - 600m	< 6%	B	B
	0.2 - 1.14	Medium Risk (9.56 - 12.34)	20 - 40 years	——	3.25m - < 3.5m	1m - < 2m	240m - 460m	——	C	C
	1.14 - 1.7	Medium - High Risk (12.34 - 16.44)	> 40 years	≥ 4.2	3.0m - < 3.25m	< 1m	90m - 240m	> 6%	D	D
	> 1.7	High Risk (> 16.44)	——	——	——	——	< 90m	——	E	E

Data source: Geoscience Australia, 250K Topographic Data Series 3

Figure 7.10 Section 10 Dunedoo to Dubbo Road corridor performance and priorities.



Short term actions (0 - 5 years)	Medium term actions (5 - 10 years)	Long term actions (> 10 years)
Where shoulder widening works are programmed in the area, provide minimum Basic Left-turn/Basic Right-turn treatments to intersections.	Upgrade intersections on a prioritised basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash risk and road hierarchy (such as State and Regional roads). Intersections will also be progressively upgraded in towns.	Monitor the need to provide additional overtaking lanes between Dunedoo and Dubbo.
Provide heavy vehicle parking bays in Elong Elong.	Continue to monitor and manage all rail level crossings in accordance with agreed management plans with the rail operator.	Continue to monitor and manage all rail level crossings in accordance with agreed management plans with the rail operator.
Undertake accelerated pavement rehabilitation between Dunedoo and Dubbo (with lane and shoulder widening works, and clearzone works) to minimise long term maintenance costs and reduce road safety risk.	Where shoulder widening works are programmed in the area, provide minimum Basic Left-turn/Basic Right-turn treatments to intersections.	Upgrade the Beni and Barbigal level crossings to boom gates.
Review the speed limit aross all high speed level crossings against the NSW Speed Zoning Guidelines to identify the benefits of a reduced 80km/h r regulatory speed limit at Barbigal and Beni level crossings.		Upgrade intersections on a prioritised basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash risk and road hierarchy (such as State and Regional roads).
Continue to manage all rail level crossings in accordance with agreed management plans with the rail operator.		Where shoulder widening works are programmed in the area, provide minimum Basic Left-turn/Basic Right-turn treatments to intersections.
Provide enhanced delineation of narrow bridge and bridge approaches to improve driver awareness. Install raised retro-reflective markers along the full length of the Golden Highway to provide route consistency.		
Upgrade intersections on a prioritised basis to provide left and right turn bays. Upgrade the intersections of Cobbora Road (west), Muronbung Road and Durraween Lane.		
Enable access for Performance Based Standards (PBS) Class 2B heavy vehicles of up to 30m in length following completion of enabling works.		

0 1 2 4 6 8
Kilometres

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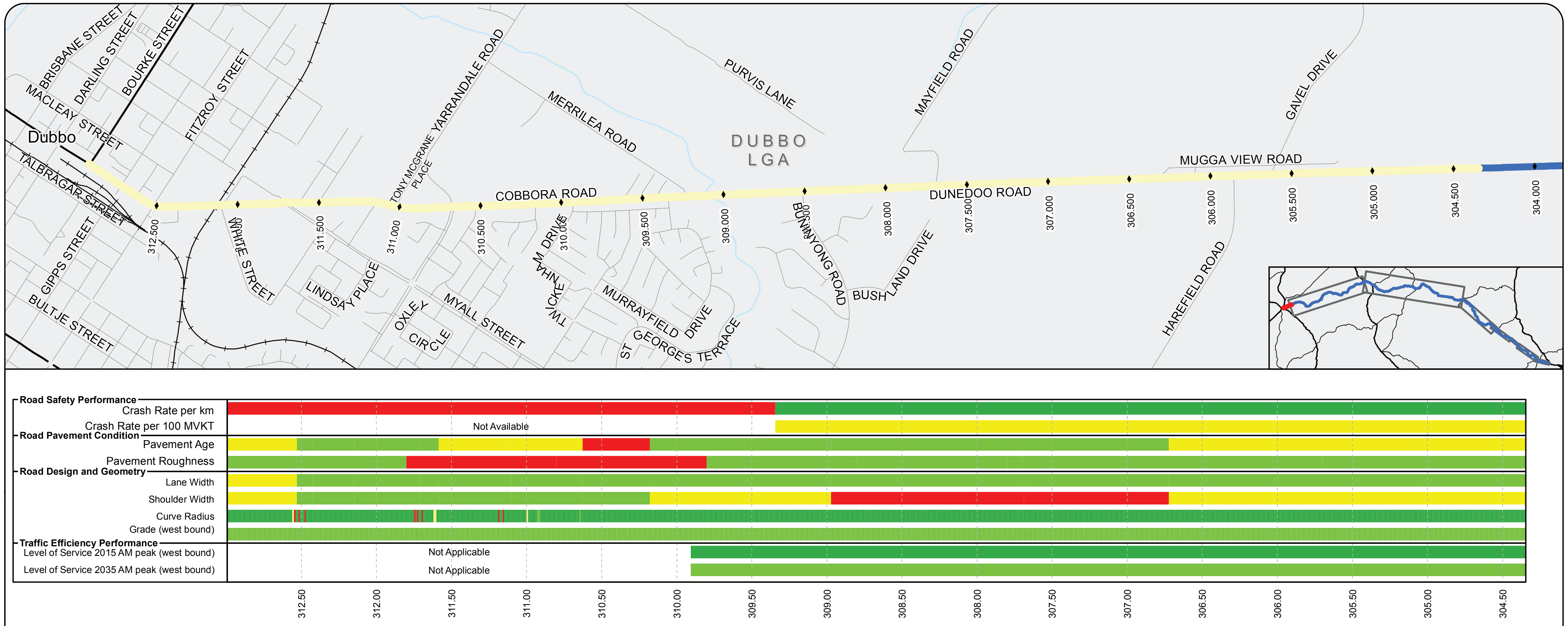
LEGEND
Section 10

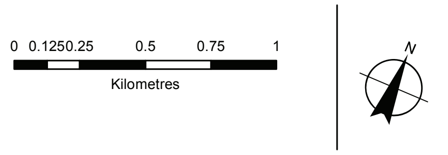
	Crashes per km	Crashes per MVKT	Pavement Age	Pavement Roughness	Lane Width	Sealed Shoulder Width	Curve Radius	Grade	LOS 2015	LOS 2035
(green)	< 0.18	Low Risk (< 6.85)	——	——	——	——	> 600m	——	A	A
(light green)	0.18 - 0.2	Low - Medium Risk (6.85 - 9.56)	< 20 years	< 4.2	≥ 3.5m	≥ 2m	460m - 600m	< 6%	B	B
(yellow)	0.2 - 1.14	Medium Risk (9.56 - 12.34)	20 - 40 years	——	3.25m - < 3.5m	1m - < 2m	240m - 460m	——	C	C
(red)	1.14 - 1.7	Medium - High Risk (12.34 - 16.44)	> 40 years	≥ 4.2	3.0m - < 3.25m	< 1m	90m - 240m	> 6%	D	D
(black)	> 1.7	High Risk (> 16.44)	——	——	——	——	< 90m	——	E	E

Data source: Geoscience Australia, 250K Topographic Data Series 3

Figure 7.11 Section 11 Dubbo Road corridor performance and priorities.



Short term actions (0 - 5 years)	Medium term actions (5 - 10 years)	Long term actions (> 10 years)
Work with Western Plains Regional Council to provide a safe, consistent and connected pedestrian and cycling network along the Golden Highway corridor from Buninyong Road (particularly the university and hospital precinct) to the central business district.	Monitor the amenity impact of heavy vehicle volumes and types on Dubbo. Undertake traffic calming or other works where warranted.	Monitor the amenity impact of heavy vehicle volumes and types on Dubbo. Undertake traffic calming or other works where warranted.
Install raised retro-reflective markers along the full length of the Golden Highway to provide route consistency.	Rationalise and upgrade intersections in the Dubbo urban area from White Street to Tony McGrane Place.	Duplicate the highway from the level crossing near White Street to Yarrandale Road, to provide improved access to the hospital and university precinct, and industrial areas on Yarrandale Road.
Enable access for Performance Based Standards (PBS) Class 2B heavy vehicles of up to 30m in length following completion of enabling works.	Upgrade intersections on a priority basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash risk and road hierarchy (such as State and Regional roads). Intersections will also be progressively upgraded in urban areas including Dubbo.	Upgrade intersections on a priority basis to provide left and right turn bays. Intersections will be prioritised by crash history, crash risk and road hierarchy (such as State and Regional roads).
Roads and Maritime have developed a Dubbo Traffic Model in consultation with Western Plains Regional Council for the purpose of testing options for a second high level crossing of the Macquarie River. That model will be used in future to investigate network expansion requests from Council on a priority basis. Safety performance will continue to be monitored and prioritised on an annual basis.	Continue to monitor and manage all rail level crossings in accordance with agreed management plans with the rail operator.	Continue to monitor and manage all rail level crossings in accordance with agreed management plans with the rail operator.



LEGEND

Section 11

	Crashes per km	Crashes per MVKT	Pavement Age	Pavement Roughness	Lane Width	Sealed Shoulder Width	Curve Radius	Grade	LOS 2015	LOS 2035
	< 0.18	Low Risk (< 6.85)	——	——	——	——	> 600m	——	A	A
	0.18 - 0.2	Low - Medium Risk (6.85 - 9.56)	< 20 years	< 4.2	≥ 3.5m	≥ 2m	460m - 600m	< 6%	B	B
	0.2 - 1.14	Medium Risk (9.56 - 12.34)	20 - 40 years	——	3.25m - < 3.5m	1m - < 2m	240m - 460m	——	C	C
	1.14 - 1.7	Medium - High Risk (12.34 - 16.44)	> 40 years	≥ 4.2	3.0m - < 3.25m	< 1m	90m - 240m	> 6%	D	D
	> 1.7	High Risk (> 16.44)	——	——	——	——	< 90m	——	E	E

Data source: Geoscience Australia, 250K Topographic Data Series 3

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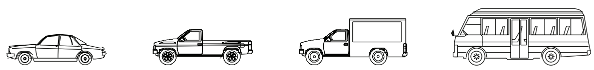
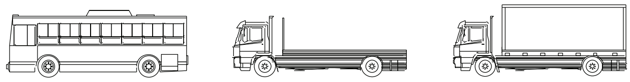
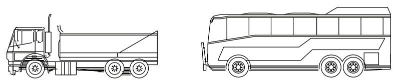
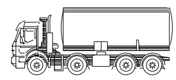
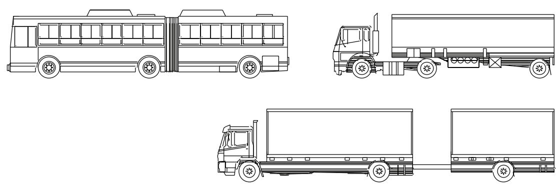
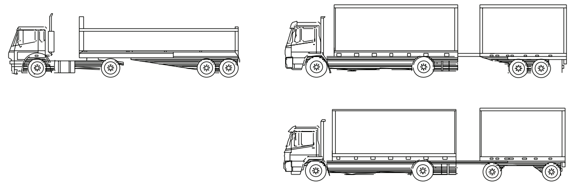
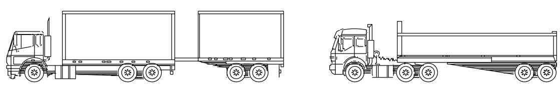
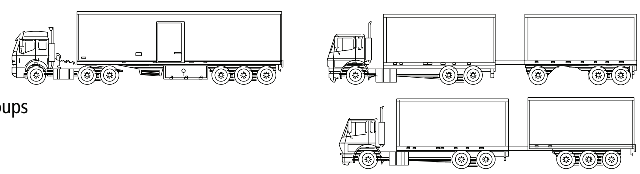
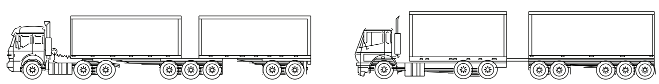
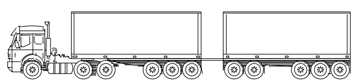
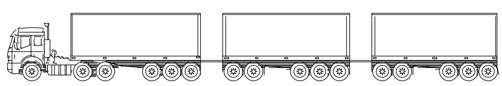
APPENDIX A – AUSTROADS VEHICLE CLASSIFICATION SYSTEM

VEHICLE CLASSIFICATION SYSTEM

AUSTROADS

CLASS	LIGHT VEHICLES	
1	SHORT Car, Van, Wagon, 4WD, Utility, Bicycle, Motorcycle	
2	SHORT - TOWING Trailer, Caravan, Boat	
	HEAVY VEHICLES	
3	TWO AXLE TRUCK OR BUS *2 axles	
4	THREE AXLE TRUCK OR BUS *3 axles, 2 axle groups	
5	FOUR (or FIVE) AXLE TRUCK *4 (5) axles, 2 axle groups	
6	THREE AXLE ARTICULATED *3 axles, 3 axle groups	
7	FOUR AXLE ARTICULATED *4 axles, 3 or 4 axle groups	
8	FIVE AXLE ARTICULATED *5 axles, 3+ axle groups	
9	SIX AXLE ARTICULATED *6 axles, 3+ axle groups or 7+ axles, 3 axle groups	
	LONG VEHICLES AND ROAD TRAINS	
10	B DOUBLE or HEAVY TRUCK and TRAILER *7+ axles, 4 axle groups	
11	DOUBLE ROAD TRAIN *7+ axles, 5 or 6 axle groups	
12	TRIPLE ROAD TRAIN *7+ axles, 7+ axle groups	

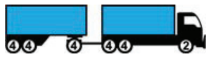
APPENDIX B – NSW PERFORMANCE BASED STANDARDS (PBS) HEAVY VEHICLE COMBINATIONS

PERFORMANCE BASED STANDARDS APPROVED COMBINATIONS

(Mass limits for PBS vehicles are subject to final PBS vehicle approval)

PBS Truck and Three Axle Dog Trailer Combination (Tri Dog)****

≤ 20.0 metres at Level 1 Access

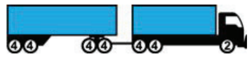


16.5t 9.0t 16.5t 6.5t

GML^: 48.5t

PBS Truck and Four Axle Dog Trailer Combination (Quad Dog)****

≤ 20.0 metres at Level 1 Access



13.75t 13.75t 16.5t 6.5t

GML^: 50.5t

17.0t 17.0t 17.0t 6.5t

HML^: 57.5t***

PBS Quad Axle Semi-Trailer Combination

≤ 20.0 metres at Level 1 Access

20.0t 16.5t 6.5t

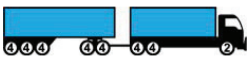
GML^: 43.0t

27.0t 17.0t 6.5t

HML^: 50.5t***

PBS Truck and Five Axle Dog Trailer Combination (Quin Dog)****

≤ 30.0 metres at Level 2 Access



20.0t 16.5t 16.5t 6.5t

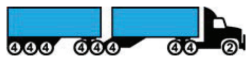
GML^: 59.5t

22.5t 17.0t 17.0t 6.5t

GML^: 63.0t***

PBS B-Double Combination

≤ 30.0 metres at Level 2 Access



20.0t 20.0t 16.5t 6.5t

GML^: 62.5t

21.0t 21.0t 17.0t 6.5t

CML^: 64.5t**

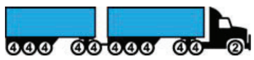
22.5t 22.5t 17.0t 6.5t

HML^: 68.5t***

Internal dimensions vary between PBS and prescriptive B-Doubles

PBS A-Double Combination

≤ 30.0 metres at Level 2 Access



20.0t 16.5t 20.0t 16.5t 6.5t

GML^: 79.5t

21.0t 17.0t 21.0t 17.0t 6.5t

CML^: 81.5t**

22.5t 17.0t 22.5t 17.0t 6.5t

HML^: 85.5t***

PBS Super B-Double Combination (Quad Tri)****

≤ 30.0 metres at Level 2 Access

20.0t 20.0t 16.5t 6.5t

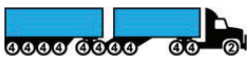
GML^: 63.0t

22.5t 27.0t 17.0t 6.5t

HML^: 73.0t***

PBS Super B-Double Combination (Quad Quad)****

≤ 30.0 metres at Level 2 Access



20.0t 20.0t 16.5t 6.5t

GML^: 63.0t

27.0t 27.0t 17.0t 6.5t

HML^: 77.5t***

* Under Gazette Notices published in NSW, vehicles with a GVM of 15 tonnes or more meeting Front Under-run Protection Systems, cabin strength and engine emissions standards (ADR80/01) can operate at 6.5 tonnes on the steer axle. The extra 500kg permitted on the steer axle increases the total gross mass of the combination by 500kg.

** Vehicles accredited under the NHVAS Mass Management Accreditation Scheme are permitted 1 tonne above the total combination mass for a vehicle or vehicle combination with an allowable gross mass not exceeding 55 tonnes and 2 tonnes above the total combination mass for a vehicle or vehicle combination with an allowable gross mass exceeding 55 tonnes.

*** Requirements for HML operation: enrolment into the Intelligent Access Program (IAP), accreditation under the NHVAS Mass Management Accreditation Scheme and certified Road Friendly Suspension fitted on all axle and axle groups except the steer axle on the prime mover

**** A PBS Permit is required for operation on NSW Roads.

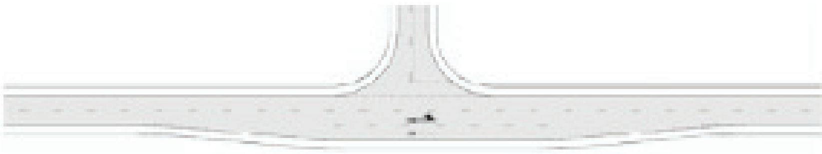
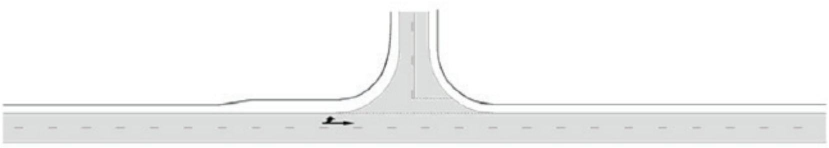
GML General Mass Limits.

CML Concessional Mass Limits.

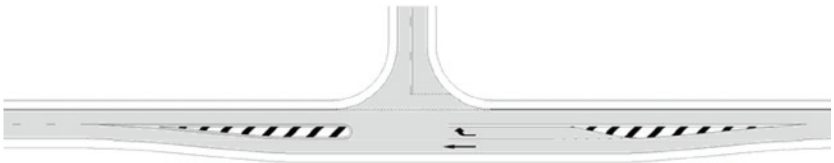
HML Higher Mass Limits.

^Mass limits refer to the Total Combination Mass (TCM) of a heavy vehicle combination.

APPENDIX C – GLOSSARY OF TERMS

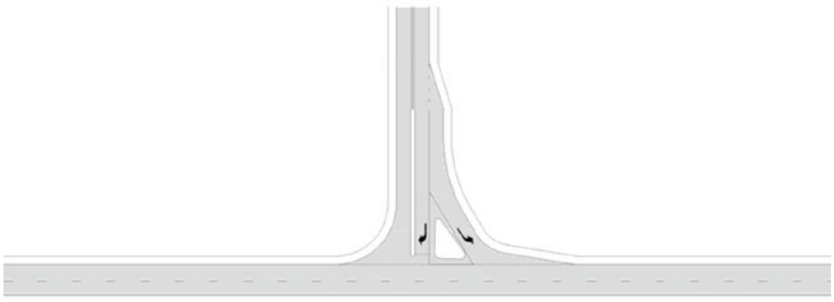
TERM	DEFINITION
AADT	The Annual Average Daily Traffic is the total yearly two-way traffic volume divided by 365, expressed as vehicles per day, in this document.
abutment	An end support of a bridge or similar structure.
ADT	The Average Daily Traffic is the total two-way traffic volume during a stated period, divided by the number of days in that period, normally over a seven day week and expressed as vehicles per day.
auxiliary lane	A portion of the carriageway adjoining through traffic lanes, used for speed change or for other purposes supplementary to through traffic movement.
AUR & AUL	Auxiliary intersection treatment Right and Left.  Auxiliary Right Turn (AUR) on the Major Road (Two-lane, Two-way Road) This turn not as safe as a channelised treatment at unsignalised intersections  Auxiliary Left Turn (AUL) on the Major Road CHL treatment is preferred at unsignalised intersections to ensure a clear line of sight for vehicles turning from the minor road.
axle	An axle is a central shaft for a rotating wheel or gear. It refers to the pairs of wheels of the vehicle.
axle group	A set of closely spaced axles acting as a unit.
BAR & BAL	Basic intersection treatment Right and Left.  Basic Right Turn (BAR) on the Major Road (Two-lane, Two-way Road)  Basic Left Turn (BAL) on the Major Road

TERM	DEFINITION
bunching	Where a group of vehicles are closely spaced on a carriageway, moving or stopped and ready to move, with relatively large spaces ahead and behind. The cause is natural conditions on the road.
carriageway	That portion of a road or bridge devoted particularly to the use of vehicles, that is between guide posts, kerbs, or barriers where these are provided, inclusive of shoulders and auxiliary lanes.
CHR & CHL	Channelised intersection treatment Right and Left.



Channelised Right Turn (CHR)
on the major Road

Channelised Left Turn (CHL)
on the major Road



Channelised Left Turn (CHL)
on the minor Road

TERM	DEFINITION
CHR(s)	Short channelised intersection treatment, the channelised portion of the intersection is shorter than a CHR
culvert	One or more adjacent pipes or enclosed channels for conveying water, a watercourse or stream below the surface of a road. Culverts minimise flooding by minimising water building up alongside the road and overtopping the road surface (causing flooding) to escape.
deflection	The vertical movement of a pavement due to the application of a load.
DESA	Design Equivalent Standard Axles.
formation level	The general level of the surface of the ground proposed or obtained on completion of earthworks.
General Access Vehicle	A vehicle that has unlimited access to the road network (with the exception of local access restrictions), limits being 2.5 metres wide, 4.3 metres high, 12.5 metres long for rigid vehicles and 19 metres long for single combinations and conforming axle groups.

TERM	DEFINITION
HML vehicle	Higher Mass Limits is a nationally agreed scheme that permits approved heavy vehicles to operate with additional mass on certain types of axle groups, on a restricted road network and subject to specified conditions. Details are specific to each vehicle type, see http://www.ntc.gov.au.
HPV	High Productivity Vehicles – vehicles approved to carry loads above standard mass limits under Higher Mass Limits or Performance Base Standards
NAASRA	National Association of Australian State Road Authorities. NAASRA is now known as *AUSTROADS*.
NLTN	The National Land Transport Network is a single integrated network of land transport linkages of strategic national importance.
PBS	Performance Based Standards are a national system for the regulation of heavy vehicles based on the performance, safe operation, manoeuvrability and characteristics of the vehicle on the road rather than the vehicle type. The Performance Based Standards scheme is a key element of the Council of Australian Government's national reform agenda for transport. The scheme offers the heavy vehicle industry the potential to achieve higher productivity and safety through innovative truck and bus design. PBS vehicles are designed to perform their tasks as productively, safely and as sustainable as possible. These trucks and buses are tested against 16 stringent safety standards and four infrastructure standards to ensure that they can stop, turn and travel safely. Vehicles are certified as able to operate on PBS Access Level routes 1, 2, 3 or 4.
pier	An intermediate support in a bridge having more than one span.
RAV	Restricted Access Vehicle is a vehicle that is longer than 19 metres, 4.3 metres high or 42.5 tonnes gross mass and is not given as-of-right access to the road network. Includes B-doubles, road trains and larger truck-trailer combinations.
road smoothness	A surface condition in which the aggregate is worn and the texture depth is minimal.
roadloc chainage	The name given to the Linear Referencing System used by the Roads and Maritime Services.
roughness	The consequence of irregularities in the longitudinal profile of a road with respect to the intended profile.
rutting	The longitudinal vertical deformation of a pavement surface in a wheel path, measured relative to a straightedge place at right angles to the traffic flow and across the wheel path.
shoulder	The portion of the carriageway beyond the traffic lanes and contiguous and flush with the surface of the pavement.
through lane	A lane provided for the use of vehicles proceeding straight ahead.
trailer	Vehicle without motive power constructed to be drawn behind a motor vehicle.
TRARR	Traffic on Rural Roads is a micro-simulation model of traffic flow on uninterrupted two-lane roads used to investigate overtaking lane projects in particular.
verge	The section of the road formation that joins the shoulder with the batter.

LIST OF TABLES

Contents

LIST OF FIGURES

Contents

NSW GOVERNMENT

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