LISMORE TO BANGALOW ROAD DRAFT CORRIDOR STRATEGY

May 2016

Transport MASTER PLAN

Lismore to Bangalow DRAFT CORRIDOR STRATEGY

NSW GOVERNMENT

Dawson Street and Ballina Street (Bruxner Highway), Lismore

EXECUTIVE SUMMARY

Lismore to Bangalow Road is a south-north two lane undivided rural road, approximately 33 kilometres in length in the NSW Northern Rivers region. The corridor connects the Bruxner Highway at Lismore to the Pacific Highway at Bangalow. The corridor serves as a general access route between Lismore and Bangalow with further connections to Byron Bay.

The road is an important link between Lismore and surrounding communities, and further to the Byron coastal area. The Bruxner Highway is the major freight link between Lismore and the Pacific Highway, while the Pacific Highway, part of the National Land Transport Network, is the major link between Sydney and Brisbane.

This Lismore to Bangalow Road Draft 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. The strategy sets out the 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 and vision statements specific to the Lismore to Bangalow Road Corridor that support the *NSW Long Term Transport Master Plan*, *Regional Transport Plans* and other State plans (Chapter 2).
- The community involvement and customer market (Chapter 3).
- The sources of transport demand along the road corridor (Chapter 4).
- The performance of the road 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 road 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 road (Chapter 7).

Cover image: Springvale Hill, Springvale

In assessing the performance of the road corridor against performance measures and targets the corridor was segmented into four smaller sections. These included:

- Section 1: Lismore
- Section 2: Lismore to Clunes
- Section 3: Clunes to Bangalow
- Section 4: Bangalow.

The vision for the Lismore to Bangalow Road has been developed to explain what actions should be achieved over the next 20 years in order to improve the performance of the road and meet the specific corridor objectives. The vision for the Lismore to Bangalow Road Corridor between Lismore and Bangalow over the next 20 years is:

- To support Lismore to Bangalow Road as **general access route** travelling north south between Lismore, Bangalow and Byron Bay, while complementing the Bruxner Highway as a principal freight route
- To enhance road safety outcomes for all road users over the length of the corridor through implementation of the **safe system approach** in the planning, development and delivery of improvement and maintenance works.
- To manage the impacts of recurrent **flooding** events of the Wilsons River between Lismore and Bexhill.
- To continue to progressively **improve** poor pavement condition, road alignment and road width along the corridor.
- To have a sufficient number of **overtaking opportunities** in both directions to maintain a safe and efficient level of service
- To maintain the **local amenity** of Bexhill, Clunes, Binna Burra and Bangalow villages
- To support the **active transport** needs of cyclists and pedestrians within towns and villages
- To support the needs of **public transport** users through appropriate facilities and infrastructure along the corridor, in particular by improving regional bus travel

Traffic volumes along the Lismore to Bangalow Road corridor vary between 7,000 vehicles per day (vpd) in rural sections and 12,000vpd within Lismore. The high volumes for the length of the route demonstrate the important link it plays between the coastal and hinterland communities of Lismore and Byron Bay. The traffic volumes are higher in Lismore, as expected. This is because the corridor forms an important link in the local road network in and around the Lismore CBD, the higher population in the regional centre of Lismore.

> “The vision includes having a sufficient number of overtaking opportunities in both directions to maintain a safe and efficient level of service.”

The traffic analysis shows the weekday peak periods are between 8am – 9am and 5pm – 6pm, weekday volumes are higher than weekend volumes, the traffic composition comprises of 90 per cent light vehicles, seven per cent rigid service vehicles and three per cent articulated vehicles (semi-trailers).

The study has examined historic traffic volumes and has predicted future growth trends based on these as well as population projections from the NSW Department of Planning and Environment and land use development information from Lismore City and Byron Shire Council. Historic traffic growth is 1.3 per cent per year within the urban area of Lismore and between 1.6-1.7 per cent per year for the rural sections. Projections over the next 20 years for the rural sections are expected to follow a similar pattern, with the urban areas of Lismore it is expected to grow between 1.3 and three per cent per year, taking into consideration possible future land development in the area.

Key findings of the Lismore to Bangalow Road Draft Corridor Strategy include:

Road safety

- The NSW Road Safety Strategy 2012-2021 sets the direction of road safety in NSW. The vision of the NSW Road Safety Strategy is working towards Vision Zero. The initiatives introduced as part of the strategy are the start of constructing a truly safe system for road travel. NSW is committed to reducing fatalities to at least 4.3 per 100,000 population by 2016 together with at least a 30 per cent reduction in fatalities and serious injuries between 2012 and 2021. Of the 245 crashes reported between 2008 and 2012 along the Lismore to Bangalow Road corridor, 103 were 'casualty crashes', which caused either an injury or fatality to one of more of the people involved. Of the 103 casualty crashes, 6 were fatal and 97 resulted in an injury. The annual average casualty crash rate per kilometre per year for Lismore to Bangalow Road ranges from 0.44 to 1.780. The NSW state wide average ranges from 0.195 to 1.69. In comparison Lismore to Bangalow Road performs below the rural state wide average in three out of the four sections, with the worst performing section between Clunes and Bangalow.
- The most prevalent crash types recorded on the Lismore to Bangalow corridor with the five year period to December 2012 included off road on curve crashes for the rural sections and intersection crashes within Lismore.
- Using available information to determine the contributing factors to crashes allows Roads and Maritime and the NSW Centre for Road Safety to understand crash patterns developing on particular roads and develop responses to prevent these crashes through engineering, maintenance or behavioural strategies. The crash data demonstrates that on the rural section, wet surface crashes and speed are the highest contributing factors.

Level of service

The level of service along the corridor varies between the peak periods and during the day. The morning peak is between 8am and 9am and the afternoon peak is between 5pm and 6pm. This represents the importance of the commuting traffic along Lismore to Bangalow Road. There are three villages between Lismore and Bangalow where the through traffic speed limit is 50km/h. This can cause platooning of vehicles and average speeds along the corridor to be lower. The analysis indicated that southbound the worst areas are between Bexhill and Lismore in the morning peak, northbound between Clunes and Binna Burra in the afternoon peak. These locations are expected to continue to deteriorate into the future.

The results of the rural road traffic modelling show that two additional overtaking lanes, one northbound in section 3 and one southbound in section 2, would improve the percentage of time spent following.

Freight productivity

- Currently General Access Vehicles can access the full length of the Lismore to Bangalow corridor. 19 metre long B-doubles not greater than 4.3 metres high (including its load) and carrying less than 50 tonne is allowed on all roads in NSW including Lismore to Bangalow Road.
- Lismore to Bangalow Road is currently not suitable for longer 26 metre B-Doubles and other Restricted Access Vehicles because of its road alignment and formation width. The Bruxner Highway provides transport and freight links between Lismore and the Pacific Highway which are suitable for 26 metres B-Doubles operating at Higher Mass Limits (HML).

Asset performance

- To understand how the road pavement is performing and to forecast future pavement condition, a number of measures are considered including pavement types and surfaces, pavement age, road surface cracking, road smoothness and rutting. Pavement age on many parts of the Lismore to Bangalow Road corridor, particularly in rural areas, has its design life and the current pavement replacement rate is lower than the required replacement rate. Over a third of the pavements between Lismore and Clunes are more than 40 years old. Nonetheless, the majority of the pavements are currently displaying ongoing structural serviceability and acceptable roughness.
- Rutting measurements show 53 per cent of the Lismore to Bangalow corridor currently exhibits 'good' to 'slight' rutting, while 46 per cent exhibit rutting deficiencies with 'moderate' to 'extreme' rutting counts. Nearly half of the Lismore to Clunes section exhibits extreme rutting and 74 per cent of that section has rutting counts arranging from 'moderate' to 'extreme'. The Clunes to Bangalow section exhibits the lowest proportion of deficiencies at 36 per cent of 'moderate' to 'extreme' rutting counts. The large proportion of the route with moderate rutting is a reflection of the long lengths with natural gravel base layers and a thin bitumen or asphalt surface, which have inadequate strength to support the increasing vehicle axle loads.

Taking action

Short term actions:

- Support opportunities for a cycleway to promote recreational travel needs of cyclists between Lismore and the Byron Bay coast. This may include a rail trail.
- Improve and prioritise cyclist connectivity within Lismore city centre.
- Work with Lismore City Council to develop a strategic traffic model focusing on the Bruxner Highway and Lismore to Bangalow Road through Lismore to determine whole of network approaches to addressing traffic movements and congestion within Lismore CBD.
- Develop and implement two overtaking opportunities along the corridor.
- Continue to assess whole of life costs for pavement maintenance to ensure value for money and identify opportunities to strengthen pavement and carry out pavement repair work along the corridor on a priority basis.
- Continue to implement the annual skid resistance monitoring process to ensure appropriate skid resistance for Lismore to Bangalow Road.
- Road realignments particularly around Binna Burra and Springvale Hill.
- Continue to assess slope stability and develop and implement management plans for slopes considered to be at high risk.
- Continue to develop and implement management plans for culverts with an assessed risk level (ARL) rating less than three for high priority culverts.
- Implement clear zone and safety barrier improvements, taking into consideration the road geometry and environmental/ land use constraints along the corridor.
- Continue to develop road safety improvements to address existing and emerging crash cluster locations.

- Complete a speed zone review of the Clunes to Bangalow section and further investigate the high incidence of speed related and off curve crashes in this section.
- Develop and implement road safety initiatives, informed by the recommendations of the speed zone review.
- Develop options to improve traffic efficiency, road safety and design standard at various intersections.
- Improve the formation width by widening sealed shoulders and improving lane width on a priority basis.
- Complete an audit on the safety and standard of the four narrow bridges and investigate options to improve safety on a priority basis.
- Continue to support the needs of public transport users through appropriate facilities and infrastructure along the corridor.
- Continue to maintain the local amenity of Bexhill, Clunes, Binna Burra and Bangalow.
- Continue to minimise and balance any impacts to the natural and built environment when carrying out work along the Lismore to Bangalow Road corridor.

Medium term actions include:

- Continue to improve cyclist connectivity within Lismore town centre (ongoing).
- Identify cost effective solutions to improve flood immunity along the corridor.
- Continue to monitor pavement condition in regards to road smoothness, rutting and cracking.
- Continue to develop and implement management plans for culverts with an assessed risk level (ARL) rating less than three for medium priority culverts.
- Continue to assess slope stability and develop and implement management plans for slopes considered to be at medium risk.
- Progressively address sections with poor alignment, narrow lanes and shoulder widths on a priority basis, particularly south of Clunes.
- Continue to implement clear zone and safety barrier improvements, taking into consideration the road geometry and environmental/land use constraints along the corridor.
- Implement safety and design standard improvements at intersections on rural sections of the corridor.
- Implement improvement works for high risk narrow bridges along the corridor on a priority basis.
- Continue to develop road safety improvements to address existing and emerging crash cluster locations.
- Continue to support the needs of public transport users through appropriate facilities and infrastructure along the corridor.
- Continue to maintain the local amenity of Bexhill, Clunes, Binna Burra and Bangalow
- Continue to minimise and balance any impacts to the natural and build environment when carrying out work along the Lismore to Bangalow Road corridor.
- Continue to monitor the level of service and investigate the need for additional overtaking lanes.
- Develop and implement traffic efficiency initiatives, informed by the Lismore traffic study.

> “Short term actions include improving the formation width by widening sealed shoulders and improving lane width on a priority basis.”

Long term actions include:

- Continue to improve cyclist connectivity within Lismore town centre (ongoing).
- Implement cost effective solutions identified to improve flood immunity.
- Continue to develop and implement management plans for culverts with an assessed risk level (ARL) rating less than three for low priority culverts.
- Continue to assess slope stability and develop and implement management plans for slopes considered to be at high risk.
- Continue to implement clear zone and safety barrier improvements, taking into consideration the road geometry and environmental/land use constraints along the corridor.
- Continue to implement safety and design standard improvements at intersections on rural sections of the corridor.
- Continue to implement improvement works for high risk narrow bridges along the corridor on a priority basis.
- Continue to support the needs of public transport users through appropriate facilities and infrastructure along the corridor.
- Continue to maintain the local amenity of Bexhill, Clunes, Binna Burra and Bangalow.
- Continue to minimise and balance any impacts to the natural and build environment when carrying out work along the Lismore to Bangalow Road corridor.
- Duplication between Ballina Street and Woodlark Street, Lismore.
- Continue to implement strategies to address existing and emerging crash clusters.
- Continue to monitor pavement condition, and implement pavement improvement works on a priority basis.

Looking north along the Stoney Ridge project

CONTENTS

LIST OF FIGURES

1 A QUICK OVERVIEW

Dawson Street and Ballina Road Roundabout, Lismore

This draft corridor strategy sets out how the NSW Government will manage road transport along Lismore to Bangalow Road in the long-term. The draft corridor strategy plans to be delivered over a 20 year timeframe, in line with the *NSW Long Term Transport Master Plan, Northern Rivers Regional Transport Plan* and other relevant national and State planning frameworks. From road safety and transport efficiency to asset maintenance issues, this strategy sets the direction for managing Lismore to Bangalow Road (B62) into the future.

Lismore to Bangalow Road is a south-north two lane undivided rural road, approximately 33 kilometres in length in the NSW Northern Rivers region. The corridor connects the Bruxner Highway at Lismore to the Pacific Highway at Bangalow (Figure 1-1). The corridor serves as a general access route between Lismore and Bangalow with further connections to Byron Bay. The road functions an alternative to the Bruxner Highway for travel between Lismore and the Pacific Highway. The Bruxner Highway is the major freight link between Lismore and the Pacific Highway, while the Pacific Highway, part of the National Land Transport Network, is the major link between Sydney and Brisbane.

Figure 1-1 Lismore to Bangalow Corridor

The road spans 33 kilometres and passes through 2 local government areas (Lismore City and Byron Shire) in the Northern Rivers region.

The corridor's transport roles include:

- Serving as a route for inter-regional business, tourism and leisure travel between Lismore and the Byron coastal area.
- Providing tourism and local business access to villages (such as Bexhill, Clunes, and Bangalow) along the corridor.
- Providing a supporting route between Lismore and coastal towns near Bangalow including Byron Bay and Brunswick Heads.
- Serving as a detour route for vehicles (other than restricted access vehicles) when an incident blocks traffic on the Bruxner Highway north of Lismore or the Pacific Highway between Ballina and Bangalow.

Natural and built geographic conditions differ along the corridor. The majority of the corridor's population lives towards the southern end within the established regional centre of Lismore. The Byron coastal region, including Bangalow, is a growing area particularly with recent improvements to transport connections between South East Queensland and Lismore. The terrain along the corridor is primarily rolling coastal hinterland with high scenic and agricultural value. Lismore is located on lower lands and is subsequently prone to intermittent flood events. The Lismore to Bangalow corridor is surrounded by a region rich in agricultural resources, which form a significant part of the local economy. The land surrounding Lismore is high quality grazing land, while the northern end of the corridor is farmed for sub-tropical fruit harvests such as macadamias, citrus and avocados.

The main means of transport within the corridor is private vehicle use. Within Lismore, average daily traffic volumes were around 12,000 vehicles in 2015, while the remainder of the corridor traffic volumes are between 7,000 and 9,000.

There are several bus routes operating along the Lismore to Bangalow Road, connecting the major regional centre of Lismore to towns along the corridor and further north and south along the Pacific Highway. Dedicated walking and cycling infrastructure, as with bus services, tends to be focused on the more densely populated areas in the corridor, such as Lismore.

The Northern Rivers region is served by NSW TrainLink's North Coast rail service line which connects Brisbane to Sydney (through Broadmeadow, Wauchope, Grafton and Casino). NSW TrainLink runs daily connecting coach services between Lismore and Bangalow.

Public transport in the Northern Rivers is focused on travel within the regional centres, particularly Tweed Heads, Lismore and Ballina. Public transport between regional centres, towns and smaller communities is more limited, and generally focused on school transport. The 2011 Census data revealed that only 0.9 per cent of Lismore employees use public transport to commute to work.

Aligned with the *Long Term Transport Master Plan*, the *Northern Rivers Regional Transport Plan* has been developed to address specific transport challenges and solutions for the region. One of the key initiatives in the *Northern Rivers Regional Transport Plan* is investigating the feasibility of a walking and cycling trail along the disused sections of the Casino-Murwillumbah rail line to the east-west of Byron Bay. A feasibility study into the development of a "rail trail" on the Casino to Murwillumbah rail line was conducted by ARUP on behalf of the Department of Premier and Cabinet in May 2014[1].

Other initiatives in the *Northern Rivers Regional Transport Plan* include improving regional bus services and transport services in towns by introducing a more robust contractual framework and working with operators to improve routes and timetables, online public transport service information, and investigating flexible or demand responsive transport across a range of delivery modes. Initiatives also include improving community transport services by working with

1. **Department of Premier and Cabinet 2014,** *Casino to Murwillumbah Rail Trail Study: Final Report, Department of Premier and Cabinet*, **Sydney**

local transport operators to ensure adequate community transport services are provided and integrated into the passenger transport system.

This draft corridor strategy sets out the objectives, current performance, current and future challenges and the NSW Government's strategic response to managing the Lismore to Bangalow corridor over the long term.

> Public transport in the Northern Rivers is focused on travel within the regional centres, particularly Tweed Heads, Lismore and Ballina.

Recent major achievements on the Lismore to Bangalow Corridor

2007-08 Delivery of roundabout at Lismore to Bangalow road and Leycester Street intersection in Lismore

2009-10 Delivery of pavement rehabilitation and minor widening at Lions Park, three kilometres north of Lismore

2010-11 Delivery of pavement rehabilitation at Donnans Road

2011-12 Delivery of slope repairs near Binna Burra

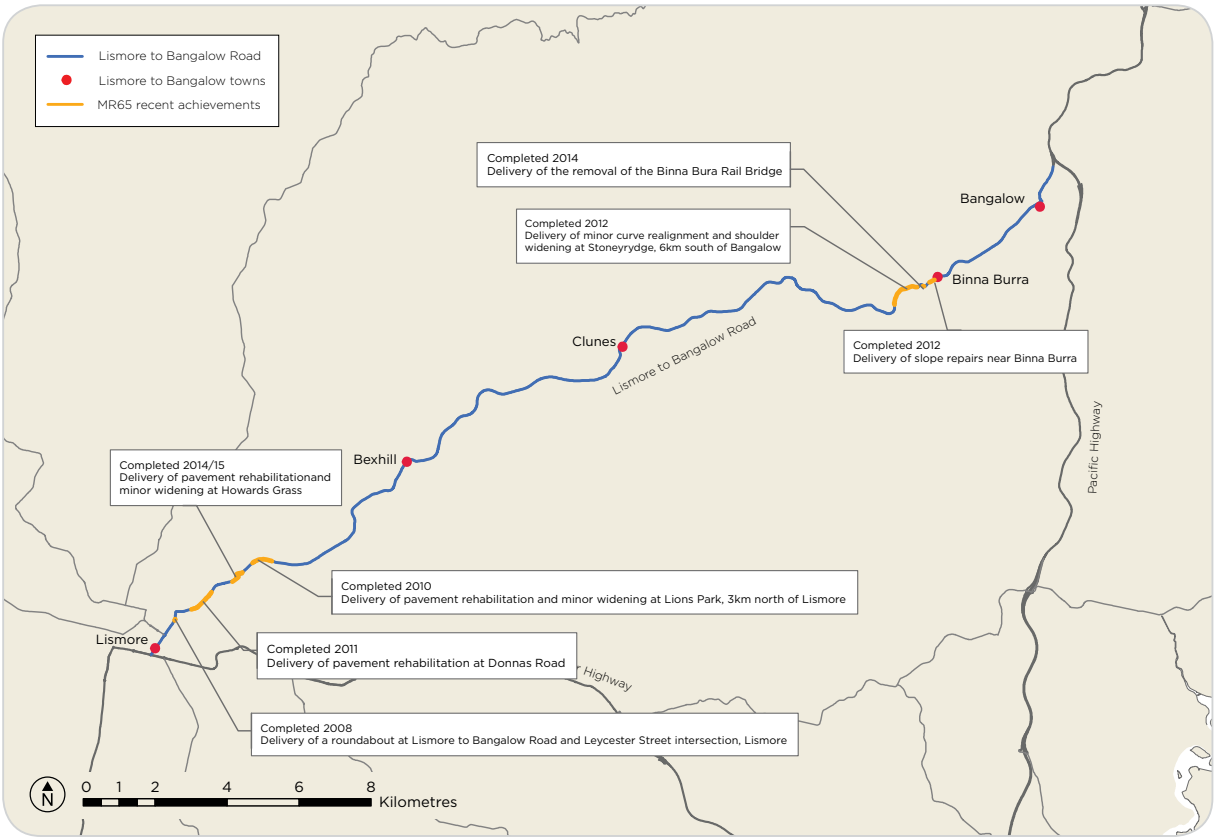
Delivery of safety works –delineation audit and remedial works

2013-14 Delivery of the removal of the Binna Burra Rail Bridge

2014-15 Delivery of minor curve realignment and shoulder widening at stoney ridge, six kilometres south of Bangalow

2014-15 Delivery of pavement rehabilitation and minor widening at Howards Grass.

Figure 1-2 Recent major achievements



2 INTRODUCTION

Heading north, top of Springvale Hill, Eureka

2.1 Why a corridor strategy?

Transport for NSW and Roads and Maritime Services (Roads and Maritime) are progressively preparing corridor strategies for every State road in NSW to create consistency in the way that the State Road Network is managed and planned.

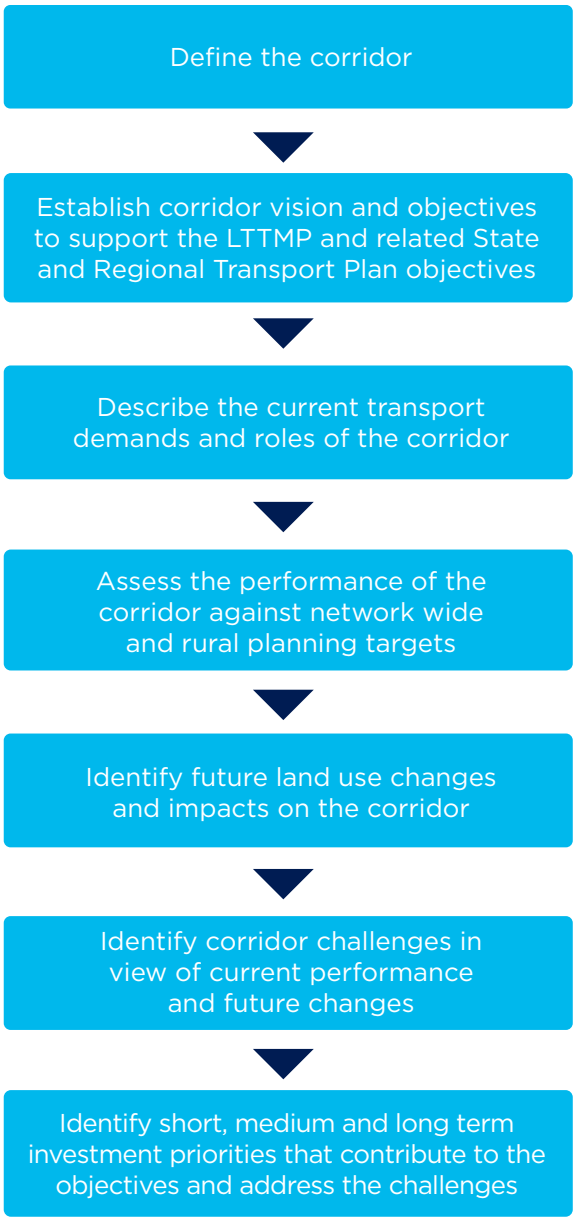
Corridor strategies make planning and investment decisions transparent to the community, councils and other government agencies.

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 *Regional Transport Plans* (and other State and national plans).
- 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 priorities and actions to manage 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 Lismore to Bangalow Road?

The NSW Government is committed to long-term management of the road transport system in the Northern Rivers region of NSW. Lismore to Bangalow Road provides an important connection between the major centre of Lismore, the village of Bangalow and urban areas along the coast north of Byron Bay.

There are number of road safety, transport efficiency and asset maintenance challenges along the corridor that need to be addressed:

- **Traffic efficiency:** High levels of traffic volumes within Lismore, with up to 12,000 vehicles per day experienced at the southern end of Lismore to Bangalow Road, can lead to congestion in the morning and afternoon peaks, a problem which will need to be continuously addressed in the future as the population grows.
- **Road safety:** Urban areas within Lismore have the greatest number of recorded casualty crashes, while the majority of rural crashes have been recorded between Clunes and Bangalow. The casualty crash rate for this rural section is considerably higher at 0.58 compared to the NSW class 4 road average of 0.195, which highlights a safety concern. The majority of these crashes highlight contributing factors of wet weather and speed on curves.
- **Road asset condition and maintenance:** The corridor has sections of varying pavement condition the worst section is between Lismore and Clunes with 43 per cent (6.06 kilometres out of 14.11 kilometre) of the pavement exhibiting extreme rutting and 39 per cent (5.5 kilometres out of 14.11 kilometre) of this section with a pavement age of greater than 40 years. The section between Lismore and Clunes has 94 per cent (13.26 kilometres out of 14.11 kilometres) with narrow shoulder widths less than standard, 92 per cent between Bexhill and Clunes, and 71 per cent (9.47 kilometres out of 13.34 kilometres) of narrow carriageway below standard between Clunes and Bangalow.
- **Environment:** The corridor experiences consistently high rainfall along its length. The area to the north of Lismore is prone to localised flooding from the Wilsons River between Lagoon Grass and Bexhill. The amount of rainfall impacts on the drainage of the road and in turn the level of maintenance required to the road surface.

This strategy identifies road safety, maintenance and traffic actions to these challenges at local and regional levels.

Process and methodology

This draft 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, transport planning and development. It provides an assessment of Lismore to Bangalow Road's road conditions, traffic and safety carried out by both agencies.

The corridor has been considered within the broader strategic planning context provided by key national, 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. Transport for NSW and Roads and Maritime asset, traffic and safety data has been analysed to determine current levels of performance.

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 goals of NSW 2021 – to ensure a coordinated and community-driven approach to planning.

NSW 2021

The NSW 2021 is NSW Government's 10 year plan to rebuild the State's economy, provide quality services, renovate infrastructure, restore Government accountability and strengthen local environment and communities.

The Lismore to Bangalow Road Draft Corridor Strategy contributes to achieving the following NSW 2021 priorities and goals:

- **Goal 3: Drive economic growth in regional NSW**

Draft Corridor Strategy: Supports access to the growing region of the Northern Rivers between Lismore (a major employment centre) and coastal towns near Bangalow including Byron Bay and Brunswick Heads.

- **Goal 7: Reduce travel times**

Draft Corridor Strategy: Improving the road geometry, providing overtaking opportunities and addressing localised intersection capacity constraints at Lismore

- **Goal 10: Improve road safety**

Draft Corridor Strategy: Providing safety improvements such as road realignments, wider sealed shoulders and lanes to improve the road safety outcomes for the community.

- **Goal 19: Invest in critical infrastructure**

Draft Corridor Strategy: Continually investing in the maintenance and upgrade of the corridor through progressively providing overtaking opportunities, wider sealed shoulders and lanes and realignment of the road to improve tight curves and steep grades.

- **Goal 28: Ensure NSW is ready to deal with major emergencies and natural disasters**

Draft Corridor Strategy: Providing emergency access in the events of natural disasters such as flooding, and incidents such as vehicle crashes.

- **Goal 29: Restore confidence and integrity in the planning system**

Draft Corridor Strategy: Delivers clear and transparent planning for the Lismore to Bangalow corridor to ensure community needs inform the planning process and infrastructure supports customer needs, travel demands, and land-use.

NSW Long Term Transport Master Plan

The Master Plan 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.

- A key aim of the Master Plan is to **provide essential access for regional NSW.**

The Lismore to Bangalow Road Draft Corridor Strategy advances this objective by supporting efficient and safe connections along Lismore to Bangalow Road to meet existing and future travel demands; provide access to villages along the corridor and services in Lismore and Byron Bay; and sustain local employment growth and economy.

- The Master Plan also sets as a priority the need to support an **efficient and productive freight industry.**

This draft corridor strategy aims to improve the travel efficiency for general access freight vehicles along Lismore to Bangalow Road, while complementing the Bruxner Highway as the north-south freight route for restricted access vehicles.

Figure 2-2 shows how the Master Plan integrates with other NSW plans to ensure a coherent, whole-of-government approach is taken to transport planning.

Figure 2-2 Planning framework

Regional Action Plans

The Regional Action Plan relevant to Lismore to Bangalow Road is the Northern Rivers Regional Action Plan. Each Regional Action Plan identifies immediate actions the NSW Government will prioritise in each of the areas.

The Northern Rivers Regional Action Plan identifies actions to improve access to public transport and improve road safety through:

- Planning for the current and future transport needs of the Northern Rivers community.
- Fast tracking the delivery of critical road upgrades and improving regional infrastructure.
- Supporting the efficient movement of freight throughout the region.

The two year *Regional Action Plans* will complement long term strategies, such as *Regional Transport Plans*.

Regional Growth and Infrastructure Plans

The NSW Department of Planning and Environment (DP&E) is currently working to review the existing NSW Regional Strategies to prepare new Regional Growth and Infrastructure Plans for the regional areas within NSW to reflect the NSW Government's new integrated planning approach that incorporates land use planning, infrastructure planning and transport planning.

The Far North Coast Regional Strategy developed in 2006 by the NSW Department of Planning, is being reviewed and updated to provide clarity to the community and industry about land use management and in particular, for housing and employment land strategies to cater for existing and future needs.

The *NSW Long Term Transport Master Plan* will be complemented by the NSW DP&E's Regional Growth and Infrastructure Plans, which will manage long term growth and land use changes across NSW[2].

2 Department of Planning and Environment 2014, *Regional Strategies and New Regional Growth and Infrastructure Plans,* **planning.nsw.gov.au/en-us/planningyourregion/regionalgrowthandinfrastructureplans.aspx,viewd 25/05/2015.**

NSW State Infrastructure Strategy

The NSW Government's 20-year State Infrastructure Strategy sets out infrastructure projects and initiatives the Government will prioritise for the short, medium and longer term.

The NSW Government's strategic priorities for regional and interstate transport that are relevant to the Lismore to Bangalow Road Draft Corridor Strategy include:

- **Safer, more efficient road freight corridors:** Safe, efficient and reliable transport connections are vital to regional communities and businesses.
- **Keep pace with regional population growth:** With strong population growth predicted for a number of regional centres over the new two decades, transport investment should focus on servicing this growth and ensuring that regional connections support the new economic and employment opportunities generated by an increasing population.

NSW Freight and Ports Strategy

The NSW Freight and Ports Strategy aims to provide a transport network that allows an efficient flow of goods to their market.

This draft corridor strategy contributes to the following freight-specific objectives and reflects the importance of the freight transport network in creating a competitive and productive NSW economy.

- **Delivery of a freight network that efficiently supports the projected growth of the NSW economy.** The draft corridor strategy supports Lismore to Bangalow Road as a general access freight route, and supports the Bruxner Highway as the principal freight route.
- **Balancing of freight needs with those of the broader community and the environment.** The draft corridor strategy aims to maintain Lismore to Bangalow Road as a general access route, and supports more efficient travel by progressively addressing sections of the corridor with poor pavement condition, poor alignment, narrow lanes and shoulders.

NSW Road Safety Strategy

The NSW Road Safety Strategy 2012-2021 sets the direction of road safety in NSW for the next 10 years. NSW is committed to reducing fatalities to at least 4.3 per 100,000 population by 2016 together with at least a 30 per cent reduction in fatalities and serious injuries between 2012 and 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 strategy follows this approach. Section 4 assesses the corridor's current performance in terms of the casualty crash rates, crash types and contributing factors. The draft corridor strategy supports road safety infrastructure improvements such as road realignments and wider sealed shoulders and lanes, to reduce the number and severity of crashes along the corridor, in particular related 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 Master Plan.

The objectives for Regional Transport Planning are:

- Improving accessibility to transport for everyone
- Addressing cross-border connectivity issues
- Appreciating the importance of intra and inter regional connectivity
- Recognising the importance of air travel
- Making sure that the transport solutions for the regions support growth and development, while protecting the viability and amenity of centres and towns
- Recognising the growing freight task and its impact.

The *Northern Rivers Regional Transport Plan* identifies specific challenges the regions' transport networks face and prioritise actions to address these challenges. The broad actions are under three themes: better transport services, ensuring effective regulation and improving transport infrastructure. The plans provide a detailed analysis of local transport needs and priorities and respond to issues raised during regional consultation to develop the Master Plan.

This draft corridor strategy elaborates on the road specific actions for Lismore to Bangalow Road as identified in the *Long Term Transport Master Plan* and *Northern Rivers Regional Transport Plan* and provides further detailed analysis to guide investment priorities for the ongoing maintenance and operation of Lismore to Bangalow Road.

Figure 2-3 shows how the *Regional Transport Plans* are linked to specific mode plans and road corridor strategies to improve regional connections.

Figure 2-3 Relationship with *Regional Transport Plans*

National infrastructure priorities

The Australian Government has identified three objectives to drive the development of a long term, coordinated national approach to infrastructure planning and investment:

- Increase the economic standard of living for Australians,
- Achieve environmental sustainability and reduced greenhouse gas emissions and
- Improve social outcomes, quality of life and reduced social disadvantage in our cities and regions.

To achieve these objectives, seven strategic priorities have been identified. This draft corridor strategy supports the following Infrastructure Australia's strategic priorities:

- Increasing Australia's productivity,
- Developing Australia's cities and regions,
- Improving social equity and quality of life in our cities and regions.

The Lismore to Bangalow Road Draft Corridor Strategy supports the State's role, on a regional scale, in increasing Australia's productivity, developing cities and regions, and improving social equity and quality of life.

Road and safety improvements of the corridor are aimed at increasing the efficiency of inter-regional business, tourism and leisure travel between Lismore and the Byron coastal area for general access vehicles. These corridor improvements will support local employment and industry growth in the Northern Rivers area by increasing accessibility of the region. The corridor will be also maintained to support connectivity to the other regions such as New England North West, Mid North Coast and south-east Queensland, in particular for tourism. Preserving the quality and character of villages along the corridor will enhance access for tourism and local business.

2.3 Key corridor challenges and issues

The Lismore to Bangalow corridor challenges are either already evident or are expected to emerge as results of future changes. A summary of the key corridor challenges relevant to Lismore to Bangalow Road corridor are listed below:

- Meeting the travel needs of the younger people wanting to travel between Lismore and Byron Bay
- Poor road alignment and narrow shoulders
- Constraints around intersection capacity during peak periods are impeding the free flow of the through traffic in Lismore
- Conflicting local and through traffic needs within the villages of Bexhill, Clunes and Bangalow, as well as local access in villages to shops and businesses
- Inadequate overtaking opportunities between Lismore and Bangalow
- Poor pavement condition particularly within Lismore and between Lismore and Clunes
- Low flood immunity resulting in road closures for more than 24 hours, particularly around the Wilson's River at Lismore and Byron Creek near Binna Burra
- High risk slopes around Binna Burra prone to land slips in heavy rainfall
- The presence of threatened flora and fauna, local cultural heritage and significant Aboriginal sites
- The prevalence of intersection crashes within Lismore
- The presence of wet weather crashes and speed related crashes particularly on curves along the corridor
- Increasing numbers of vulnerable road users, including the elderly, pedestrians and cyclists in towns
- Narrow bridges along the corridor (Lagoon Creek, Springvale Bridge over Wilsons Creek, Maori Creek and Paddys Creek).

These challenges cover existing and anticipated issues that need to be overcome to maintain and improve the Lismore to Bangalow Road's role and services for the community.

Key challenges and issues on the Lismore to Bangalow Road corridor are further discussed in Chapter 7 following detailed performance analysis in Chapter 5 of this document.

2.4 Corridor objectives

The key corridor challenges and issues are used to determine corridor objectives for the Lismore to Bangalow Road Corridor. These objectives are specific tasks that are required to address the identified issues along the corridor.

The specific corridor objectives are in line with the following *NSW Long Term Transport Master Plan* objectives as shown below.

NSW LONG TERM TRANSPORT MASTER PLAN OBJECTIVES

- **Improve quality of service**: by putting the customer at the centre of transport planning and service delivery, improving the quality of travel experiences, offering more travel choices and providing integrated services that directly meet travel requirements.
- **Improve liveability:** by improving connectivity, customer service and ease of movement in our major cities and activity centres.
- **Support economic growth and productivity:** by providing a transport system that responds directly to customer needs, is more efficient, increases freight efficiency and improves the connectivity and accessibility of people to other people, opportunities, goods and services.
- **Support regional development:** by improving accessibility to jobs, services and people, improving freight connections to markets and providing better links between clusters of business activity.
- **Improve safety and security:** by placing a high priority on addressing the causes and risks of transport accidents and security incidents.
- **Reduce social disadvantage:** by reducing transport disadvantage through improved access to goods, services and employment and education opportunities for people across all parts of the State.
- **Improve sustainability:** by optimising the use of the transport network, easing congestion, growing the proportion of travel by sustainable modes such as public transport, walking and cycling and becoming more energy efficient.
- **Strengthen transport planning processes:** by improving integrated transport planning processes and identifying areas where evidence should be collated for future decision making and continually improving governance and administration of the transport system.

Figure 2-4 Meeting the Master Plan's Objectives: the Lismore to Bangalow Road Corridor

The Lismore to Bangalow Road Draft Corridor Strategy's specific objectives will guide the corridor's long term management. These are mapped against the *NSW Long Term Transport Master Plan* objectives in Table 2-1.


Dawson Street and Uralba Street, Lismore

Table 2-1 Meeting the Master Plan's Objectives: the Lismore to Bangalow Road Corridor

NSW Long Term Transport Master Plan objectives		Lismore to Bangalow Road Corridor objectives
Improve liveability Reduce social disadvantage	CUSTOMER - Improve Quality of Service	• Address the public and active transport needs of the users along the corridor. • Balance the demand for travel with urban amenity in the villages of Bexhill, Clunes and Bangalow and in Lismore.
Economic growth / productivity		• Provide road capacity for any significant increases in traffic levels due to population and tourism growth of the Far North Coast region. • Maintain and improve asset condition through progressively upgrading pavements to ensure the corridor can accommodate local and intra regional traffic. • Continue to provide a route for general access freight vehicles.
Regional development / accessibility		• Continue to improve intersection and mid-block efficiency on the corridor within Lismore. • Maintain and improve access between the regional facilities and developments in the Lismore, Bangalow and Byron Bay areas for local and regional traffic.
Improve sustainability		• Identify and protect sensitive environments within the boundaries of the road corridor including threatened flora and fauna, local cultural heritage and significant Aboriginal sites
Safety and security		• Enhance road safety for all road users by implementing the safer systems approach to the design and management of the road to reduce the number and severity of crashes, in particular related to wet road surfaces. • Improve the widths of lanes, shoulders and narrow bridges along the corridor
Improve transport integration process		• Work with Lismore City and Byron Shire Councils to provide a road that meets the current and future transport needs of all road users.

2.5 A vision for the future

The vision for the future explains what actions should be achieved on the Lismore to Bangalow Road Corridor over the next 20 years in order to improve the performance of the road and meet the specific corridor objectives.

The vision for the Lismore to Bangalow Road Corridor over the next 20 years is to:

- Support Lismore to Bangalow Road as **general access route** travelling north south between Lismore, Bangalow and Byron Bay, while complementing the Bruxner Highway as a principal freight route
- Enhance road safety outcomes for all road users over the length of the corridor through implementation of the **safe system approach** in the planning, development and delivery of improvement and maintenance works.
- Manage the impacts of recurrent **flooding** events of the Wilsons River between Lismore and Bexhill.
- Continue to progressively **improve poor pavement** condition, road alignment and road width along the corridor
- Have a sufficient number of **overtaking opportunities** in both directions to maintain a safe and efficient level of service
- Maintain the **local amenity** of Bexhill, Clunes and Bangalow villages
- Support the **active transport** needs of cyclists and pedestrians within towns and villages
- Support the needs of **public transport** users through appropriate facilities and infrastructure along the corridor, in particular by improving regional bus travel

2.6 Taking action

These transport challenges for Lismore to Bangalow Road will be progressively addressed through strategically managing the corridor over the short, medium and long term, in line with the *Northern Rivers Regional Transport Plan* and the *Long Term Transport Master Plan*. The priorities for responding to the challenges for the Lismore to Bangalow corridor are explained in Chapter 6. These priorities generally focus on addressing safety along the route, providing upgrades to lane/shoulder widths and overtaking opportunities, and addressing emerging congestion issues in Lismore.

SPECIFIC ACTION RELEVANT TO THE LISMORE TO BANGALOW CORRIDOR IN THE *NSW LONG TERM TRANSPORT MASTER PLAN* AND THE *NORTHERN RIVERS REGIONAL TRANSPORT PLAN:*

Medium to longer term

We will commence the necessary road network planning for upgrades to support the growth of Lismore, Ballina and the Tweed Coast, and we will address congestion and capacity issues as they emerge.

3 COMMUNITY INVOLVEMENT

Bangalow roundabout

During development of the Lismore to Bangalow Road Draft Corridor Strategy consultation was undertaken with local councils and other Government agencies.

This chapter summarises the key customers along the Lismore to Bangalow Road corridor, the consultation outcomes and describes how the findings have been used during the development of the Lismore to Bangalow Road Corridor Strategy. Involvement from the community during the exhibition period is invaluable in the development of corridor strategies. Following the exhibition period, a community consultation report will be prepared and presented to the community as an attachment to the final corridor strategy. This submissions report will highlight the feedback received from local communities and all other stakeholders and responses to this feedback.

3.1 An integrated, customer-focused transport network

Key customer markets for the Lismore to Bangalow Road

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 draft 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

There are many different customers of the road network, who have different trip purposes for their journeys and different preferences for time of travel. They include motorists and passengers of private cars, bus and coach customers, taxis, hire cars, motorcyclists, cyclists and pedestrians.

Freight and commercial services are also significant users of the road network, who can take the form of articulated and rigid trucks, vans, utilities and cars.

Road customer markets are highly segmented. Table 3-1 shows some of the major road customer markets using Lismore to Bangalow Road. The three main road user market segments are:

- Commuter trips to urban activity centres and employment centres as well as a range of dispersed multi-purpose travel patterns.
- Longer personal and work-related trips between non-centre locations or requiring multiple stops including to or from regional and interstate locations.
- Heavy and light freight movements generally between industrial and business centres.

“Commuter trips to urban activity centres and employment centres as well as a range of dispersed multi-purpose travel patterns.”

Table 3-1 Key customer markets on the Lismore to Bangalow Road corridor

Urban activity centres		
Commuter travel for work		Trip purpose
Travel to Lismore and Ballina regional centres, Lismore and Ballina employment hubs	Travel by private car, bus, motorcycle, cycle, taxi, walking	Location and mode
Generally AM and PM weekday peak periods		Time of travel
Dispersed travel for work, education, health, recreational and business		Trip purpose
Travel to Lismore regional centre, education and health facilities, recreational centres and others such as family and friends	Travel by private car, hire car, bus, motorcycle, cycle, taxi, walking	Location and mode
Dispersed in time throughout the day and both weekday and weekends		Time of travel
Longer distances (interregional and interstate trips)		
Longer distance travel for work, education, health, recreational and business		Trip purpose
Highly dispersed travel to South East Queensland, North Coast NSW	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 the Lismore and Byron Bay regions	Rigid and articulated vehicles	Location and mode
Mostly weekdays and business hours, some weekends and after hours		Time of travel
Light good movement		Trip purpose
Highly dispersed locations to commercial centres	Small trucks, vans, utility vehicles	Location and mode
Mostly weekdays and business hours, some weekends and after hours		Time of travel

These markets are diverse in terms of their trip purpose, vehicles used, and time of travel. The focus of this corridor strategy is to address the needs of those customers who for a variety of reasons rely on the use of the road network. The road network also has a major part to play in supporting connections to non-road based public transport.

The road network also 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 will involve giving priority to different road users and modes at different times of the day and week to balance mobility and access needs.

Customer consultation

The *NSW Long Term Transport Master Plan* released in December 2012 also involved a wide range of consultation with customers directly affected by the transport network. Feedback raised through the consultation process varied greatly across each region. The Lismore to Bangalow corridor is within the Northern Rivers region (Figure 3-2).

Northern Rivers customers saw the need for greater efficiency from existing rail and road networks. More accessible and affordable public transport was viewed as a priority and additional funding for community transport was suggested. Road maintenance was nominated as an area for appropriate funding, including through assistance to local councils.

Many customers in the Northern Rivers region viewed improved access to South East Queensland and better integration of services across the border as important. They also suggested encouraging more walking and cycling through better facilities and generally adopting a more sustainable approach to transport. Some of the most frequently mentioned initiatives were the maintenance of Lismore to Bangalow Road and future use of the rail connection between Casino and Murwillumbah.

Regional Transport Plans have been developed to address specific transport challenges and solutions for these regions including the Northern Rivers. Some of the key initiatives in the *Northern Rivers Regional Transport Plan* are:

- **Improve cross-border connectivity** by continuing to work with Queensland Government to align state regulation and cooperation.
- **Invest in the road network** by continuing to address pinch points on the road network.
- **Improve road safety** by progressing the actions of the NSW Road Safety Strategy 2012-2021 to support the NSW 2021 target of reducing fatalities to 4.3 per 100,000 population by 2016.
- **Invest in walking and cycling infrastructure** through the Walking Communities Program, Connecting Centres Program and the Cycling towns Program, and by working together with local government.
- **Investigate walking and cycling trails including disused rail lines** such as investigating the feasibility of a walking and cycling trail along the disused sections of the Casino-Murwillumbah rail line to the east-west of Byron Bay.
- **Improve tourism related transport services** during the peak holiday periods and community transport services by working with local transport operators.
- **Improve regional bus services and transport services in towns** by introducing a more robust contractual framework and working with operators to improve routes and timetables online public transport services information.
- **Improve public transport interchanges.**
- **Investigate flexible or demand responsive transport** across a range of delivery modes.
- **Develop annual festival servicing plans** for major events to encourage public transport use.

Figure 3-2 *NSW Long Term Transport Master Plan* regional boundaries

4 TRANSPORT DEMANDS AND ROLES

Stoney Ridge, Binna Burra

Travelling north from Clunes

4.1 The Lismore to Bangalow Road corridor and the surrounding road network

With a mix of rural and more urbanised populations and industries in the Lismore to Bangalow road corridor, the transport roles of the corridor include:

- Supporting travel to and from the region:
  - forming part of a cross-border connection to south-east Queensland
  - connecting to other north coast villages to the north and south
  - serving as a route for inter-regional business, tourism and leisure travel between centres south of Lismore and the Byron coastal area.
- Supporting travel within the region by:
  - providing a supporting route between Lismore (a major employment centre) and coastal towns near Bangalow including Byron Bay and Brunswick Heads.
  - serving as a detour route for vehicles (other than restricted access vehicles) when an incident blocks traffic on the Bruxner Highway east of Lismore or the Pacific Highway between Ballina and Bangalow.
- Supporting travel in the major centres and towns:
  - providing tourism and local business access to villages such as Bexhill, Clunes and Bangalow.
  - supporting local access to jobs, shops, education, community services, health care and tourism facilities within Lismore and between Lismore and Byron Bay.

The Lismore to Bangalow Road corridor intersects with a series of road and rail links. These are summarised in Table 4-1.

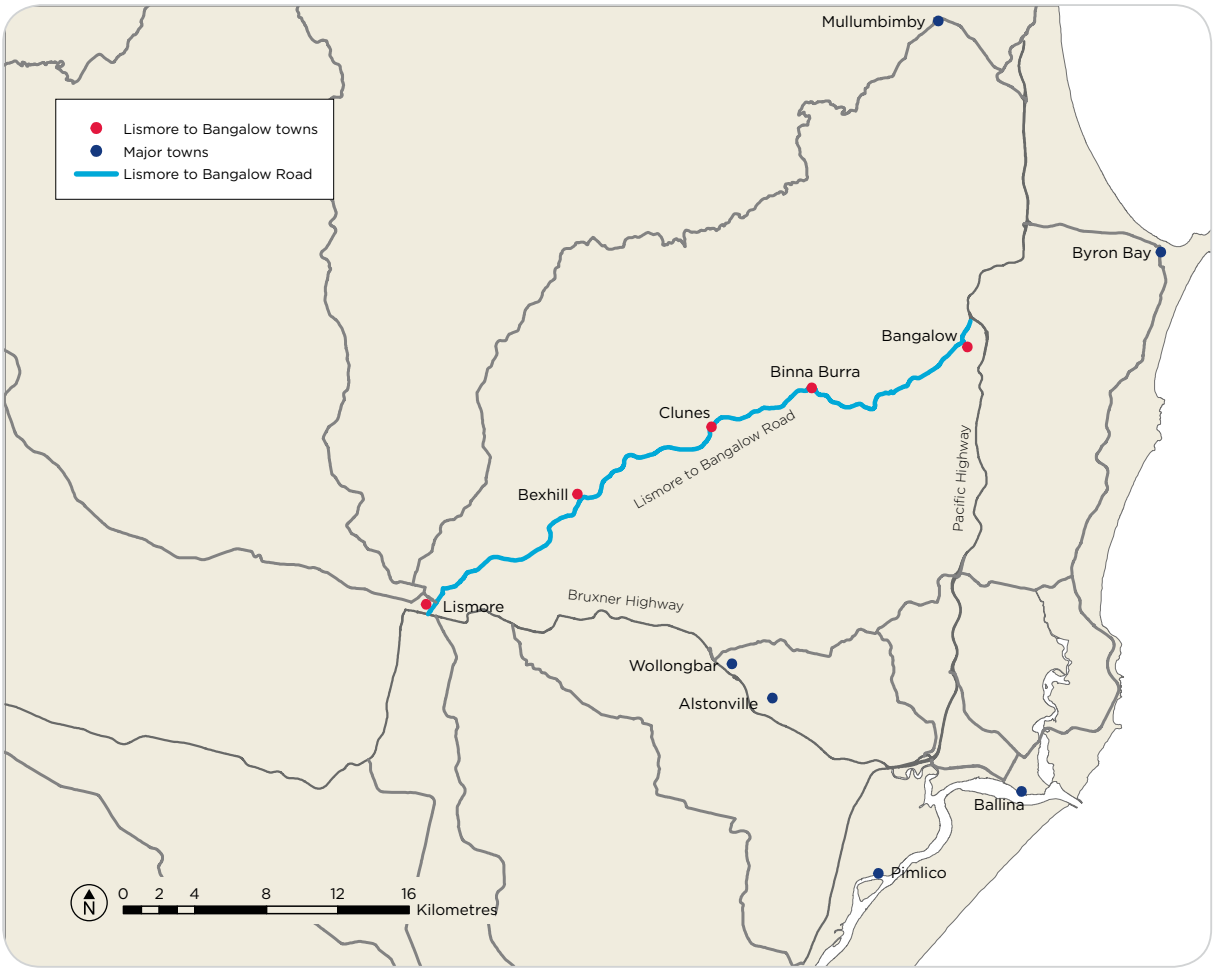
Table 4-1 Corridor connections

Network connection	Transport connection
Bruxner Highway	Connecting Lismore to the Pacific Highway
Pacific Highway	Part of the National Land Transport Network, is the major link between Sydney and Brisbane.
Casino to Murwillumbah rail line	The line connects Casino, Lismore, Bangalow, Byron Bay and Murwillumbah, however the rail service was suspended in 2004.

The Lismore to Bangalow road corridor passes directly through or next to the following towns, localities and villages from south to north (Figure 4-1):

- Lismore within Lismore City Council
- Bexhill within Lismore City Council
- Clunes within Lismore City Council
- Binna Burra within Byron Shire Council
- Bangalow within Byron Shire Council

Figure 4-1 Locality Map of the Lismore to Bangalow Road Corridor



4.2 Current population and employment in the corridor

The Far North Coast Region as defined in the Department of Planning Regional Strategy[3] covers an area over 10,000 square kilometres. The region extends from the Queensland border in the north, south along the coast to Evans Head and south to Woodenbong and Tabulam. The Far North Coast Region is built on a network of towns and villages.

An estimated 30,226 people live along the corridor, with about 42 per cent residing in major regional towns and centres.

The overall population of the main urban centres along the Lismore to Bangalow corridor is estimated at around 30,000 (2011 data). Current population and employment figures specific to each town within the corridor vary depending on the demographic and community characteristics of each local government area.

Key demographic data for each of the major towns are summarised in Table 4-2. There are noticeable differences in the demographics and economies of the northern and southern ends of the corridor, with health, higher education and hospitality dominant in the south, and hospitality and primary education in the north.

Table 4-2 LGA and urban centre demographics

LGA	2011 LGA population	Localities	2011 localities population	% Aged over 65 years	Median age	Main employment by industry in the LGAs
Lismore	44,350	Lismore	27,474	16.0%	38	Hospitals, School Education, Cafes, Restaurants and Takeaway Food Services
		Bexhill	485	10.1%	38	School Education, Legal and Accounting Services, Dairy Cattle Farming and Automotive Repair and Maintenance
		Clunes	559	7.5%	38	Cafes, Restaurants and Takeaway Food Services, School Education and Hospitals
Byron	30,700	Binna Burra	188	11.2%	41	School Education, Tertiary Education, Residential Building Construction, and Medical Services
		Bangalow	1,520	12.2%	40	Cafes, Restaurants and Takeaway Food Services, School Education and Hospitals
Total	**75,050**		**30,226**	**11.4% (average)**	**39 (average)**	
NSW State average				**14.7%**	**38**	

3 **Department of Planning 2006,** *Far North Coast Regional Strategy*, **Sydney**


Lismore

Lismore

Lismore is the major centre in the corridor, with an urban population of 27,474 people in 2011. One of its major industries is education, with Southern Cross University and the North Coast Institute of TAFE located in the city. Lismore also features important regional health and retail facilities, including Lismore Base Hospital, Lismore Shopping Square and several NSW Government offices. Lismore is classified as a major regional centre in the Far North Coast Regional Strategy and is expected to continue to increase in regional significance over the coming decades.

Bexhill, Clunes and Binna Burra

With a total population of 1,232 people in the three villages in 2011, Clunes is the largest of three small villages between Lismore and Bangalow. Bexhill, Clunes and Binna Burra are classified in the Far North Coast Regional Strategy as inland villages.

Clunes

Approaching Lismore Road, Byron Street roundabout, Bangalow

Bangalow

With an urban population of 1,520 people in 2011, Bangalow is located at the junction of Lismore to Bangalow Road and the Pacific Highway. The town serves its local population and functions as a local service centre for nearby villages. It is also a popular destination for tourists visiting Byron Bay. Bangalow is classified as an inland village in the Far North Coast Regional Strategy.

Although located outside the Lismore to Bangalow corridor, the coastal town of Byron Bay impacts the corridor due to its proximity to Lismore. With a total population of 4,959 people in 2011, the main employment industry for Byron Bay area is tourism, food service and accommodation. Byron Bay is a significant year-round tourist destination, with dramatic increases in the number of people staying within Byron Bay during the summer holiday periods.

The accommodation and food services provide significant employment in Byron Bay (19.4 per cent of total employment), reflecting the importance of tourism to the town. The farming industry is a significant employer in Bexhill areas, however, is not a significant employer in most other centres along the corridor.

Major regional centres are defined in the Far North Coast Regional Strategy[4] as existing centres suited to accommodate the majority of regional population growth and employment opportunities, and to deliver state and regional services to the entire region or within the centre's subregion. A concentration of medium to higher density living, business, employment, professional services, higher order shopping, warehouses, transport logistics and bulky goods operations will be located in these centres. They will be focal points for subregional road and other transport networks.

A **village** in the Far North Coast Regional Strategy means a place that:

- Is a relatively small 'stand alone' settlement (generally walkable) or may comprise the outlying suburbs of larger centres
- Has developed its own distinctive image because of a historical and/or geographical location
- Has a strong relationship with its surrounding environment
- Generally has a small vibrant mixed use commercial, retail and residential precinct at its centre surrounded by small-scale residential development
- Has a strong sense of community.

4 Department of Planning 2006, *Far North Coast Regional Strategy*, **Sydney**

In 2011, the average unemployment rate of urban centres along the Lismore to Bangalow road corridor was 6.3 per cent, compared with a NSW average of 5.9 per cent. Within the corridor, an average of 48.5 per cent of the labour force was in full-time employment, compared with a NSW of 60.2 per cent.

Higher proportions of part-time employment and unemployment tend to be factors producing higher levels of non-peak period travel than would otherwise be the case.

Table 4-3 Employment rates along the corridor 2011

City/Town/Village	% Labour force employed full time	% Labour force employed part time	% Unemployed
Lismore	51.0	34.4	9.3
Bexhill	54.0	33.1	7.2
Clunes	45.1	45.4	4.2
Binna Burra	47.0	38.6	4.8
Bangalow	45.5	42.4	6.2
Corridor average	**48.5**	**38.8**	**6.3**
NSW State average	**60.2**	**28.2**	**5.9**

Age demographics echo trends experienced in many rural and regional areas within Australia, with an ageing population. In 2011, the average age in Lismore (given the TAFE and University), Clunes and Bexhill urban centres was 38. The average age along the whole corridor was 39, compared to the NSW average of 38. In the urban centre of nearby Byron Bay however, the average age was 42. In Lismore, people aged 65 years and over made up 16 per cent of the population, compared to the State average of 14.7 per cent. In the other urban centres along the corridor, the percentage of people aged 65 years and over was below the state average.

These trends create different challenges in terms of the transport network and the specific needs of industry and people. Demand for public transport and road user vulnerability, for example, is a specific consideration for the elderly; while extended or unusual peak traffic periods can result from modern flexible work practices and increasing numbers of shift workers.

4.3 Current traffic volumes and heavy vehicles

Traffic volumes along the Lismore to Bangalow Road corridor (2015) vary between 7,000vpd in rural sections and 12,000vpd within Lismore. The high volumes for the length of the route demonstrate the important link it plays between the coastal and hinterland communities of Lismore and Byron Bay. The traffic volumes are higher in Lismore, as expected. This is because the corridor forms an important link in the local road network in and around the Lismore CBD, the higher population in the regional centre of Lismore.

As with overall traffic volumes, heavy vehicle traffic is higher in Lismore and Bangalow, than along the corridor between the towns. Only general access heavy vehicles (including 19 metre B-doubles) are permitted to travel along Lismore to Bangalow Road. The majority of vehicles are classified as light vehicles with (on average) there are 10 per cent (or 850vpd of 8900vpd) heavy vehicles on the corridor, this includes approximately 7 per cent rigid service vehicles (638) and 3 per cent articulated vehicles (217).

Lismore to Bangalow Road is not recognized as a major freight route. Restricted access vehicles such as B-doubles over 19 metres are not permitted along the length of the route. The topography, narrow lane and shoulder widths, and poor road alignment (in particular through Binna Burra) restricts the use of longer B-doubles. The connection for restricted access vehicles between Lismore, Bangalow and beyond is provided by the Bruxner Highway east of Lismore, which connects with the Pacific Highway near Ballina.

4.4 Public transport and active transport in the corridor

The NSW Government actively promotes the use of non-car based modes of transport as a means of reducing congestion on our roads and reducing the impact of greenhouse gases on the environment. Public transport use also improves the economic viability of operating public transport infrastructure such as buses and trains and provides for those unable to operate a motor vehicle. Infrastructure that supports active transport modes such as walking and cycling also provides for those unable to operate a motor vehicle and helps to improve health and wellbeing. Improved health and wellbeing also reduces the costs involved in operating hospitals and other public medical facilities.

North of Lismore

Public transport

Rail and bus services

The Northern Rivers region is served by NSW TrainLink's North Coast rail service line from Brisbane to Sydney (through Broadmeadow, Wauchope, Grafton and Casino). NSW TrainLink runs daily connecting coach services between Lismore and Bangalow. The services, including both all stop and express services, connect to NSW Train's North Coast Sydney to Brisbane train services at Casino. All stop services stop at Lismore, Bexhill, Eltham, Clunes, Binna Burra and Bangalow.

Public transport in the Northern Rivers is focused on travel within the regional centres, particularly Tweed Heads, Lismore and Ballina. Public transport between regional centres, towns and smaller communities is more limited, generally focused on school transport. Several bus routes operate along Lismore to Bangalow Road, connecting the major regional centre of Lismore to towns along the corridor and further north and south along the Pacific Highway. These bus services mainly transport school children. The 2011 Census data revealed that only 0.9 per cent of Lismore employees use public transport to commute to work.

The bus routes include:

- Routes 610 connect Mullumbimby, Brunswick Heads and Byron Bay to Lismore via Lismore to Bangalow Road from Monday to Friday during school days. Total bus travel time between Bangalow and Lismore is 40 minutes for express service and 45 minutes for all stops in the morning, between Lismore and Bangalow it is 45 minutes in the afternoon.
- The 610 service also runs on school holidays via Bangalow, Byron Bay, Ewingsdale, Brunswick Heads, Mullumbimby, Montecollum, Goonengerry, Federal, Eureka, Clunes, Eltham, and Bexhill to Lismore.
- There are also school bus routes that service the corridor.

A public transport information website has also been developed by the Northern Rivers Social Development Council (NRSDC) for the Northern Rivers Region at **goingplaces.org.au.**

The *Northern Rivers Regional Transport Plan* identifies actions to improve regional bus services, TrainLink and coach services, and improve public transport interchanges throughout the region. A future NSW TrainLink servicing plan will be developed for the region, introducing a more robust contractual framework and working with operators to improve routes and timetables. This includes the realignment of rail and coach timetables, investing in fleet improvements, and continuing work to investigate a future rail corridor to the Gold Coast via Tweed Heads.

Air services

Although no airports are located within the Lismore to Bangalow road corridor, an airport is located in Lismore. The closest airport to Bangalow is the Ballina-Byron Gateway airport located in Ballina.

Lismore Regional Airport terminal is located on the Bruxner Highway 3 kilometres from the Lismore CBD. Regional Express Airlines (REX) operates three scheduled services on weekdays to Sydney. The Ballina-Byron Gateway Airport is located 5 minutes from Ballina CBD and less than 30 minutes to Byron Bay and Lismore. The airport is currently serviced by Virgin Australia, Jetstar, and Regional Express (REX), with direct flights to and from Sydney, Melbourne and Newcastle.

In the four years between 2009-10 and 2013-14 average quarterly passenger numbers from Ballina-Byron Gateway Airport increased from 62,450 to 76,176. In the same time, average quarterly passenger numbers from Lismore Airport decreased from 13,813 to 7,819[5].

Future development in the coastal areas, in particular the upgrading of the Pacific Highway, is likely to see Ballina-Byron airport increasingly become the preferred airport for residents along the Lismore to Bangalow road corridor and in towns north of Bangalow. The Gold Coast airport at Coolangatta is another preferred airport, as it provides some international flights.

5 TfNSW 2013, Quarterly passenger statistics for NSW air routes to and from Sydney Airport

The *Northern Rivers Regional Transport Plan* identifies an action to support ongoing access to Sydney Airport through regional airports including Lismore airport, by maintaining the 20 per cent of flight slots allocated to regional NSW.

Active transport

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 that connect residents with different land uses in an integrated and accessible fashion is a key part of achieving this objective.

Safe walking and cycling opportunities via dedicated infrastructure are generally restricted to the urban centres. Between towns the sealed road shoulder should provide a facility for bicycle travel. Austroads (2010) recommends a two to three metre shoulder width where a speed limit is up to 100km/h[6].

Lismore currently has about 18 kilometres of predominantly on-road cycle ways linking retail, recreational, educational and health facilities. Roadside sealed shoulders, where provided, serve as a cycling facility on many of the local roads. The Lismore City Council Cycleway Strategy Plan 2007 proposes a total of 33.1 kilometres of cycleways and infrastructure comprising off-road cycleways (14.6 kilometres), on-road cycleways (5.4 kilometres), existing paths to be widened (13.1 kilometres), and an education and promotional strategy.

The city centre of Lismore is the area of highest pedestrian activity. The 2011 Census data revealed that 4.5 per cent of Lismore employees walk to work, compared to 4.1 per cent State average and 3.7 per cent national average. Pedestrians within the urban centre of Lismore are required to cross Dawson Street (Lismore to Bangalow Road) to access different land use activities on either side of the road.

The Lismore Pedestrian Access and Mobility Plan[7] identifies the need for safe crossing facilities across Dawson Street to complete the link between the Lismore Base Hospital Precinct, the Lismore Shopping Square area, Lismore Park and the CBD. Along Dawson Street, the intersections with Woodlark Street and Magellan Street are priorities for continual improvement.

Within Lismore, one pedestrian crossing and several refuge islands provide opportunities for pedestrians to cross Lismore to Bangalow Road. There is also a pedestrian underpass located near Leycester Street, Lismore, which offers safe access to split campuses for students. However, north of Woodlark Street no dedicated crossing opportunities exist.

In the villages, Bexhill has most of the town and associated land uses located on the northern side of the road. There is a pedestrian crossing on Lismore to Bangalow Road north of Withers Street and a refuge island either side of Clunes Street. In Clunes, most development is located on the southern side of the road. In Bangalow the road bypasses the area of highest pedestrian activity. These characteristics reduce the need for several crossings in these towns. There are currently no formalised pedestrian crossing facilities in villages of Bexhill and Clunes.

There are two school zones along Lismore to Bangalow Road. One is near the intersection of Dawson Street and Leycester Street, Lismore, and the other is at Bexhill from Hill Street to North Street. There are no school crossing supervisors at these locations. At Lismore there is an underpass in the place of a supervisor, while in Bexhill there is a flashing light school zone system.

6 Austroads 2010, Geometric Design, Austroads *Guide to Road Design*, Part 3, AGRD03/10, Austroads, Sydney, NSW

7 Lismore City Council 2011, Pedestrian Access and Mobility Plan,, Lismore City Council, Lismore, NSW

There are opportunities to encourage cycling and walking in many of the towns in the region. Improving pedestrian and cyclist infrastructure and providing greater priority for these modes will encourage use of active transport and reduce congestion. These opportunities will not exist in every location and priorities for improvement should be those areas that are most densely populated, have significant tourist populations and suffer from localised congestion. In Lismore an off road shared path has recently been constructed adjacent to Lismore to Bangalow Road from Hindmarsh Street to Carolina Street. This provides a link to the CBD for pedestrians, cyclists and disabled residents in motorised wheelchairs.

The *Northern Rivers Regional Transport Plan* identifies actions to investigate opportunities and invest in the improvement of walking and cycling facilities, through the Walking Communities Program, Connecting Centres Program and the Cycling towns Program, and by working together with local government. The Plan includes specific actions for Lismore.

In 2013, the NSW Government released a detailed study[8], focusing on the transport needs of the community along the disused Casino to Murwillumbah rail line. The study investigated the feasibility of reinstating passenger services on the 130 kilometre rail line, which has been out of service since 2004. The study found that the rail line would not meet current or future transport needs and there was no demand for it to carry freight. The study also recognised that the rail corridor has potential to be converted to a rail trail for use by pedestrians and cyclists, and that further investigation to assess potential demand, benefits, cost and feasibility would be worthwhile. Details of the Casino to Murwillumbah Rail Trail Study[9] are discussed in Chapter 6.

40km/h high pedestrian zone

8 Transport for NSW, 2013, Casino to Murwillumbah Transport Study
9 Department of Premier and Cabinet 2014, *Casino to Murwillumbah Rail Trail Study: Final Report*, Department of Premier and Cabinet, Sydney

5 CURRENT CORRIDOR PERFORMANCE

Bangalow Road and Booyong Road Intersection, Nashua

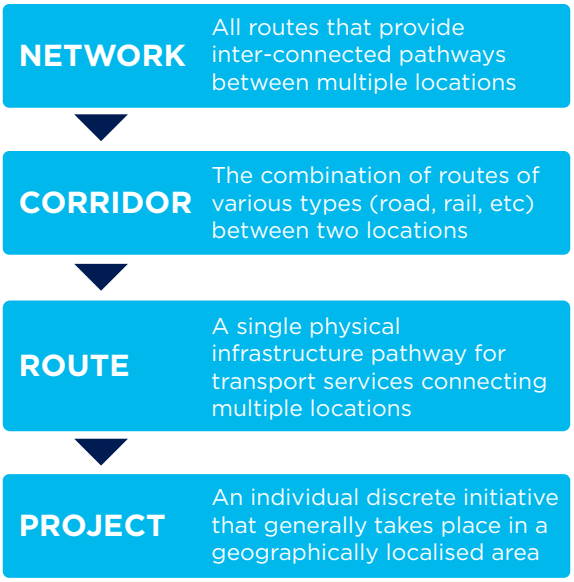
Overview

Transport for NSW has adopted the *National Guidelines for Transport System Management in Australia*[10] to guide its high quality 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[11]



Road network management hierarchy

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 Roads network against network planning targets and average class performance, spanning road safety, traffic efficiency and asset condition. To undertake this comparative analysis, the State Roads 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 indicate Lismore to Bangalow Road has been classified as a **Class 4 rural road** (4R) along its entire length.

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

11 Australian Transport Council 2006, *National Guidelines for Transport System Management in Australia*, ATC, Canberra, p. 9 & 15

12 Roads and Maritime Services 2010, Network Performance Measures and Network Planning Targets, Roads and Maritime Services, Sydney, p. 19

The Network and Corridor Planning Practice Notes[13] state that:

"Class 4R roads are important rural State Roads and contribute to the National Land and 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 exceeding 10,000 vehicles per day
- Average heavy vehicle volumes exceeding 1000 vehicles per day
- Speed limits ranging from 80km/h to 110km/h.

Class 6, 5 and 4 roads experience higher pressure and demand from development and freight and therefore require detailed, longer version corridor strategies. Lower class roads (Class 3, 2 and 1) experience less pressure from development and traffic and therefore will often require less detailed strategies, than higher order roads.

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 Lismore to Bangalow Road corridor has been divided into four corridor planning sections. These are shown in Table 5-1 (refer to Figure 5-2).

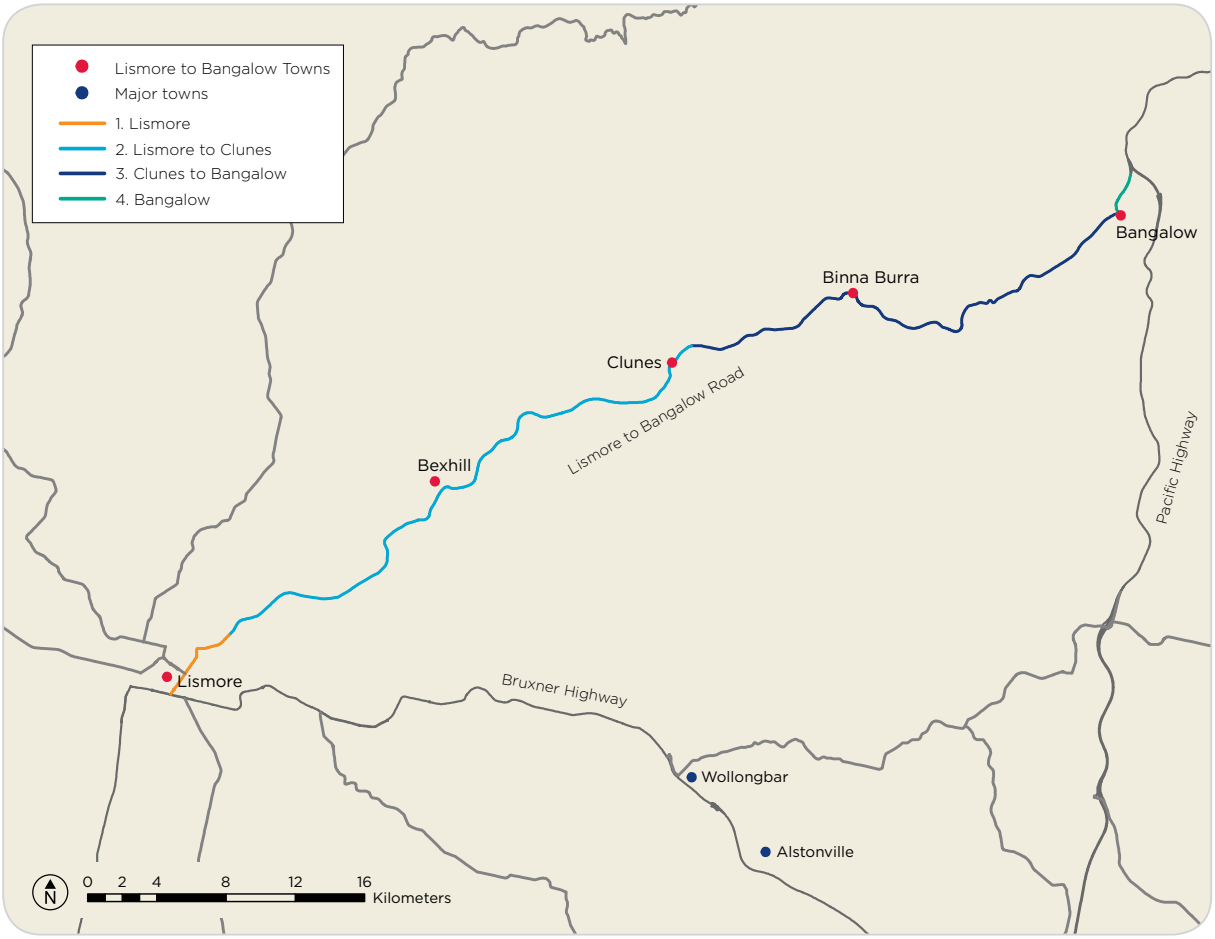
Table 5-1 Corridor planning sections

No.	Sections	Land use	Chainage (km) from	Chainage (km)** to	Length (km)
1*	Lismore (from HW16 Bruxner Highway to 180m north of Bangalow Street)	Urban Commercial/ Urban/Fringe Urban	0	3.04	3.04
2	Lismore to Clunes (from 180m north of Bangalow Street to 230m south of Jarvis Street)	Fringe Urban/ Rural	3.04	17.15	14.11
3	Clunes to Bangalow (from 230m south of Jarvis Street to 170m north of Dudgeons Lane)	Rural/Fringe Urban	17.15	30.49	13.34
4*	Bangalow (170m north of Dudgeons Lane to Pacific Highway on-ramp)	Urban/Fringe Urban	30.49	33.19	2.7
	Total			**33.19**	**33.19**

* Shaded sections indicate urban areas
** Based on Roadloc chainage

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

Figure 5-2 Lismore to Bangalow Road corridor planning sections



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 measure and monitor roads performance against network performance measures and targets to achieve this.

A measure is 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 – cumulative condition targets that apply to the entire network, unless otherwise specified.
- Rural planning targets that apply to regional NSW, not including Wollongong, Newcastle and Sydney.

To assess the Lismore to Bangalow current corridor performance, the following sources have been used:

- Network Performance Measures and Network Planning Targets[14]
- Network and Corridor Planning Practice Notes[15].

It should be noted that these planning measures are not standards, but a target to try and achieve. Physical and other constraints may prevent a target from being met, and similarly factors such as higher than normal crash rates may lead to minimum targets being exceeded at some locations.

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 vary 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 assessment of the risks associated with road conditions, and the upper end of road condition is determined based on the level of available investment.

This document groups the Lismore to Bangalow Road's current corridor performance into the following sections:

- **Section 5.1** – Road safety
- **Section 5.2** – Traffic
- **Section 5.3** – Road design and geometry
- **Section 5.4** – Road pavement condition
- **Section 5.5** – Environment.

Road characteristics data sources

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

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

- Strategic Network Performance Analysis (SNPA)
- 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).

5.1 Road safety

Improving road safety is the most important goal of this strategy with all recommendations for the Lismore to Bangalow Road corridor ultimately targeting to improve safety for road users. Assessment of crash data, community and other stakeholder feedback along with a safety review of Lismore to Bangalow Road have been undertaken as a part of this study to increase safety levels along Lismore to Bangalow Road.

This section outlines the safety assessment undertaken for the Lismore to Bangalow Road Draft Corridor Strategy, and the overall safety performance over the past several years.

14 **Roads and Maritime Services,** *Network Performance Measures*

15 **Roads and Maritime Services,** *Network and Corridor Planning*

This section will discuss the following:

- Speed zones
- Number of crashes
- Severity index
- Crash types
- Contributing factors
- Fixed speed cameras.

Speed zones

Speed zones are determined according to the Roads and Maritime Speed Zoning Guidelines and are posted to provide motorists safe passage along roads, in relation to the geometry and environment[16].

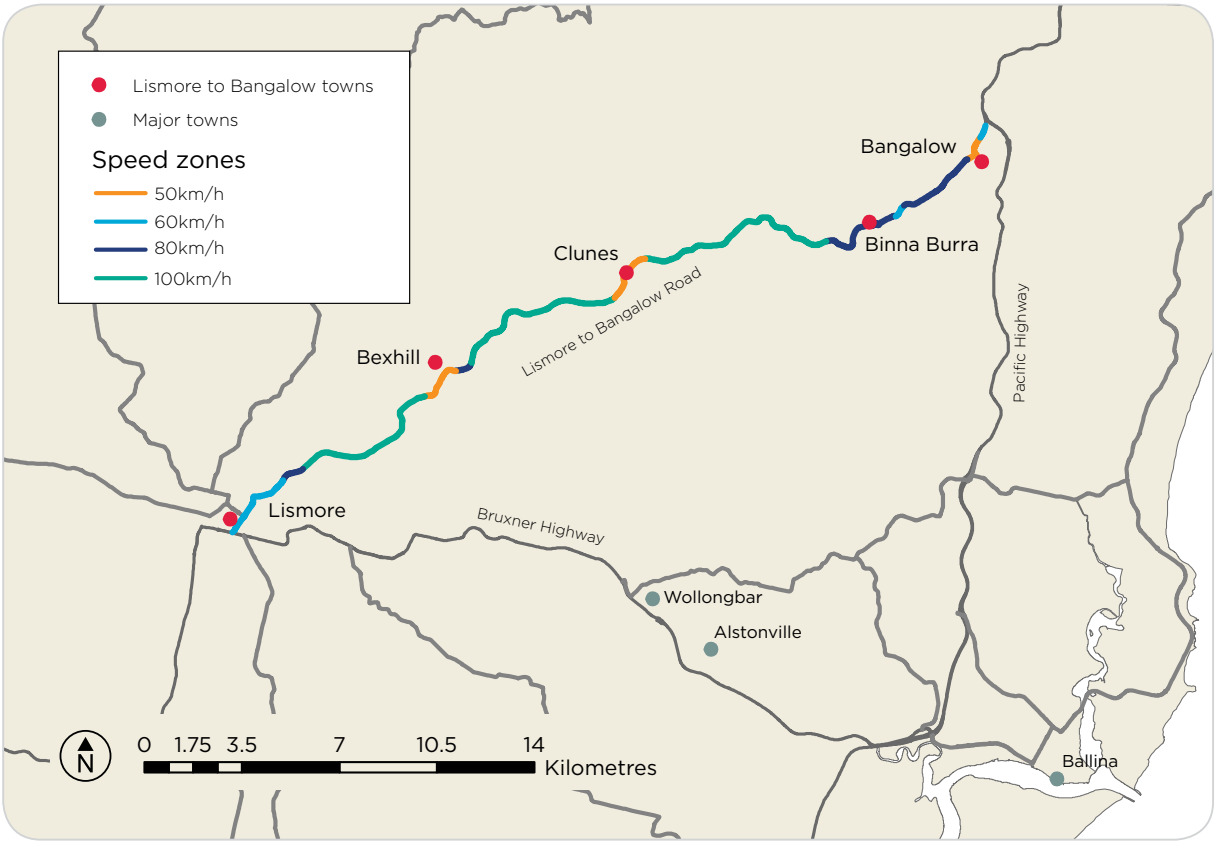
The Speed Zoning Guidelines are used to determine appropriate speed limits on all roads, applied in conjunction with enforcement measures, engineering treatments and education to reduce speeding.

Roads and Maritime 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 record and access points along the route.

Speed limits along the Lismore to Bangalow road corridor vary from 100km/h to as low as 40km/h through towns and urban areas. The speed zone in urban areas is generally 50km/h except where school zones operate in Lismore and Bexhill, where the speed zone is 40km/h before and after school hours. Where there are topographical constraints, adverse crash history, multiple accesses or limited clear zones, speed zones are reduced to improve motorist and road users safety. For example, on the southern approach to Binna Burra, where the road has tight curves, minimal clear zones and below average safety performance, the speed limit is reduced to 80km/h.

A summary of the speed zones along the corridor is shown in Figure 5-3.

Figure 5-3 Lismore to Bangalow Road corridor speed zones



16 Roads and Maritime Services 2011, *NSW Speed Zoning Guidelines*, Roads and Maritime Services, Sydney

Number of crashes

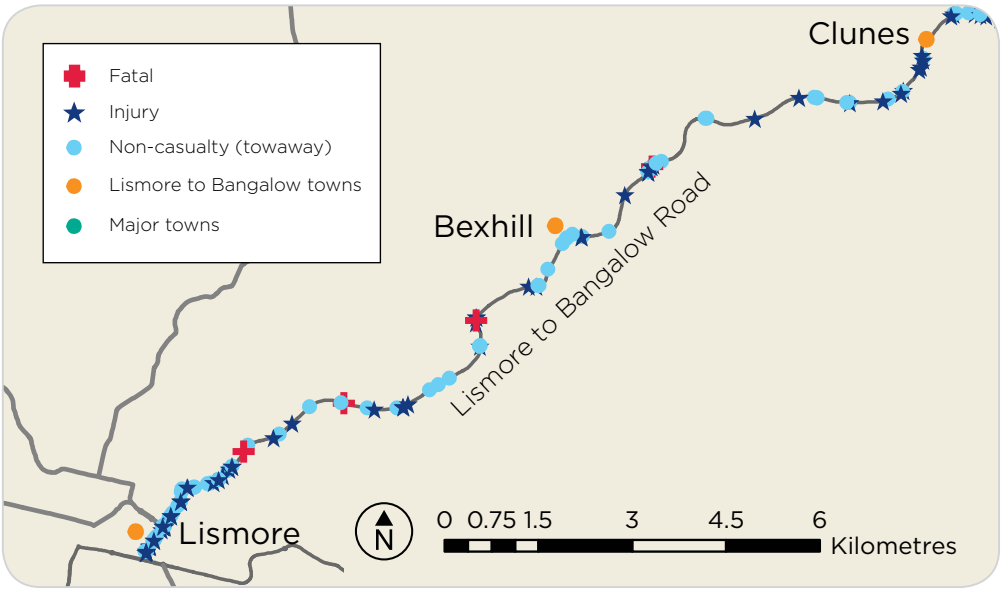
There were 245 crashes reported between 2008 and 2012 along the Lismore to Bangalow Road corridor. Of these crashes, 103 were 'casualty crashes', which caused either an injury or fatality to one or more of the people involved. Of the 103 casualty crashes, 6 were fatal and 97 resulted in an injury (Figure 5-4).

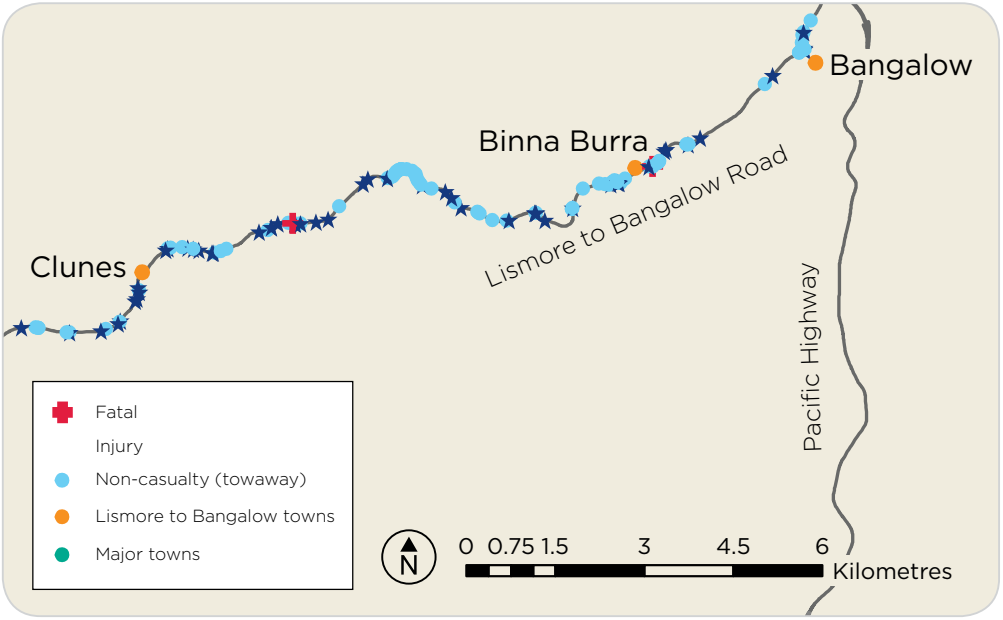
In addition to measuring the number and severity of crashes, a range of other measures have been developed to compare road safety criteria across different roads.

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

1. Annual casualty crashes per kilometre.
2. Annual casualty crash rate per 100 million vehicle kilometres travelled (100 MVKT).
3. Severity index.

Figure 5-4 Crash data, 2008 to 2012





Casualty crash rates

Table 5-2 sets out the NSW state-wide class average for the casualty crash rates on the network for class 4 roads in rural and urban environments. Table 5-3 compares annual casualty crash rates per kilometre on the Lismore to Bangalow corridor with class averages in NSW.

Table 5-2 Annual average casualty crash rates per kilometre

Rural hierarchy class	Land use	Casualty crash rate per kilometre (2008-2012)
4R	Urban, Urban Commercial	1.69
	Fringe Urban, Rural, Vegetation Conservation	0.195

Table 5-3 Annual average casualty crash rates per kilometre

Corridor planning section	Lismore to Bangalow Corridor (2008 – 2012)	NSW class 4 road average
1. Lismore	1.78	1.69
2. Lismore to Clunes	0.44	0.195
3. Clunes to Bangalow	0.58	0.195
4. Bangalow	0.44	1.69

The annual average casualty crash rate per kilometre for Lismore to Bangalow Road ranges from 0.44 to 1.78. In comparison, the NSW state-wide average annual casualty crash rate per kilometre for Class 4 rural roads adjacent to urban and urban commercial land use is 1.69, and for Class 4 rural roads adjacent to fringe urban, rural and vegetation conservation land use is 0.195.

The typical adjacent land use of each section of the corridor has been used to determine which average annual casualty crash rate it should be measured against. Sections 1 and 4 of the corridor run through Lismore and Bangalow, where the land use is typically urban and urban commercial with short lengths of fringe urban, as such the casualty crash rates have been compared against the urban class average of 1.69. Sections 2 and 3 lies adjacent to rural and fringe urban land uses and the casualty crash rates have been compared against 0.195. Sections 1 to 3 of Lismore to Bangalow Road exceed the NSW state-wide average annual casualty crash rate per kilometre.

An 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, an additional measure of casualty crashes per 100 million vehicle kilometres travelled can also be used. This is particularly useful to compare casualty crash rates on sections of a road that carry higher or lower traffic volumes. This can help to identify those areas that present a higher than normal risk for travel and may need to be further scrutinised to identify potential causes.

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

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

Where:
L= length in kilometres
A = ADT
M = number of years of crash data

The casualty crash rate on rural sections of the Lismore to Bangalow corridor for the five years to December 2012 ranged from 28.2 to 11.96 crashes per 100 million vehicle kilometres travelled (Table 5-4).

Table 5-4 shows the highest rate is in Lismore, which also has the highest volume of traffic. In the rural areas the section between Clunes and Bangalow is also comparatively higher.

Table 5-4 Casualty Crashes per 100 MVKT

Corridor planning section	Lismore to Bangalow Corridor (2008–2012)
1. Lismore	28.20
2. Lismore to Clunes	14.74
3. Clunes to Bangalow	21.48
4. Bangalow	11.96

Severity index

To enable a comparison of the impacts of crashes from a wider community perspective, a third measure, the 'severity index' has been developed. The severity index considers the total number of crashes on a road and assigns a weighting to fatal and casualty crashes which aims to reflect their relative impact on the community.

The severity index is calculated on any given length of road as follows:

$$\text{Severity index} = \frac{(3x + 1.5y + z)}{t}$$

Where:
x = number of fatal crashes
y = number of injury crashes
z = number of non-casualty crashes
t = total number of crashes

Table 5-5 summarises the severity index along the Lismore to Bangalow corridor for the five year period to December 2012. This suggests that when crashes do occur on the Lismore to Bangalow corridor, they tend to be more severe on the rural sections of the corridor. This can be attributed to a number of factors, including higher speeds, narrow formation width and poor alignment that contribute to crash types that typically result in more severe injuries.

Table 5-5 Crash types and severity

Corridor planning section	Total non-casualty crashes	Injury crashes	Fatal crashes	Severity Index
1. Lismore	37	26	1	1.23
2. Lismore to Clunes	35	29	2	1.28
3. Clunes to Bangalow	58	36	3	1.25
4. Bangalow	12	6	0	1.17

Crash types

Figure 5-5 and Table 5-6 detail the most prevalent crash types recorded on the Lismore to Bangalow corridor within the five year period to December 2012.

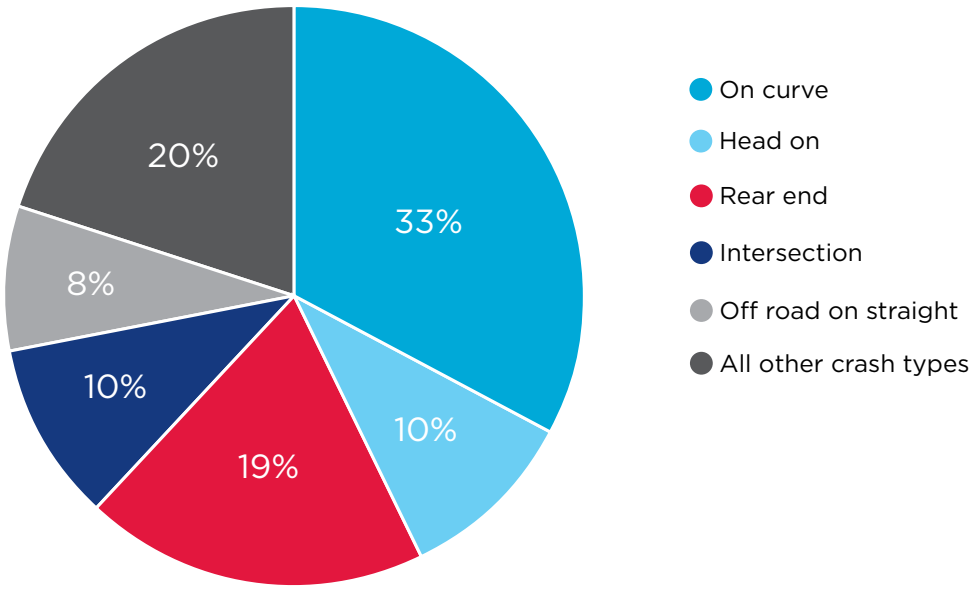
Crash types tend to differ between urban and rural areas. Within the urban areas of Lismore and Bangalow, intersection crashes including rear end crashes are the most prevalent. Investigations into the design and safety of these intersections should be considered to reduce these crashes.

Head on, off road on straight -hit object and curve related crashes are the most prevalent in the rural sections along the corridor. Twenty one per cent of all crashes (51 of 245) along Lismore to Bangalow Road involve vehicles crossing the opposing carriageway. Of these 51 crashes, 35 or 69 per cent occurred on a curve and 27, or 53 per cent were wet surface related. Investigations into curve realignment or installation of median treatments are options that may help in the reduction of crashes.

Table 5-6 Crash types, 2008 to 2012

Crash Types	Number of crashes (casualty and non-casualty)	On curve	Head on	Rear end	Intersection	Off road on straight – hit object
1. Lismore	64	2%	0%	22%	30%	9%
2. Lismore to Clunes	66	32%	12%	20%	6%	11%
3. Clunes to Bangalow	97	50%	18%	9%	1%	9%
4. Bangalow	18	11%	6%	61%	6%	6%

Figure 5-5 Crash types, 2008 to 2012



Contributing factors

Using available information to determine the contributing factors to crashes allows Roads and Maritime and the NSW Centre for Road Safety to understand crash patterns developing on particular roads and develop responses to prevent these crashes through engineering, maintenance or behavioural strategies.

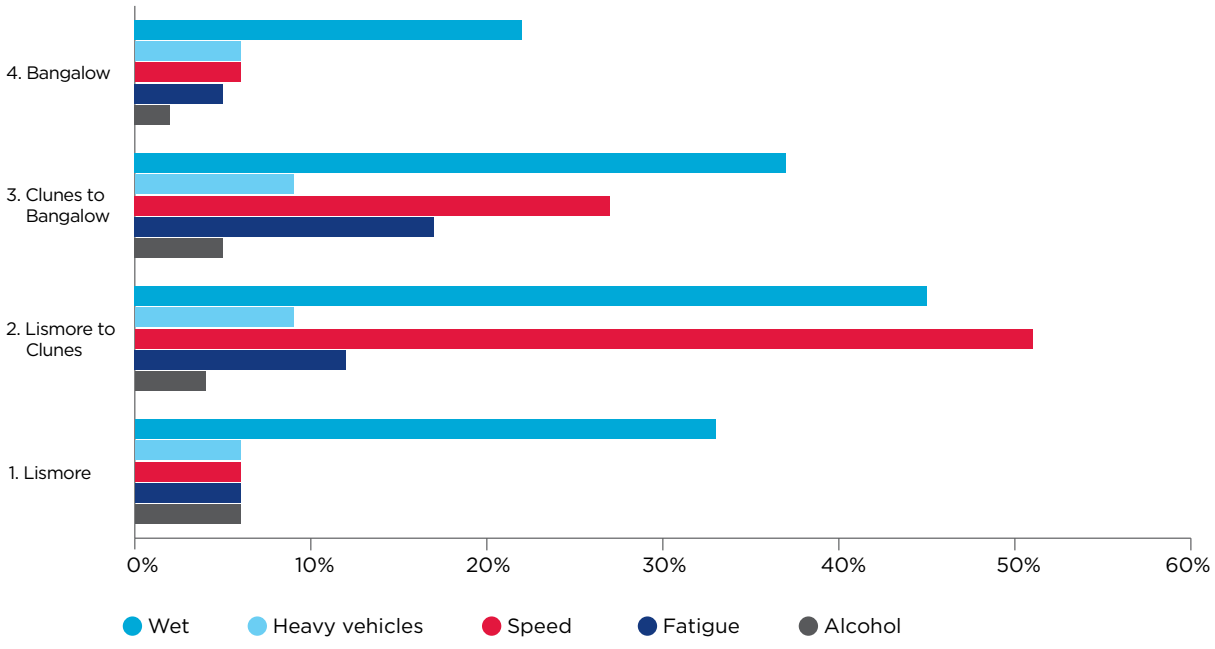
Table 5-7 and Figure 5-6 summarises the contributing factors recorded for all reported crashes within the five year period to December 2012.

Table 5-7 Contributing factors in crashes between 2008 to 2012

Planning Section	Length	Number of crashes	*Motorcycle involvement	*Heavy truck crash#	Road surface condition		Behavioural factors		
					Wet	Dry	Speed	Fatigue	Alcohol
1. Lismore	3.04	64	9%	6%	22%	78%	6%	5%	2%
2. Lismore to Clunes	14.11	66	6%	6%	37%	62%	27%	17%	5%
3. Clunes to Bangalow	13.34	97	4%	9%	45%	55%	51%	12%	4%
4. Bangalow	2.7	18	0%	6%	33%	67%	6%	6%	6%

* These categories are not mutually exclusive
# Rigid or articulated truck

Figure 5-6 Contributing factors in crashes between 2008 to 2012




Looking south at Binna Burra curves

The crash data (Figure 5-6) demonstrates that on the rural sections, wet surface crashes and speed are the highest contributing factors. In the urban areas of Lismore and Bangalow the crash types, rather than the contributing factors, are more demonstrative of crash trends as in Figure 4-5.

Of the three key behavioural contributing factors, speed was the most common factor ranging from 6 per cent in Lismore to 51 per cent between Clunes and Bangalow. 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 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 accurately identify the involvement of speed in all instances.

Road user behaviour

In response to the contributing factors outlined above, initiatives are deployed that aim to modify road user behaviour. These include:

- Education campaigns for drivers, cyclists, pedestrians and other road users.
- Increased police focus.
- Camera technology such as fixed or mobile speed cameras.

Fixed speed cameras

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

There is one fixed speed camera located along the Lismore to Bangalow corridor at Clunes between Flatley Drive and Johnston Road. In August 2011, a report by the NSW Auditor General resulted in the decommissioning of 38 speed cameras including this camera. Following a crash in the area and community objection to its removal, a request was accepted for the camera to be reinstated, operating in warning mode only[17]. Warning mode changes the way infringements are issued to speeding motorists. Generally, those detected travelling less than 30km/h above the speed limit are issued warning letters for their first two offences after which they receive a court notice. If a vehicle is detected travelling greater than 30km/h over the posted speed limit a court attendance notice is issued. Since activating warning mode between August 2012 and February 2014, an average of 19 offences per month have been sent to speeding motorists compared to 560 offences per month from January 2010 to July 2011.

Mobile speed cameras

Mobile speed cameras produce a sustained change in driver behaviour by creating a perception that speeding can be enforced anywhere at any time. Drivers are less able to predict where the enforcement will occur meaning that speed limit compliance and consequently a reduction in crashes can be achieved more broadly across the network.

Ongoing investigations will continue to identify where speed cameras are warranted. Education programs, Intelligent Transport System options and additional focus from the NSW Police Service will be further considered and investigated for known speeding problem areas.

Summary of road safety issues

In summary, the road safety performance of the Lismore to Bangalow corridor, as measured by the casualty crash rate, is worse than the average for a road of its class. This poor road safety performance may be attributed to the deficiencies in horizontal alignment, and minimal clear zones in the high speed rural sections along the corridor, and demand for access in the urban centres particularly Lismore. Overall, the crash trends differ along the length, with urban areas featuring more intersection and rear end crashes, and speed and wet surface crashes typifying the rural sections of the corridor.

The Clunes to Bangalow section yielded poor road safety results across all road safety indicators discussed above, including the highest number of crashes (97), and the highest number of fatal crashes (3). The section also shows a consistently poor crash severity index and a high annual average casualty crash rate. Speed was a contributing factor to 51 per cent of all crashes on this section and 50 per cent of crashes occurred on curves. This indicates that driver perception does not align with the condition of the road, and can be seen specifically in rural sections along the corridor.

5.2 Traffic

This section outlines the traffic investigations carried out for the Lismore to Bangalow Road Draft Corridor Strategy, covering the traffic performance over the past several years. It describes the current traffic volumes (including composition of light and heavy vehicles) and past traffic growth trends. Forecast performance for the road is discussed in chapter six, which takes into account future changes along the corridor.

This section will discuss the following:

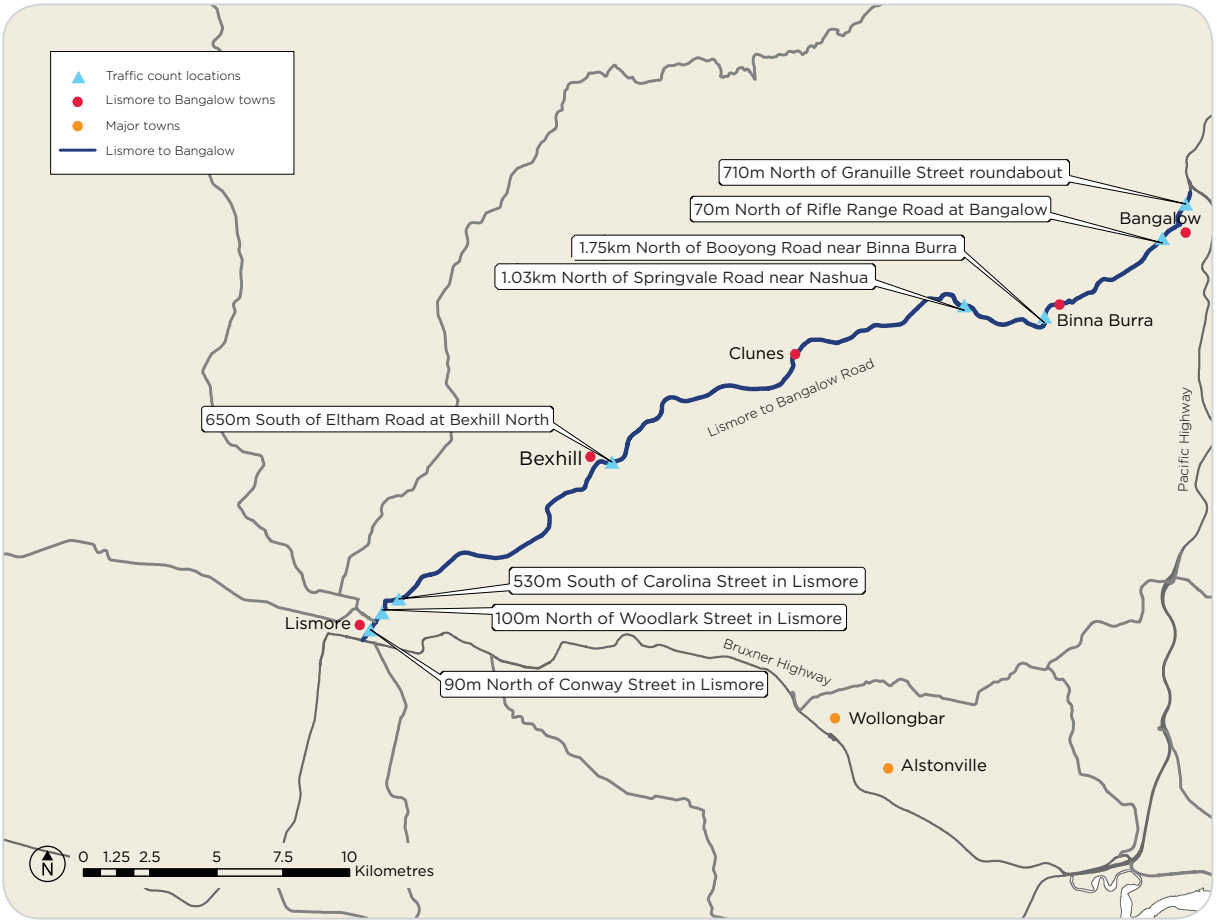
- Traffic volumes
- Trends in the performance of the road given a typical operating day (weekday and weekend), now and over the past 25 years.
- The current average level of service and the peak hour level of service over the length of the corridor.
- Performance of the corridor given existing overtaking opportunities.
- Intersection performance.
- Incident management.
- Regional centre and town bypasses.

Traffic volumes

Traffic count data has been collected along the Lismore to Bangalow Road corridor since 1967. During this time specific count locations have been established. For the purpose of the strategy automated tube counts were carried out at various locations to determine current traffic demands along Lismore to Bangalow Road. Figure 5-7 shows the locations of all conducted surveys.

17 NSW Government, 2013 roadsafety.transport.nsw.gov.au/downloads/current_speed_camera_locations.pdf viewed 23/07/2013 and transport.nsw.gov.au/media-releases/new-speed-camera-strategy-save-lives

Figure 5-7 Traffic count survey locations



Traffic volumes along the Lismore to Bangalow Road corridor (2015) vary between 7,000vpd in rural sections and around 12,000vpd within Lismore. The high volumes for the length of the route demonstrate the important link it plays between the coastal and hinterland communities of Lismore and Byron Bay. The traffic volumes are higher in Lismore, as expected. This is because the corridor forms an important link in the local road network in and around the Lismore CBD, the higher population in the regional centre of Lismore.

> “The traffic volumes are higher in Lismore, as expected.”

The traffic analysis shows

- Weekday peak periods are 8am – 9am and 5pm – 6pm
- Weekday volumes are higher than weekend volumes
- Traffic composition comprises of 90 per cent light vehicles, seven per cent rigid service vehicles and three per cent articulated vehicles (semi-trailers)

The traffic numbers, daily traffic volumes and the percentage of heavy vehicles at the survey locations are detailed in Table 5-8 and Figure 5-8.

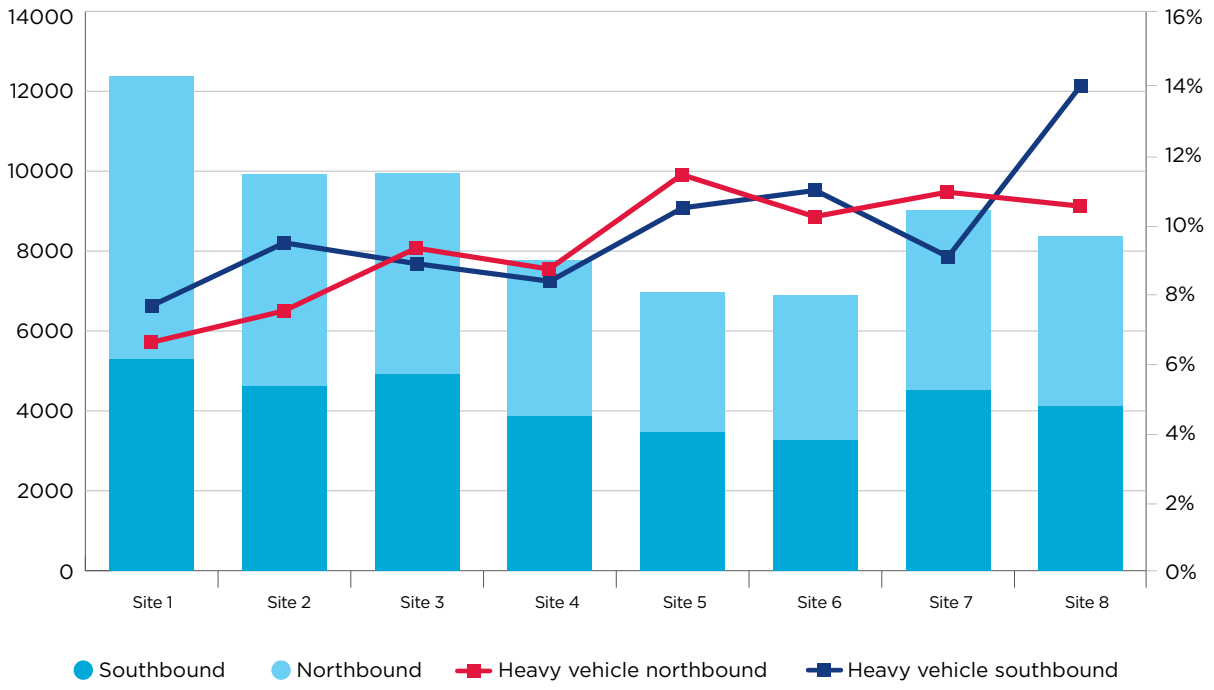
Table 5-8 Lismore to Bangalow Road – daily traffic volumes 2015

Corridor planning sections	Site	Description	(vehicles per day)	Average heavy vehicles*	% heavy vehicles*	Year completed
1	1	90m North of Conway Street in Lismore	12366	919	7.4%	2015
1	2	100m North of Woodlark Street in Lismore	9920	865	8.7%	2015
1	3	530m South of Carolina Street in Lismore	9949	924	9.3%	2015
2	4	650m South of Eltham Road at Bexhill North	7782	684	8.8%	2015
3	5	1.03km North of Springvale Road near Nashua	6958	776	11.2%	2015
3	6	1.75km North of Booyong Road near Binna Burra	6892	749	10.9%	2015
3	7	70m North of Rifle Range Road at Bangalow South	9024	921	10.2%	2015
4	8	710m North of Granuille Street roundabout, Bangalow	8382	1045	12.5%	2015

* Currently only General Access Vehicles can access the full length of the Lismore to Bangalow corridor. A 19 metre long B-doubles not greater than 4.3 metres high (including its load) and carrying less than 50 tonne.

Travelling north into Bexhill

Figure 5-8 Lismore to Bangalow Road – daily traffic volumes 2015



As expected, there is a higher volume of traffic on average during the weekdays than weekends, especially within the urban areas of Lismore. The peak period differ from weekday to weekend (Figure 5-9 and Figure 5-10).

The peak periods for weekdays are between 8am and 9am in the morning and 5pm to 6pm in the evenings, this likely represents traffic accessing services such as schools or commuting to and from work. The weekends show a peak period between 11am and 1pm during the day, this likely represents leisure and tourist travel.

“The peak periods for weekdays are between 9am and 9am in the morning and 5pm and 6pm in the evenings, this likely represents traffic accessing services such as schools or commuting to and from work.”

Figure 5-9 ADT Weekday compared to Weekend on Lismore to Bangalow Road – Lismore to Clunes

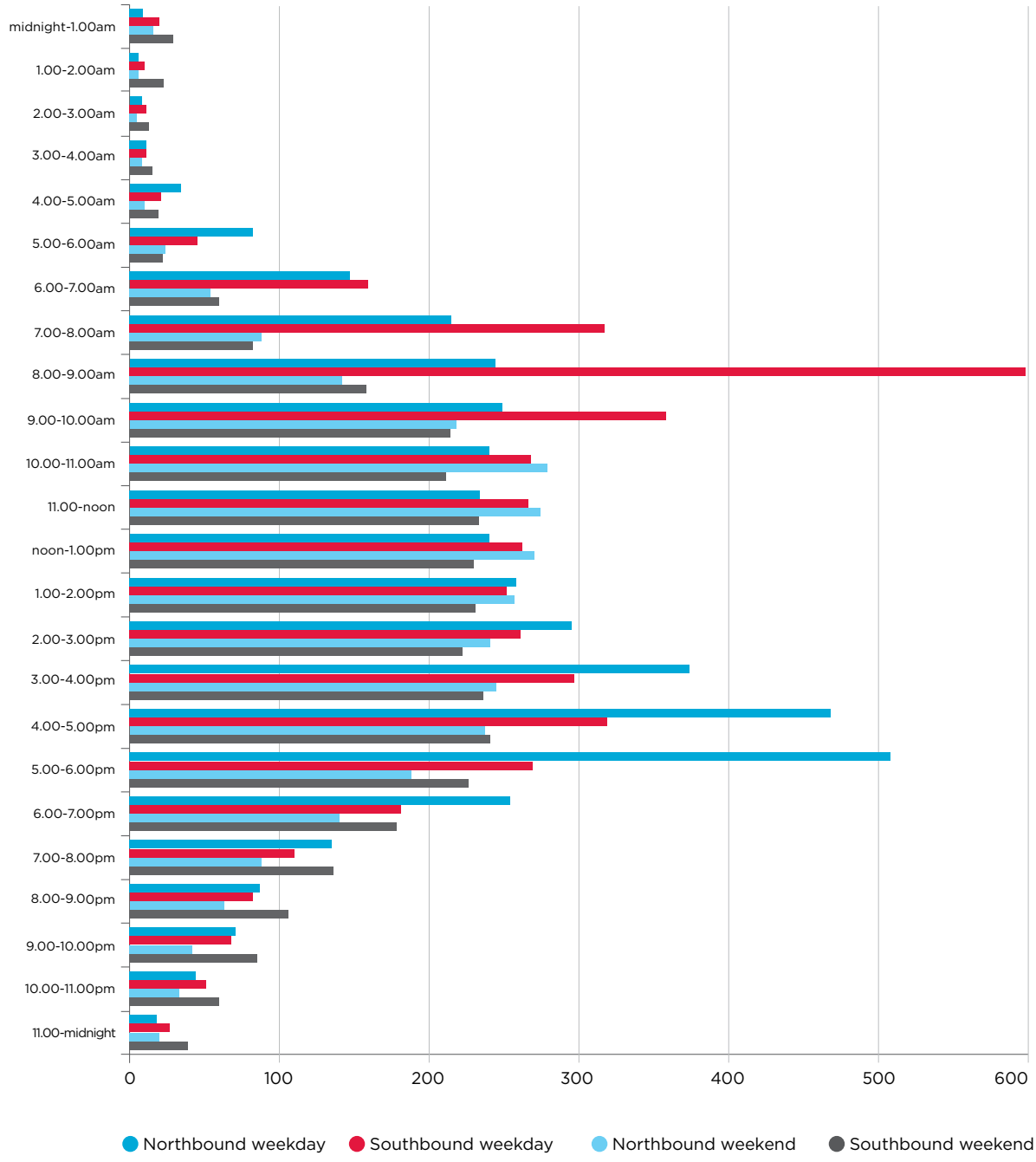
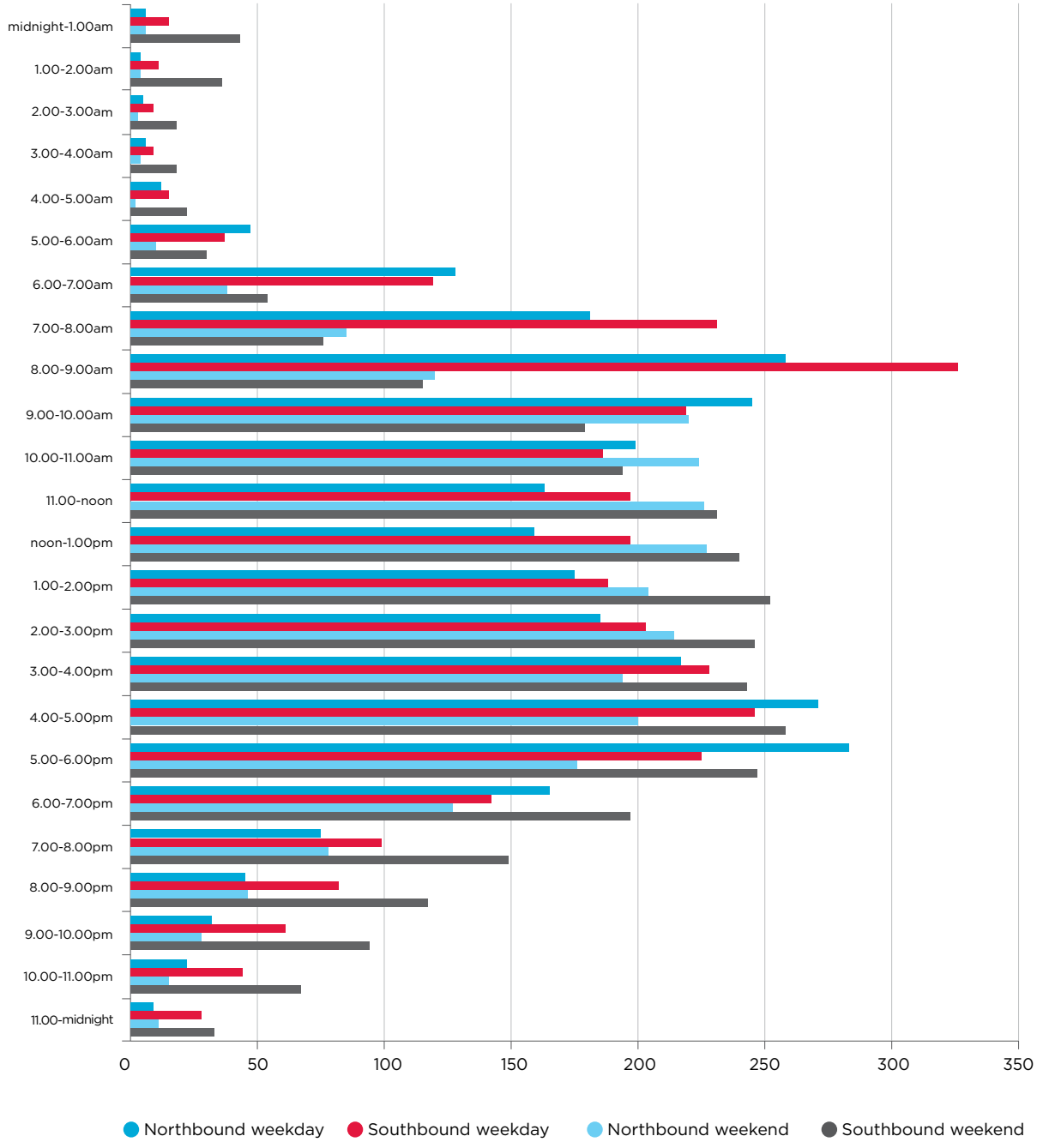


Figure 5-10 ADT Weekday compared to Weekend on Lismore to Bangalow Road – Clunes to Bangalow



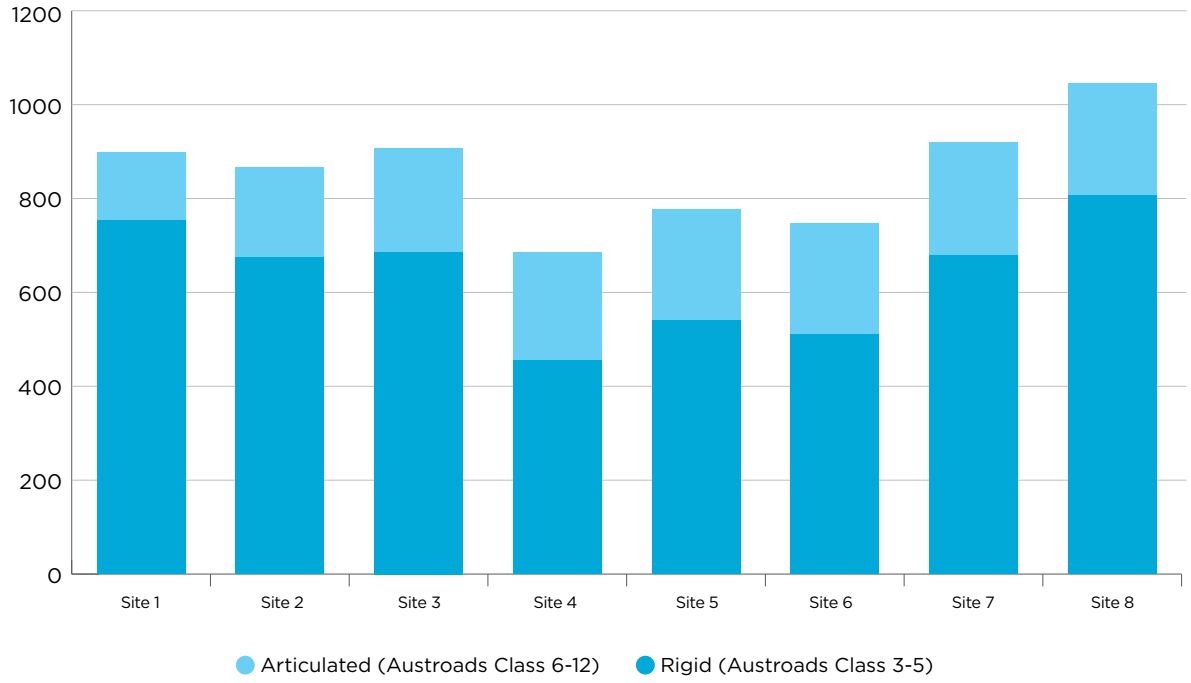
The majority of vehicles are classified as light vehicles with (on average) around 10 per cent (or 850vpd of 8900vpd) heavy vehicles on the corridor; this includes approximately seven per cent rigid service vehicles (638) and three per cent articulated vehicles (217).

Heavy vehicle access on the Lismore to Bangalow Corridor

Currently General Access Vehicles can access the full length of the Lismore to Bangalow corridor. A 19 metre long B-doubles not greater than 4.3 metres high (including its load) and carrying less than 50 tonne is allowed on all roads in NSW including Lismore to Bangalow Road.

Lismore to Bangalow Road is currently not suitable for longer 26 metre B-Doubles and other RAV's because of its poor road alignment. The Bruxner Highway to the south provides transport and freight links between Lismore and the Pacific Highway which are suitable for 26 metres B-Doubles operating at HML.

Figure 5-11 Heavy vehicles along Lismore to Bangalow Road



Growth rates and trends

Measuring the volumes of traffic travelling along a route through time can be used to determine a growth rate and forecast a future traffic volume. Vehicle growth rates along a corridor are generally linear unless they are impacted by a significant change in adjacent land use, such as an airport, a freight terminal or a new residential subdivision or regulatory changes such as the gazetal of new higher productivity vehicles.

A linear annual traffic growth rate for the Lismore to Bangalow Road has been calculated using historical traffic data. From this data, it was found that the urban area of Lismore will have a growth rate ranging between 1.3 per cent and 3 per cent; 3 per cent takes into consideration possible future land development in the areas. The rural areas between Lismore and Bangalow are forecasted to have a traffic growth between 1.6 – 1.7 per cent. The high growth rates could be contributed to the large amount of development along the corridor and in surrounding areas such as Byron Bay.

Figure 5-12 Traffic growth – Lismore

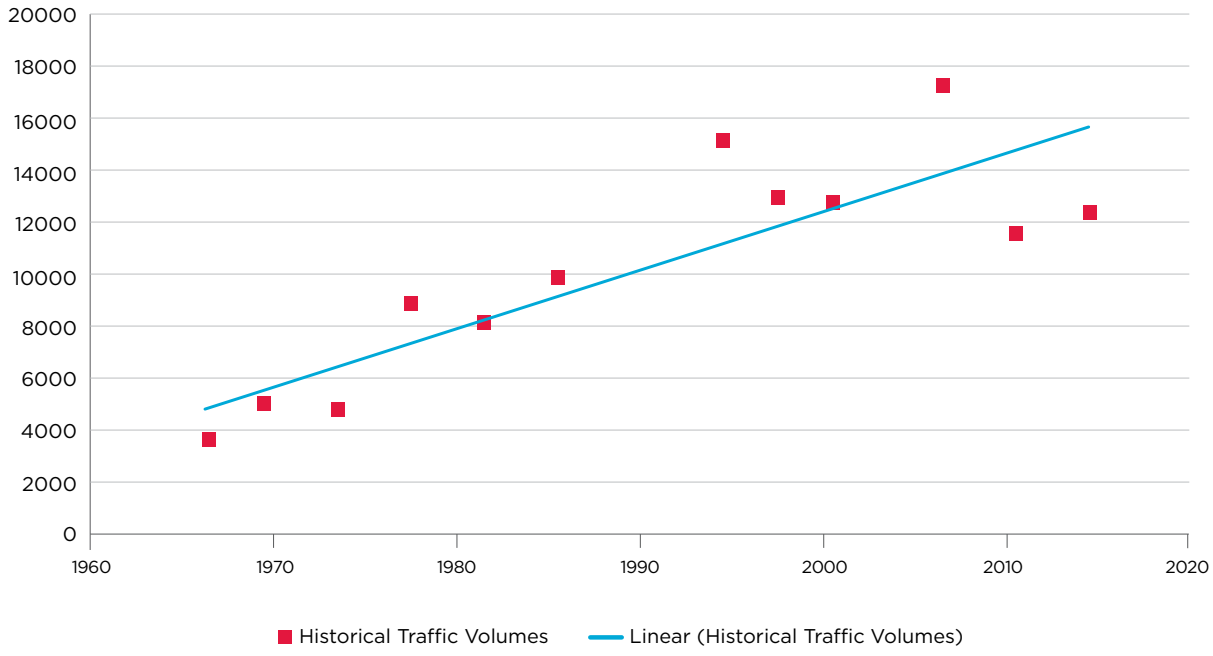


Figure 5-13 Traffic growth – Lismore to Clunes

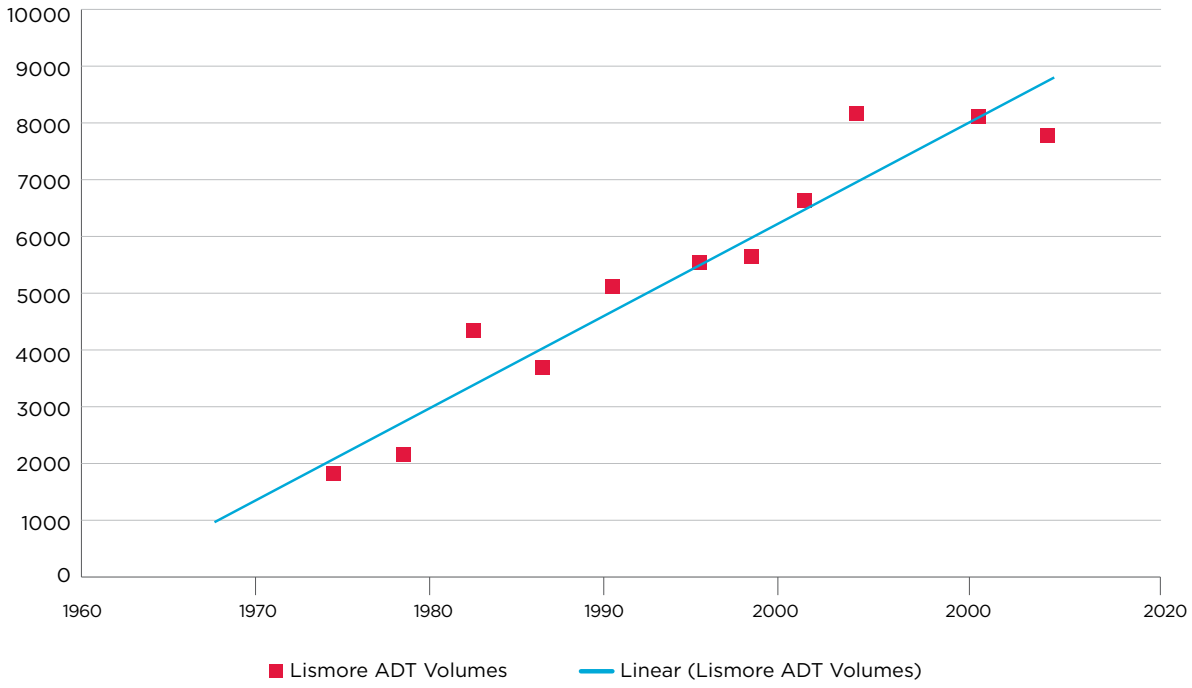


Figure 5-14 Traffic growth – Clunes to Bangalow

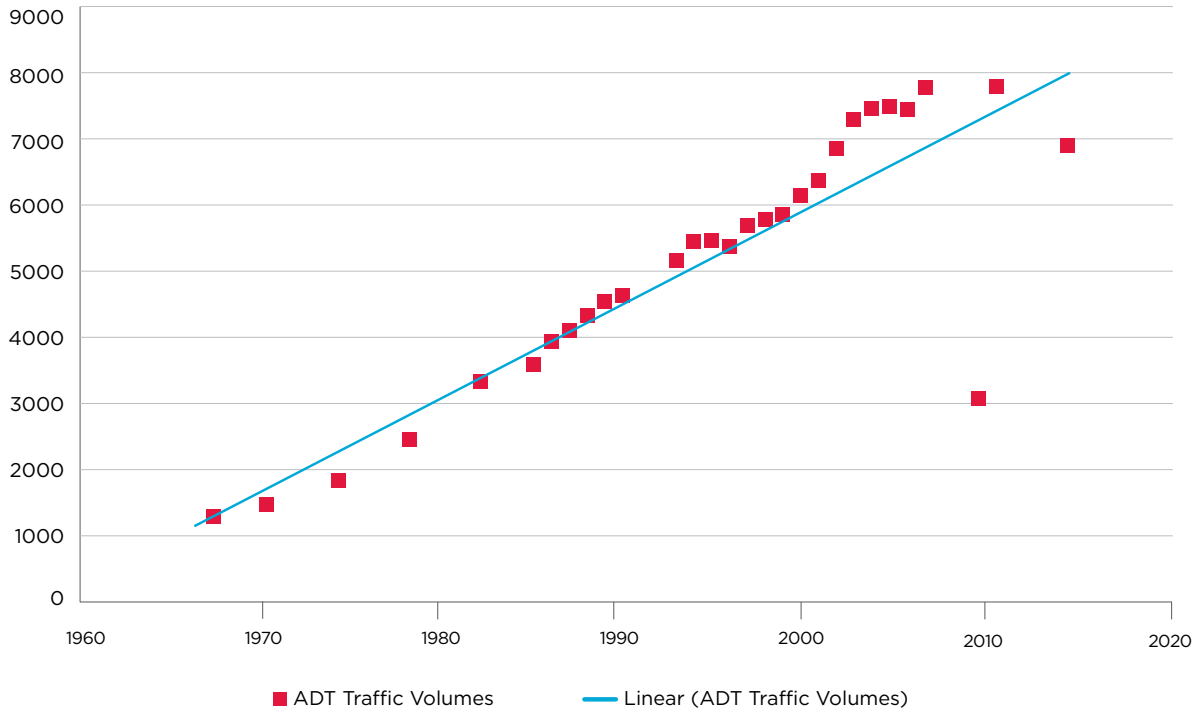
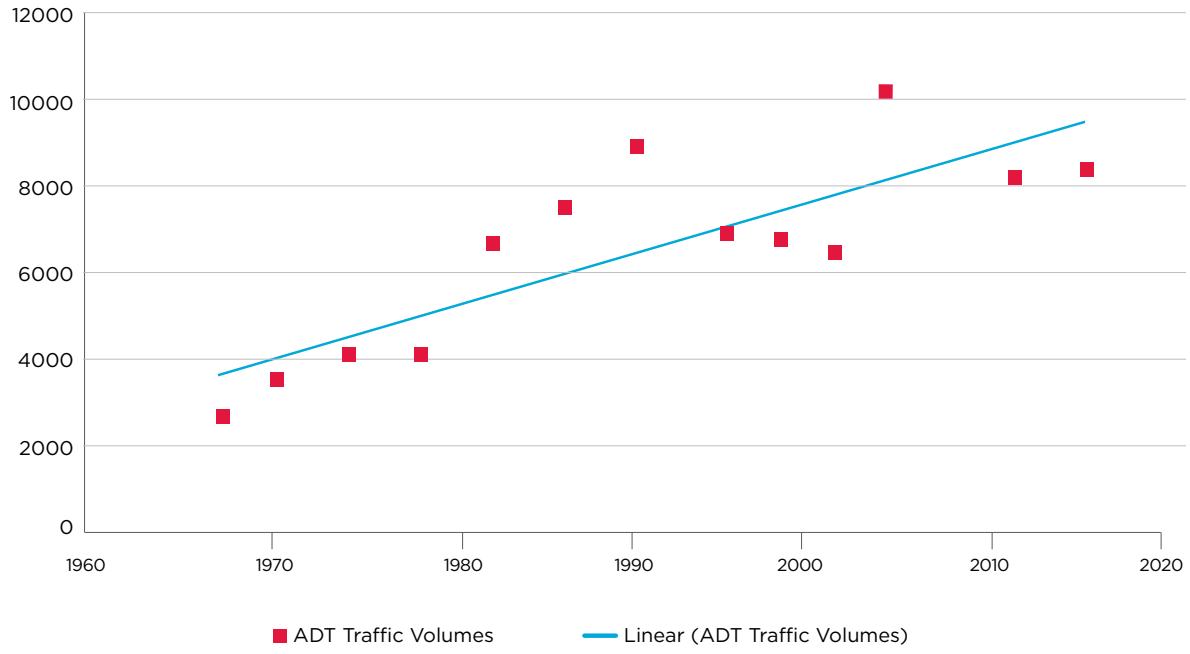


Figure 5-15 Traffic growth – Bangalow



Number of lanes and level of service

The number of through lanes along route is determined by the travel demand or a specific commitment to provide a particular standard of road. Rural class 4R roads are generally two way rural roads with overtaking lanes, reflecting their traffic volumes and the types of vehicles using the route.

The number of through lanes on a class 4R road can be calculated using the level of service rating method. The level of service of roads is used to determine if the capacity of the road is adequate and is influenced by the number of lanes in each direction on a road and the number and length of overtaking lanes provided.

The Lismore to Bangalow corridor between Lismore and Bangalow has one lane in each direction. The Roads and Maritime Network Performance Measures and Network Planning Targets[18] have a target for the number of through lanes on 4R class roads of one lane in each direction. If the travel demand for any particular road is such that target level of service C is forecast to be exceeded within the planning horizon, an assessment should be made as to the viability of increasing the number of lanes available. However, there are several treatments (such as Intelligent Transport Systems technology or strategically located overtaking lanes) that should also be considered first to improve travel reliability along the corridor and improve the level of service.

The Austroads definition of the level of service of a road 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 'F' with 'A' representing free-flowing traffic and 'F' representing severe congestion. Table 5-9 defines each level of service on uninterrupted two-lane two-way roads.

Table 5-9 Level of service definitions

Level of service (LoS)	Description[19]
A	Motorists experience high operating speeds on Class I highways and little difficulty in passing. Platoons of three or more vehicles are rare.
B	Passing demand and passing capacity are balanced. On both Class I and Class II highways, the degree of bunching becomes noticeable. Some speed reductions are present on Class I highways.
C	Most vehicles are travelling in platoons. Speeds are noticeably curtailed on all three classes of highway.
D	Bunching increases significantly. Passing demand is high on both Class I and II facilities, but passing capacity approaches zero. A high percentage of vehicles are now travelling in platoons, and PTSF is quite noticeable.
E	Demand is approaching capacity. Passing on Class I and II highways is virtually impossible, and PTSF is more than 80 per cent. Speeds are seriously curtailed.
F	Exists whenever arrival flow in one or both directions exceeds the capacity of the segment. Operating conditions are unstable, and heavy congestion exists on all classes of two-lane highway.

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

19 Austroads 2013, Guide to Traffic Management Part 3: Traffic Studies and Analysis, Austroads. Sydney, p.46

The *Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis* outlines the process to calculate the level of service of a two-lane two-way road. The process is based on the *Highway Capacity Manual 2010*[20]. The HCM 2010 distinguishes between three categories of two-lane highways. These categories are used to determine the most appropriate Level of Service measure and are described as:[21]

- Class I two-lane highways are generally major intercity routes, primary arterials, daily commuter routes or primary links in state or national highway networks. There is an expectation from motorists to travel at relatively high speeds. These facilities often serve long-distance trips or provide connecting links between facilities that serve long-distance trips.
- Class II two lane highways are generally those that function as access routes to Class I facilities, serve as scenic or recreational routes (except primary arterials), or pass through rugged terrain. Motorists do not necessarily expect to travel at high speeds. These facilities often serve relatively short trips, the beginning and ending of longer trips, or trips for which sightseeing plays a significant role.
- Class III two lane highways are generally those that serve moderately developed areas. They can be sections of Class I and Class II highways that pass through developed areas, where there is a mix between local and through traffic and the density of roadside access points is noticeably higher. These segments are often accompanied by reduced speed limits that reflect the higher activity level.

Lismore to Bangalow Road has been identified as a Class II road. The percentage of time spent following (with no opportunity to overtake) is the criteria used to determine the level.

The Lismore to Bangalow Road corridor performance has been evaluated to understand the existing level of service. The assessment has been based on various factors including traffic volumes, proportion of heavy vehicles, speed limit and overtaking opportunities using 'Traffic on Rural Roads (TRARR) modelling software developed by the Australian Road Research Board (ARRB). TRARR analyses traffic flow on uninterrupted two lane rural road segments. Each vehicle's progress is measured at one second intervals. The TRARR model can be used to simulate platooning and the percentage of vehicles following due to slower freight vehicles, for example on steeper grades where there are no overtaking opportunities.

The Lismore to Bangalow Road corridor level of service was assessed based on the percentage of time spent following another vehicle along the stretch of Lismore to Bangalow Road with the performance criteria outlined in Table 5-10.

> "Class II two lane highways are generally those that function as access routes to Class I facilities, serve as scenic or recreational routes (except primary arterials), or pass through rugged terrain."

20 Transportation Research Board 2010, *Highway Capacity Manual: HCM 2010*, TRB, Washington

21 Austroads 2013, Guide to Traffic Management Part 3: Traffic Studies and Analysis, Austroads. Sydney, p. 42

Table 5-10 Level of service performance criteria[22]

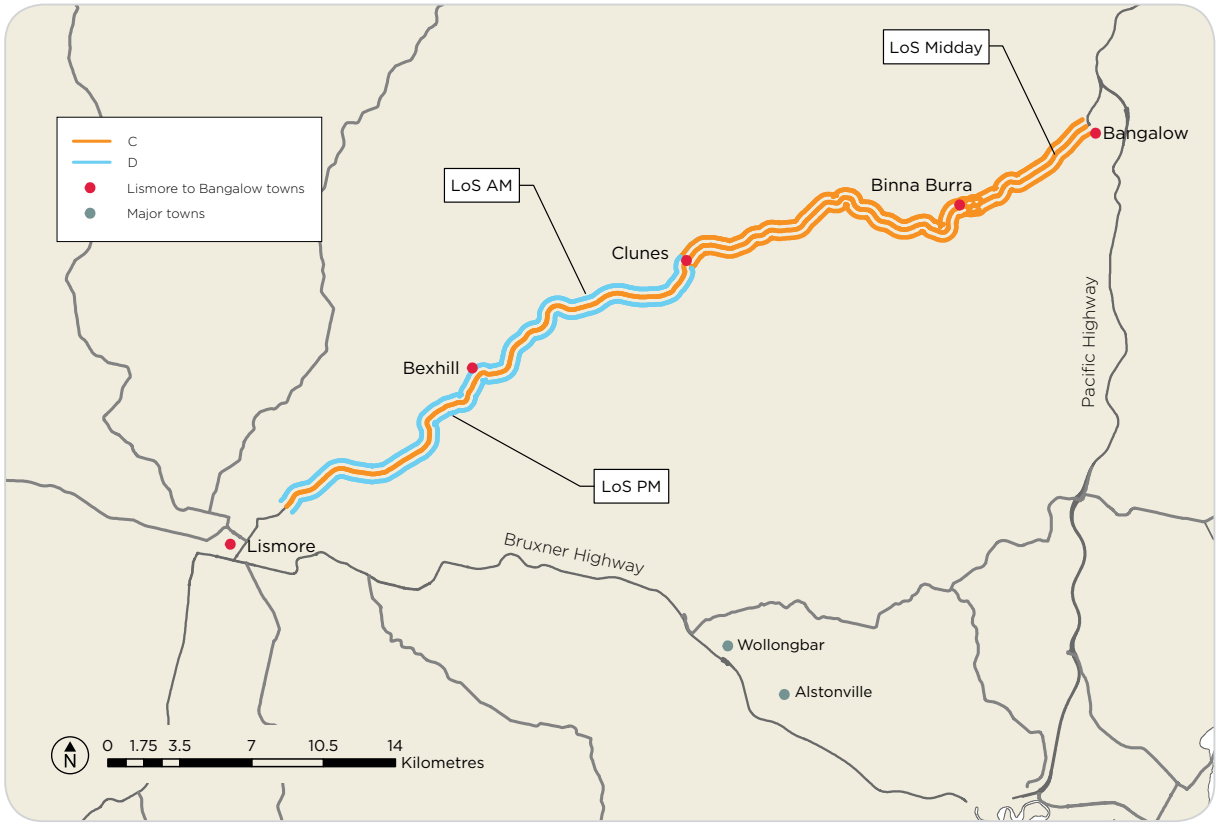
Level of service	Class 4R Road Class II Per cent time-spent-following PTSF (%)
A	<40
B	>40 – 55
C	>55 – 70
D	>70 – 85
E	>85

The level of service along the Lismore to Bangalow Road corridor varies throughout the day with the number of vehicles using the route.

Level of service for percentage of time spent following other vehicles varies along the Lismore to Bangalow Road corridor. Results of a TRARR analysis provide guidance as to where additional overtaking opportunities might improve the level of service. Roads and Maritime Network Performance Measures and Network Planning Target[23] recommend an overtaking lane should be provided at locations where 65 per cent of time is spent following other vehicles which means that the level of service is worse than C.

As expected, the level of service is worst during the peak periods in the peak direction of heaviest traffic flow. Specifically the level of service observations during peak and non-peak periods are shown below in figure 5-16.

Figure 5-16 Level of Service – Lismore to Bangalow Road



The level of service varies along the length of the road and is presented in Table 5-11 and Table 5-12. Level of service for future predicted traffic volumes is presented in Chapter Six.

22 Austroads 2013, Guide to Traffic Management Part 3: Traffic Studies and Analysis, Austroads. Sydney, p. 45

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

Table 5-11 Lismore to Bangalow Road current corridor performance – Northbound

Corridor section	% time spent following			Average speed (km/h)			Level of service		
	AM peak hour	PM peak hour	Day time	AM peak hour	PM peak hour	Day time	AM peak hour	PM peak hour	Day time
Section 2 – Lismore to Clunes	76.9	73.2	62.2	62.9	66.2	68.6	D	D	C
Section 3 – Clunes to Bangalow	69.8	67.9	57.5	62.7	63.4	66.4	C	C	C

Table 5-12 Lismore to Bangalow Road current corridor performance – Southbound

Corridor section	% time spent following			Average speed (km/h)			Level of service		
	AM peak hour	PM peak hour	Day time	AM peak hour	PM peak hour	Day time	AM peak hour	PM peak hour	Day time
Section 2 – Lismore to Clunes	80.5	73	64.2	62.9	66.2	68.6	D	D	C
Section 3 – Clunes to Bangalow	69.3	66.4	56.9	62.7	63.4	66.4	C	C	C

The level of service along the corridor varies between the peak periods and during the day. The morning peak is between 8am – 9am and the afternoon peak is between 5pm – 6pm. This represents the importance of the commuting traffic along Lismore to Bangalow Road. There are three villages between Lismore and Bangalow where the thru traffic speed limit is 50km/h, this can cause platooning of vehicles and average speeds along the corridor to be lower. The analysis indicated that southbound the worst areas are between Bexhill and Lismore in the morning and afternoon peaks, these locations are expected to continue to deteriorate into the future.

The results of the rural roads traffic modelling show that two additional overtaking lanes, one northbound in section 3 and one southbound in section 2, would improve the percentage of time spent following:

- Section 2 AM Peak (both directions) – 78.9 down to 74
- Section 2 PM Peak (both directions) – 73.1 down to 70
- Section 2 during the day (both directions) – 63.1 down to 58
- Section 3 AM Peak (both directions) – 69.6 down to 67
- Section 3 PM Peak (both directions) – 67.5 down to 63
- Section 3 during the day (both directions) – 57.1 down to 53

Overtaking lanes and opportunities

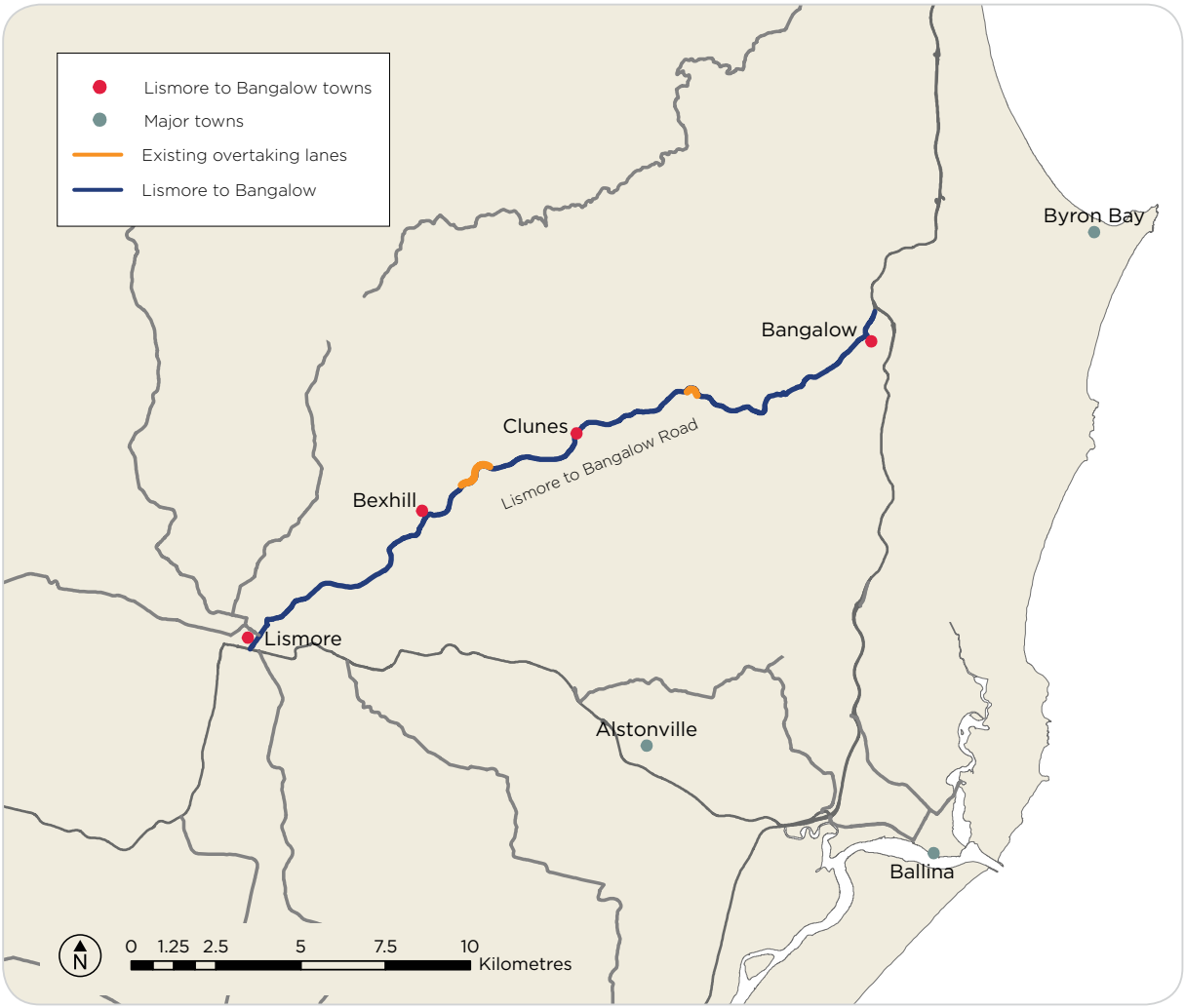
Providing overtaking lanes and other opportunities to pass slower vehicles improves travel time and level of service. In addition, overtaking opportunities reduce driver frustration and unsafe behaviour, reducing the risk of road crashes.

The decision to construct an overtaking lane depends on the level of service of the road, the traffic volumes, percentage of slow vehicles, including light trucks and cars towing a load and the availability of overtaking opportunities on adjoining sections.

There are only two overtaking lanes provided on Lismore to Bangalow Road (Figure 5-17). In the northbound direction the overtaking lane is 1.5 kilometres in length and is located two kilometres to 3.5 kilometres north of Bexhill while the short southbound overtaking lane (600m) is midway between Clunes and Binna Burra at Springvale Hill.

As vehicles platoon travelling between Lismore and Bangalow, there are limited opportunities to overtake. Around 88 per cent of the northbound direction lane and 85 per cent of the southbound direction lane has a barrier line because of steep grades, tight curves and limited sight distance. This, combined with relatively high traffic volumes, generally limit safe overtaking opportunities along the route.

Figure 5-17 Lismore to Bangalow overtaking lanes



Roads and Maritime Network Performance Measures and Network Planning Target[24] recommend an overtaking lane should be provided, where possible, at locations where 65 per cent of time is spent following other vehicles or the level of service is 'C' or lower.

The results of the TRARR analysis reflects the driver experience and is considered to be indicative for the route as a whole. Slower vehicles tend to develop a platoon of following vehicles at numerous locations along the route. The terrain and road alignment provide very few safe overtaking opportunities and there is only one dedicated overtaking lane in each direction. The southbound overtaking lane at Springvale Hill is also very short.

The provision of two additional dedicated overtaking lanes, one in each direction in the short to medium term would improve the level of service for this road.

Increased traffic flows between the Pacific Highway at Bangalow and Lismore resulting from further coastal development along the Byron coast may warrant the investigation of further overtaking opportunities in the longer term. Actual locations will again need to be considered in the context of physical constraints and constructability.

Intersection performance

The operational performance of key intersections along the Lismore to Bangalow Road corridor, using traffic volumes obtained by survey counts in 2011 and 2012, was modelled using the SIDRA software package. SIDRA is an analytical traffic modelling software for intersections and small road networks. The key unsignalised intersections assessed are listed below:

- Ballina Street and Dawson Street, Lismore
- Woodlark Street and Dawson Street, Lismore
- Magellan Street and Dawson Street, Lismore
- Dawson Street/ Zadoc Street, Lismore
- Bangalow Road/Granuaille Street, Bangalow.

Operational Performance Criteria

Three operational criteria have been adopted for benchmarking existing intersection performance, being:

- Level of service
- Average vehicle delay
- Degree of saturation.

Each of these criteria is defined below.

The Roads and Maritime's *Guide to Traffic Generating Developments* (Version 2.2, 2002)[25] provides a guide in assessing level of service for various intersections. This is summarised in Table 5-13 and highlights the key indicators in evaluating intersection performance.

The average vehicle delay provides a measure of the operational performance of an intersection as indicated in Table 5-14 which relates average vehicle delay to level of service. The average vehicles delay should be taken as a guide only as longer delays could be tolerated in some locations (i.e. inner city conditions) and on some roads (i.e. minor side street intersecting with a major arterial route).

Another form of operational measurement is to assess the degree of saturation of individual intersections. It is preferred to operate with a degree of saturation of less than 0.9, with a degree of saturation of up to 0.8 considered satisfactory. Intersections are deemed close to capacity as the degree of saturation approaches 0.9, with queue lengths increasing.

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

25 RTA (2002), G*uide to Traffic Generating Developments,* **Version 2.2, accessed 5 March 2015 at: rms.nsw.gov.au/documents/projects/guide-to-generating-traffic-developments.pdf**

Table 5-13 Intersection performance criteria – level of service

Level of service	Type of intersection	
	Give way/stop sign/T junction	Traffic signal/roundabout
A	Good operation	Good operation
B	Acceptable delays and spare capacity	Good with acceptable delays and spare capacity
C	Satisfactory but accident study required	Satisfactory
D	Near capacity and accident study required	Operating near capacity
E	At capacity, requires other control mode	At capacity; at signals, incidents will cause excessive delays. Roundabouts require other control mode
F	Unsatisfactory and requires additional capacity	Unsatisfactory and requires additional capacity

Roads and Maritime's *Guide to Traffic Generating Developments* identifies the key criteria in assessing the level of service based on average vehicle delays as shown in Table 5-14.

Table 5-14 Intersection performance criteria – average vehicle delay

Level of service	Average delay per vehicle (seconds/vehicle)
A	<14
B	15 to 28
C	29 to 42
D	43 to 56
E	57 to 70
F	>70

The results of the SIDRA analysis for each intersection reported in terms of the above performance criteria are presented in Table 5-15. The 95th percentile queue is the maximum queue length that is only exceeded five per cent of the time.

Traffic congestion at Dawson Street and Ballina Street, Lismore

Table 5-15 Intersection performance results – Summary

Scenario	AM peak				PM peak			
	DOS	Delay (s)	Level of service	95th percentile queue (m)	DOS	Delay (s)	Level of service	95th percentile queue (m)
Dawson Street/ Ballina Street (2012)	0.6	18.7	B	35.0	0.6	17.2	B	33.7
Dawson Street/ Woodlark Street (2011)	0.8	25.3	C	130.7	0.7	16.1	B	68.8
Dawson Street/ Zadoc Street (2011)	0.6	11.8	A	56.3	0.3	11.0	A	16.5
Dawson Street/ Magellan Street	0.3	2.8	A	0.9	0.3	3.5	A	1.4
Bangalow Road/ Granuaille Street (2011)	0.5	11.5	A	24.4	0.4	11.5	A	16.8

Table 5-15 illustrates that in 2011-2012 the intersections were performing between good to satisfactory. The existing demands on the intersection were projected forward for 10 years to produce a future demands model for both AM and PM peak. The analysis showed that Zadoc Street, Magellan and Granuaille Street continues to perform in good operation but Ballina Street and Woodlark Street performance drops to unsatisfactory.

The capacity of the road network in Lismore and at some intersections along the rural sections of the corridor will need to be subject to further analysis to determine appropriate treatments and potential upgrades in accordance with predicted demand. The development of a strategic traffic model focusing on the Bruxner Highway and Lismore to Bangalow Road through Lismore will help determine whole of network approaches to address traffic movements and congestion within Lismore CBD.

Figure 5-18 Current level of service at key intersections on the corridor during the AM peak period

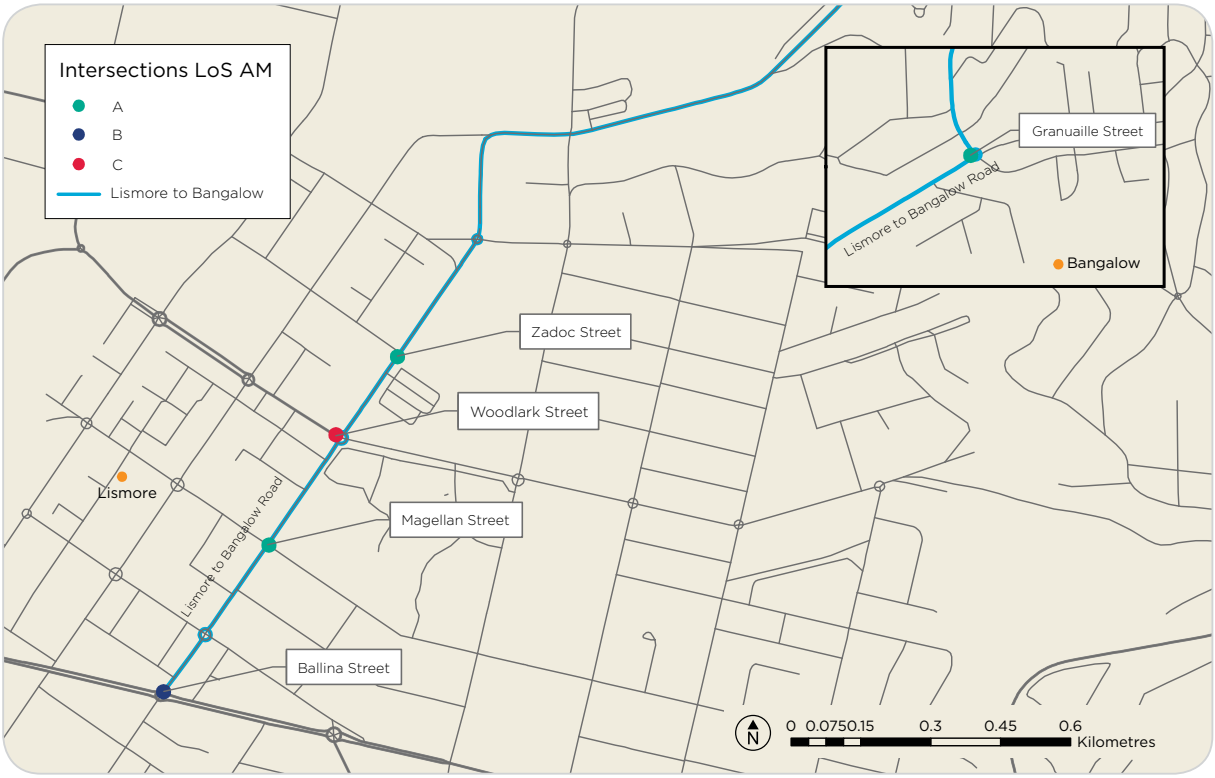
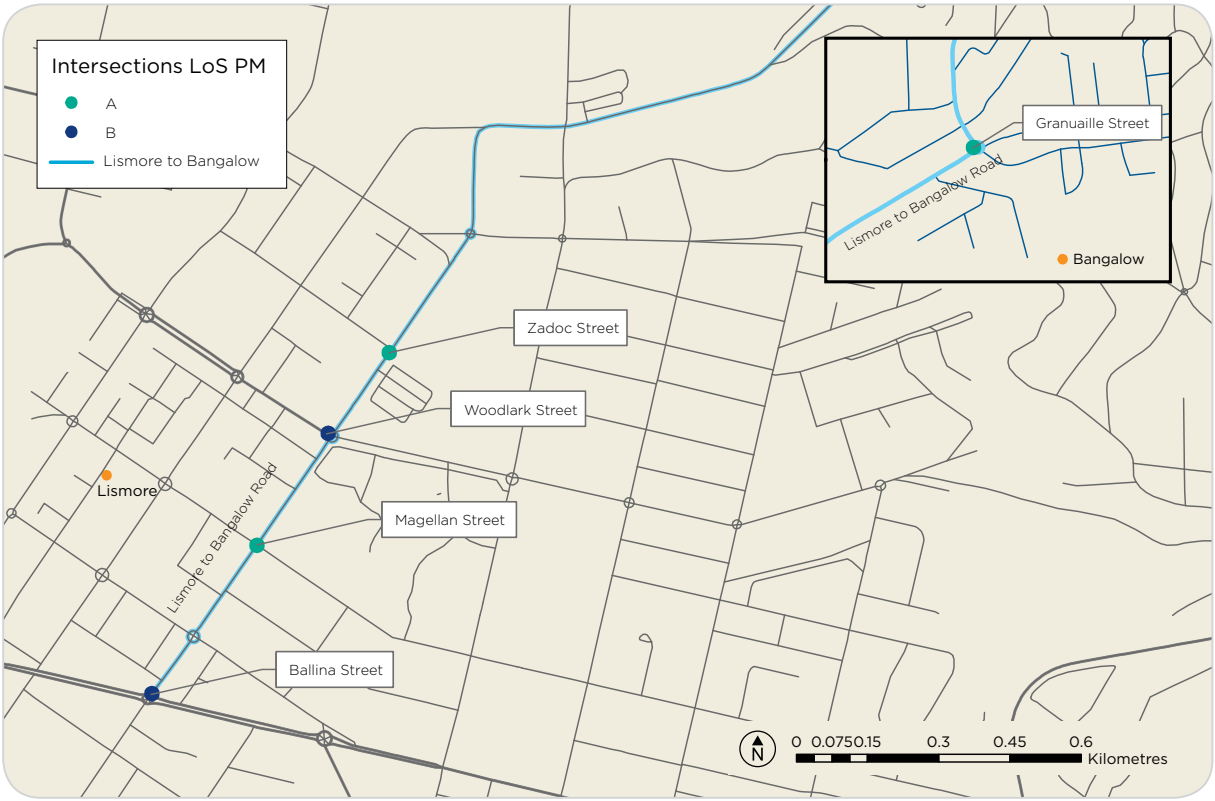


Figure 5-19 Current level of service at key intersections on the corridor during the PM peak period



Incident management

Traffic incident management refers to the delivery of planning and operational tasks by the responsible road authority in response to an 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.

There is no formal Incident Response Plan (IRP) for Lismore to Bangalow Road. The Bruxner Highway provides an alternate road between the coastal areas and Lismore, with various local rural roads providing connections to other arterials for communities along the length. During flood events, local movement can be restricted between Lismore and Bexhill for more than 24 hours.

The Lismore to Bangalow Road can, on occasions be used as part of a Pacific Highway detour route when unplanned incidents between Ballina and Byron Bay close the highway. Following the completion of the Tintenbar to Ewingsdale upgrade project, the frequency of these road closures are expected to be greatly reduced.

Rest areas

There is a road-side rest area maintained by the local Lions Club located 3 kilometres north of Lismore adjacent to the northbound lane. It provides basic facilities including tables and chairs and rubbish bins. There are no toilet facilities. A current rest area is located on the Pacific Highway between Bangalow and Ewingsdale. The rest area provides a toilet and basic facilities such as a sheltered table and rubbish bins. With the completion of the Tintenbar to Ewingsdale project, this section of road will become part of the Lismore to Bangalow route (B62).

Regional centres and town bypasses

The need for town bypasses on the Lismore to Bangalow corridor 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 road hierarchy divides the State Road network into six classes of urban roads and six classes of rural roads. This classification system serves as the basis for assessing relative performance across the network, and enables a better understanding of relative functional roles and importance of all the State routes from a whole-of-network perspective.

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). The Roads and Maritime Network Planning Targets[26] call for consideration for bypasses of **Urban Commercial** (Class 6R, 5R and 4R) and **Urban** (Class 6R) areas on major highway classes.

The Lismore Bangalow corridor serves as a main through traffic route connecting Lismore to the Pacific Highway for inter-regional travel to the Byron coastal area and other parts of the Northern Rivers. It provides access for local traffic to larger towns and centres for business and for tourism to the villages of Bexhill, Clunes and Bangalow.

The *NSW Long Term Transport Master Plan* discusses bypasses in the context of separating through traffic and local traffic and in relation to removing conflicts between heavy vehicles and pedestrians – for example bypassing the main urban commercial street of a town.

Town bypasses can be a solution to this problem and can improve travel within towns, reduce delay for freight vehicles and improve road safety, by reducing conflict points between local and through traffic and between vehicles and pedestrians.

The *NSW Long Term Transport Master Plan* prioritises a program of town bypasses to improve travel within towns, reduce delays caused to freight traffic and increase safety. Assessing town bypass proposals involves considering:[27]

- **The road's hierarchy classification.** Higher-order roads carry higher levels of through-traffic and generate greater benefits than other areas where volumes are much lower. For example, the Hume Highway (M31) and Pacific Highway (M1) have the highest

classification, and roads such as the Silver City Highway (B79) and Kings Highway (B52) have the lowest road hierarchy classification.

- **Proportion of through-traffic for both light and heavy vehicles.**
- **Travel time benefits.**
- **Town or regional centre size.** Large towns tend to experience many local trips, which can impact through-traffic and create localised congestion.
- **Difficult terrain, major rivers and urban development.** These factors impact project cost and influence the decision to prioritise a particular bypass.
- **Dispersed urban development.** This limits town bypass options, as does the nature of development next to the corridor. A bypass is more likely to be provided on higher order roads next to commercial development, such as shops and businesses.

> Higher-order roads carry higher levels of through-traffic and generate greater benefits than other areas where volumes are much lower.

The type of bypass to be provided is also an important consideration. Typical bypass options include:

- **Full bypass.** This is where the road corridor has controlled access to the town. This can mean it is separate to the town itself or run alongside – or parallel to – a corridor through the centre of town. Typically, full bypasses are required where there are high volumes of through-traffic combined with a high proportion of local traffic, including pedestrians. This type of bypass is the most expensive.
- **Inner bypass.** This is where the existing road corridor is shifted away from the main street and an adjacent local road is upgraded to accommodate a new flow of traffic. This option is typically considered when volumes of through and local traffic are lower. This option is less expensive than a full bypass.
- **Heavy vehicle bypass.** This is where heavy vehicle traffic is directed away from the main street, however, all other local and through-traffic can continue to use the existing road. A heavy vehicle bypass can be less expensive than a full or inner bypass and can accommodate the interests of local businesses who benefit from both improved amenity and continuing passing trade.

27 Transport for NSW 2012, *NSW Long Term Transport Master Plan*, TfNSW, Sydney, p. 244

Bexhill and Clunes

The villages are small settlements with local businesses, grouped amongst a collection of residences. The local businesses are heavily reliant on the economic benefits of passing trade. The need for town bypasses along the corridor has been assessed using the Long Term Transport Master Plan principles. Neither Clunes nor Bexhill are subject to high volumes of heavy vehicle traffic or have significant conflicts between local and through traffic. There will continue to be a need to manage the speed of traffic through these small communities recognising that there is the potential for pedestrians and other vulnerable road users to cross the road, however it is unlikely that a bypass would be economically justified.

Bangalow

In 2010 the Roads and Traffic Authority (now Roads and Maritime) assessed the viability of a southern bypass of Bangalow, as part of the planning for the Tintenbar to Ewingsdale Pacific Highway upgrade project. The study found that the Bruxner Highway and Lismore to Bangalow Road served similar functions in the area. The Bruxner Highway, however, is a higher functioning route particularly given the improvements in travel stemming from the Pacific Highway Upgrade projects and Alstonville Bypass. It was considered that the Lismore to Bangalow corridor would continue to serve a secondary function to the Bruxner Highway in the long term and would therefore not warrant a bypass of the Bangalow township. The recommendation was that a southern bypass of Bangalow could not be justified in the medium to long term. The Lismore to Bangalow Road does not run through the main commercial centre of Bangalow.

Summary of Traffic Issues

- The main traffic function of the route is commuters connecting regional city of Lismore and the Byron Bay region with weekday peak periods between 8am – 9am and 5pm – 6pm.
- Traffic composition comprises of 90 per cent light vehicles, seven per cent rigid service vehicles and three per cent articulated vehicles (semi-trailers).
- The rural areas between Lismore and Bangalow are forecasted to have a traffic growth between 1.6-1.7 per cent and the urban area of Lismore is forecasted to have a traffic growth between 1.3-3 per cent depending on future development.
- The level of service for intersections assessed along the corridor is currently acceptable. The analysis showed two out of the five intersections performance drops to unsatisfactory with future traffic growth.
- The current level of service in section 2 was assessed as a D during peak hours and C during non-peak hours. Section 3 was assessed as a C in both peak and non-peak hours.. The provision of two additional dedicated overtaking lanes, one in each direction in the short to medium term would improve the level of service for this road.
- The importance of incident management will continue to increase in particular during the peak times with improvements including Intelligent Transport Systems being implemented to allow for better travel decision making for customers along the entire route.

Looking south at Corndale Road, Bexhill

28 NSW Government RTA, 2010 rta.nsw.gov.au/roadprojects/projects/pac_hwy/ballina_tweed_heads/bangalow/documents/bangalow_bypass_community_update_march_2010.pdf viewed 23/07/13

5.3 Road design and geometry

Horizontal curves

Properly designed curves allow motorists to negotiate changes in the horizontal alignment of the road at a consistent rate. The design radius of the curve is dependent on the design speed, superelevation 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 an accident.

To allow for a design speed of 100km/h, the Austroads *Guide to Road Design* (RTA Supplement) recommends providing a minimum horizontal curve of 437 metres based on 6 per cent superelevation and 492 metres based on 4 per cent superelevation and 0.12 assumed value of friction[29].

For ease of segmentation, tight curves below 460 metres are shown in Table 5-16, 38.7 per cent of Lismore to Bangalow Road consists of curves with radii of less than 460 metres. Curve radii between 200 and 460 are considered to present the most risk to motorists due to the perception of safety while those with a curve radius of less than 200 metres often necessitate the vehicle operator to slow to an adequate speed. While much of the corridor traverses similar topography, the rural sections between Boatharbour Road and three kilometres north of Eltham Road Bexhill and between Springvale Road and Friday Hut Road Binna Burra has the majority of tight curves less than 460 metres.

Table 5-16 Corridor planning sections by curve radii

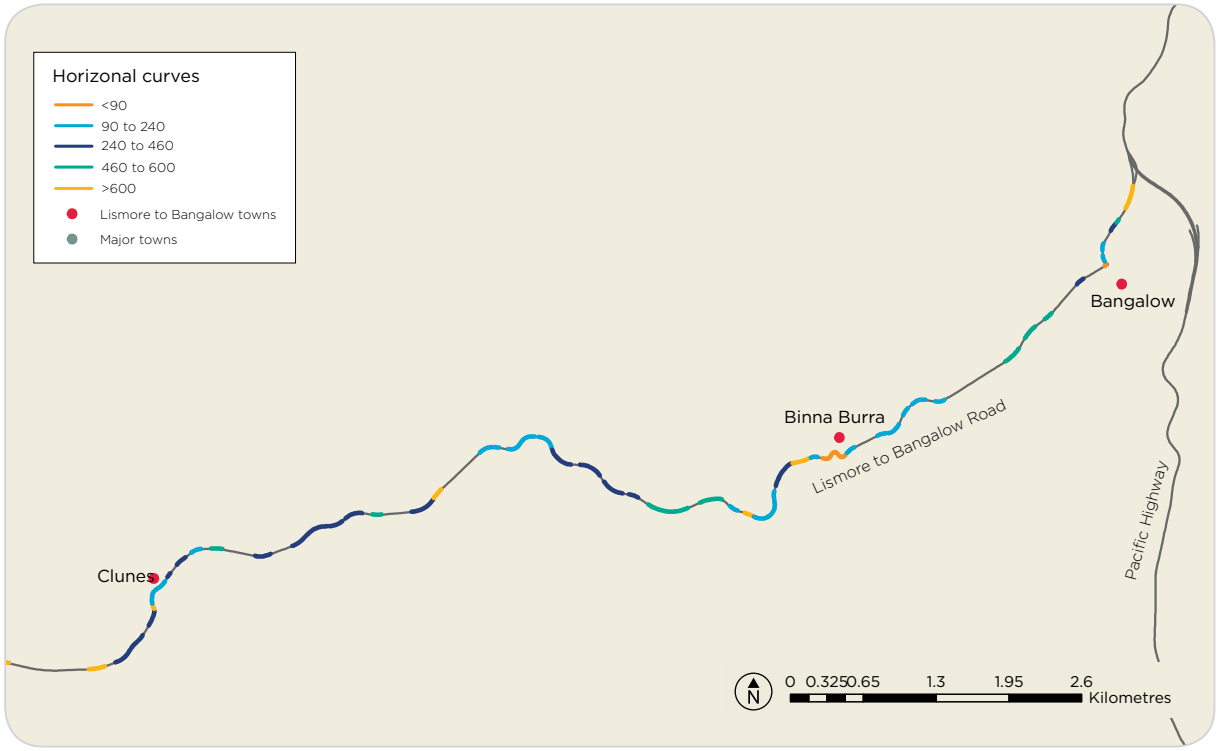
Corridor planning sections	Curve radii (metres)					
	<90	90-240	240-460	460-600	>600	Straight
1. Lismore (from HW16 Bruxner Highway to 180m north of Bangalow Street)	3.1%	17.1%	8.5%	0.0%	0.0%	71.3%
2. Lismore to Clunes (from 180m north of Bangalow Street to 230m south of Larvis Street	0.0%	11.0%	31.0%	10.8%	9.3%	38.0%
3. Clunes to Bangalow (from 230m south of Larvis Street to 170m north of Dudgeons Lane)	2.4%	18.0%	21.4%	11.8%	3.2%	43.2%
4. Bangalow (170m north of Dudgeons Lane to Pacific Highway on-ramp)	1.7%	6.3%	9.6%	1.8%	10.7%	69.9%
Total (by length)	**1.4%**	**14.0%**	**23.3%**	**9.5%**	**6.1%**	**45.7%**

29 Austroads 2010, *Guide to Road Design: Part 3: Geometric Design*, Austroads, Sydney, and RTA 2011, Supplement to Austroads

Figure 5-20 Curve radii

Figure 5-21 Curve radii

Figure 5-22 Curve radii



The section of road approaching the (now removed) Binna Burra Rail Bridge consists of a series of tight radius curves (<90 metres) combined with narrow shoulders, and a tight alignment, contributing to a high crash rate typified mostly by off road on curve crashes. These curves are some of the tightest along the corridor and have contributed to a reduction of the posted speed limit to 80km/h.

Figure 5-23 Binna Burra curves

A safety assessment of the Binna Burra rail bridge was carried out by John Holland Rail in response to the safety concerns and recommendations of the Casino to Murwillumbah Transport Study. As a result, the Binna Burra rail bridge was found to be at the end of its functional life and was recommended for demolition. This work was completed on 18 June 2014 during a night closure of the road due to the lack of alternative traffic routes around this location. The timber bridge span was removed back to the abutments, with the concrete trestle supports left in place. This presents an opportunity for investigation into the potential realignment of Lismore to Bangalow Road at this location in order to remove or improve the curves on this section of the corridor which has a poor road safety record.

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 'platoons' 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 Network Performance Measures and Planning Targets recommend maximum grades of six per cent for rural Class 4 roads[30].

Table 5-17 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

Lismore to Bangalow Road has grades of six per cent or more for 11.8 per cent (Table 5-18) of its length with the highest concentrations occurring within Lismore and between Clunes and Bangalow. The section between Clunes and Bangalow traverses the most mountainous rolling terrain along the corridor and is accompanied by narrow lane and shoulder widths.

Table 5-18 Vertical grades

Highway planning section	Length	≤ 6% grade	> 6% grade
1. Lismore	3.04km	92.9% (2.824km)	7.1% (0.216km)
2. Lismore to Clunes	14.11km	91.7% (12.94km)	8.3% (1.170km)
3. Clunes to Bangalow	13.34km	82.5% (11.010km)	17.5% (2.33km)
4. Bangalow	2.7km	92.4% (1.495km)	7.6% (0.205km)
Total (by length)	**33.19km**	**88.2% (29.269km)**	**11.8% (3.921km)**

30 **Roads and Maritime Services,** *Network Performance Measures*, **p.40**

Overall, there are a significant number of sections along Lismore to Bangalow Road with grades of 6 per cent or greater; the implications are enhanced when combined with tight curves. The road between Clunes and Bangalow is worst performing with the longest section of steep grades and tight curves.

Table 5-19 summarises the proportions of each section of the Lismore to Bangalow corridor which have vertical grades of greater than six per cent on differing curve radii. It demonstrates that many of the steep grades occur on curves with a radius of between 90 and 240 metres and in combination are a particular risk for road users.

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 5-19 Proportion of corridor planning sections with vertical grades exceeding 6 per cent (by curve radii)

Corridor planning sections	Curve radii (metres)					
	<90	90-240	240-460	460-600	>600	Straight
1. Lismore (from HW16 Bruxner Highway to 180m north of Bangalow Street)	-	2.3%	-	-	-	4.8%
2. Lismore to Clunes (from 180m north of Bangalow Street to 230m south of Larvis Street)	-	0.6%	3.9%	0.1%	0.7%	3.0%
3. Clunes to Bangalow (from 230m south of Larvis Street to 170m north of Dudgeons Lane)	-	8.5%	4.2%	0.1%	0.7%	4.0%
4. Bangalow (170m north of Dudgeons Lane to 98m South of Leslie Street)	-	3.6%	-	-	-	4.0%
Total (by length)	**-**	**15.0%**	**8.1%**	**0.2%**	**1.4%**	**16.0%**

While there are significant restrictions to improving the alignment and reducing the grade of the road, due to the challenging topography and high value conservation environment, minor improvements such as curve realignments, increased advisory signage, and improved delineation of lane configurations can assist motorists negotiating the terrain, improve driver behaviour and improve road safety.

For sections where the horizontal curves and vertical grade exceeds the Roads and Maritime Network Performance Measures and Planning Targets, closer assessment of the road should be undertaken to examine options for bringing both horizontal and vertical grades in line with current standards.

Speed on curves

Run off road on curve crashes are a major area of concern in NSW crash statistics on the rural network. To improve road safety a road with a 100km/h operating (design) speed should aim to have a minimum horizontal curve radius of 460 metres.

Around 64 per cent of Lismore to Bangalow Road meets this standard. However, this also means that about 36 per cent of curves on the route fall below 460 metres – or around 12 kilometres by lengths of the highway.

The grades and curvature of the road, particularly in the sections north of Bexhill and midway between Clunes and Binna Burra, reflect the age of the road and the difficult terrain. There are also a number of tighter curves on the southern approach to Binna Burra. These areas in particular could be investigated in more detail for potential realignment.

Examining the last five years of crash data, there were 52 "off road on curve hit object" crashes, which equates to around 21 per cent of total crashes. Around 32 per cent of all crashes have occurred in a 100km/h zone, which is also the highest speed zone limit. Of all the crashes where speed was able to be determined as a contributing factor, it also rated the highest at 29.3 per cent, as opposed to fatigue (10.6 per cent) and alcohol (3.7 per cent). This shows that excessive speed into curves is a contributing factor to crashes along Lismore to Bangalow Road[31].

Analysing the radius of the curves along the route, there appears to be some sections where additional delineation such as chevron alignment markers could be utilised to advise the driver of a sharp corner and to guide them around the corner. This may be a preventative measure to decrease the number of 'off road' crashes on curves.

Lane widths

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

Roads and Maritime' Network Performance Measures and Planning Targets guideline recommends a minimum lane width of 3.5 metres should be maintained for all sections of the Lismore to Bangalow corridor as it is a Class 4R road.

A large proportion of the corridor does not meet this standard. A review of lane widths for Lismore to Bangalow Road indicates that they are equal to or greater than 3.5 metres for about 29 per cent of its length, with 32.7 per cent ranging between 3.25 – 3.5 metres. Lane widths between Clunes to Bangalow meet the recommended lane width target for only 17.8 per cent. Generally these sub-standard locations are spread throughout each planning section; however there are several locations with a concentration of narrow lanes with radii less than 460 metres:

- 4.1 kilometres to 6.7 kilometres south of Clunes.
- 7.6 kilometres to 8.9 kilometres south of Clunes.

While lane widths less than 3.5 metres do not meet the performance targets, particular attention should be focused on road sections which have lane widths significantly below the performance target – that is, less than or equal to 3.25 metre road widths. Significant sections along Lismore to Bangalow Road that should be targeted for lane widening are the sections outlined above south of Clunes. These areas should be addressed and pavements widened so that they are closer to current design standards.

31 NSW Government – NSW Centre for Road Safety. Summary Crash Report 1/1/2008 – 31/12/2012

Table 5-20 Lane widths

Corridor planning sections	Performance target	<3.0m	3.0m-<3.25m	3.25-<3.5m	Normal lane width ≥3.5m
1. Lismore (from HW16 Bruxner Highway to 180m north of Bangalow Street)	>3.5m	0.0%	0.0%	50.0%	50.0%
2. Lismore to Clunes (from 180m north of Bangalow Street to 230m south of Larvis Street	>3.5m	0.0%	19.2%	40.2%	40.6%
3. Clunes to Bangalow (from 230m south of Larvis Street to 170m north of Dudgeons Lane)	>3.5m	0.0%	62.6%	19.6%	17.8%
4. Bangalow (170m north of Dudgeons Lane to Pacific Highway on-ramp)	>3.5m	0.0%	60.3%	39.7%	0%
Total (by length)	**>3.5m**	**0.0%**	**38.3%**	**32.7%**	**29.0%**

Bridge widths are also a significant factor, because they are generally the narrowest point along any route. The *Performance Based Standards Scheme Network Classification Guidelines*[32] recommend a minimum width of 8.4 metres for bridges when the AADT is greater than 500 vehicles.

There are five bridges, three bridge sized culverts and one pedestrian underpass on Lismore to Bangalow Road. Of the bridges and bridge sized culverts, four have a carriageway width less than the desired minimum width as detailed in Table 5-21. Additionally, all of these narrow bridges are more than 60 years old. An audit should be carried out on these four bridges to address road safety, road standards and consideration for improvements.

Table 5-21 Narrow Bridges and culverts less than 8.4 metres wide

Location	Reference	Carriageway width	Built
4.62km North of Lismore	Lagoon Creek	6.7m	1948
Springvale Hill	Springvale Bridge – Wilsons Creek	7m	1941
East Dudgeons Lane	Maori Creek	7.6m	1947
0.47km west of Bangalow	Paddys Creek	7.6m	1946

32 National Transport Commission 2007, *Performance Based Standards Scheme Network Classification Guidelines*, **NTC**

Sealed shoulder widths

Sealed shoulder widths are the portion of the road that extend beyond the marked traffic lanes. Sealed shoulders 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. Pavements with shoulder treatments last longer than road sections without it. Sealed shoulder treatments also improve the pavement structure and reduce insitu moisture levels.

As a guide, the Roads and Maritime Network Planning Targets recommend a minimum sealed shoulder width of two metres for rural Class 4 roads[33]. Extra shoulder width is required on the outside of curves. The *Roads and Maritime Network and Corridor Planning Practice* Notes indicate that, on average, 15 per cent of Class 4 roads have sealed shoulder widths less than the desirable minimum.

As illustrated in Table 5-22, only 11 per cent of the Lismore to Bangalow corridor has sealed shoulders at least two metres wide in both directions. The remaining 89 per cent of the corridor has sealed shoulders less than the desired minimum sealed shoulder width. This compares to a class average of 56 per cent below the two metres target.

There are approximately six kilometres of the corridor where there are shoulders less than 0.5 metre. These are located south of Binna Burra, north of Clunes and north of Bexhill. There are eight kilometres where the shoulder widths are between 0.5 metre and 1.0 metre when combined is approximately 42 per cent of the route.

It is recognised that the provision of wider sealed shoulders can have a significant effect in reducing 'run off road' casualty crashes across the network, particularly on smaller radius curves. Sections of road where the topography allows additional width, particularly on the outside of curves, will continue to be targeted for shoulder widening and sealing.

While it should be noted that the shoulder widths of these roads are a legacy of historic design codes, those lengths of the Lismore to Bangalow corridor with shoulder widths less than the desirable minimum should be progressively upgraded to meet the requirements of the Network Performance Measures and Network Planning Targets and aim to provide a safer road environment.

Although more sealed shoulder widths 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 constructability issues makes achieving the recommended minimum sealed shoulder widths a significant challenge.

Table 5-22 Sealed shoulder widths

Corridor planning sections	Performance target	Sealed shoulder widths (metres)		
		<1.0m	≥1m & <2 m	≥2.0m
1. Lismore (from HW16 Bruxner Highway to 180m north of Bangalow Street)	2.0m	27.3	32.5	40.2
2. Lismore to Clunes (from 180m north of Bangalow Street to 230m south of Larvis Street	2.0m	66.4	27.2	6.4
3. Clunes to Bangalow (from 230m south of Larvis Street to 170m north of Dudgeons Lane)	2.0m	64.3	27.5	8.2
4. Bangalow (170m north of Dudgeons Lane to Pacific Highway on-ramp)	2.0m	60.3	24.1	15.6
Total (by length)		**61.4%**	**27.6%**	**11.0%**

33 ibid., p 45

North of Carolina Street, Lismore

Clear zone and safety barriers

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

Roads and Maritime Network Performance Measures and Network Planning Targets[34] state that for Class 4 roads, the width of the clear zone varies based on the speed limit.

- Three metres for speeds less than 60km/h
- Four metres for speeds between 60-80km/h
- Five metres for speeds between 80-110km/h

Where these clear zone widths cannot be achieved, 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 section of the road within the immediate area[35].

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

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

Table 5-23 Clear zones along the corridor

Location	Clear zone achieved	Why is the clear zone not achieved?
Lismore	Within the urban section of Lismore, the clear zones are comparable to other urban environments. North of Lismore a clear zone of only 1m to 2m is achieved.	Utilities
Lismore to Bexhill	From Lismore through to Bexhill in a 100km/h speed environment, clear zones averaging 3m to 4m are achieved. Approaching Bexhill, the clear zone is significantly reduced and trees and power poles line the road.	Vegetation and utilities present
Bexhill	In Bexhill township clear zones are generally achieved on the northbound sections of roadway; though improvements could be made on the southbound roadside.	Vegetation
Bexhill to Clunes	From Bexhill through to Clunes clear zones are less than desired, averaging around 3m. In some locations trees line the road, while in other locations clear zones are difficult to achieve due to environmental constraints. Steel guardrail is used to protect motorists from driving over embankments on these sections of road.	Vegetation
Clunes	In Clunes township clear zones are less than desired.	Utilities and vegetation
Clunes to Binna Burra	Between Clunes and Binna Burra clear zones vary considerably, ranging between 1m and 6m. There are several curves where the clear zone is 1m to 2m. Several descending embankments prevent clear zones from being achieved; though generally only on straight sections of road.	Embankments and vegetation
Binna Burra	Clear zones are mostly achieved through Binna Burra.	NA
Binna Burra to Bangalow	Between Binna Burra and Bangalow, clear zones range from 2m to 4m; less than desired for the prevailing 80km/h speed environments.	Vegetation
Bangalow	In Bangalow township, clear zones are achieved south of the Lismore Road roundabout.	Utilities

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.

Any increase in the width of the corridor's clear zones would improve safety compared to the existing situation, even if it falls short of the Austroads guidelines. This would, however, need to be balanced with environmental impacts, attract high expenditure and potentially stringent environmental mitigation works.

Significant lengths of the corridor do not meet desired clear zone widths due to dense vegetation adjacent to the road, power poles, and fences lining the road. Clear zones should be provided to target levels wherever possible particularly those sites with a significant crash history for 'off-road hit object' crashes. Where this cannot be achieved, roadside safety barriers should be installed at high risk areas to reduce crash severity. A targeted clear zone strategy would help to ensure that a proactive and systematic approach is taken to address these clear zone concerns.

Edgelines

Edgelines 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. Edgelines provide important markings for motorists.

Roads and Maritime Network planning targets recommend roadways across all types of terrain should have edgelines on a Class 4R road, provided there is sufficient pavement to accommodate a minimum three metre wide lane between the edgeline and centre line[36].

Based on Table 5-24, this depicts the Lismore section of having 55.1 per cent (1.675 kilometres) with edgelines. Although the Lismore section is largely urban, some parts of the road are wide and could benefit from edgeline to define the travel lanes.

Edgeline treatments are not of major concern along Lismore to Bangalow Road.

> Edgelines provide important markings for motorists.

Table 5-24 Edgelines

Corridor planning sections	Performance target	Percentage with edgelines
1. Lismore (from HW16 Bruxner Highway to 180m north of Bangalow Street)	100.0%	55.1%
2. Lismore to Clunes (from 180m north of Bangalow Street to 230m south of Larvis Street	100.0%	100.0%
3. Clunes to Bangalow (from 230m south of Larvis Street to 170m north of Dudgeons Lane)	100.0%	100.0%
4. Bangalow (170m north of Dudgeons Lane to Pacific Highway on-ramp)	100.0%	100.0%
Total (by length)	**100.0%**	**95.6%**

It should be noted that:

- Edges lines need to be replaced on parts of the corridor that have been resealed or experienced pavement repairs
- Edgelines are not always practical to implement in some parts of urban towns where the road is generally adjacent to multiple lanes and parking areas.

36 ibid., p. 48

Intersections

The Roads and Maritime network planning targets identify the required intersection treatments, based on volumes of through-traffic and turning traffic. Minimum intersection treatments relevant to the Lismore to Bangalow corridor include[37]:

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

There are 57 intersections along the corridor, which include

- 46 T-Junctions
- Seven four-way crossings
- One staggered four-way junction
- Two staggered T-Junctions
- One interchange.

There are numerous intersections with drainage issues, loose gravel (from side streets), poor sight distance, poor pavement condition and inadequate signage. These will be addressed on a priority basis, with intersections that have a significant crash history, posing the greatest risk, and more highly trafficked being addressed first.

There are two intersections with Lismore to Bangalow Road that require improvements to traffic efficiency and road safety, these are:

- Ballina Road in Lismore
- Woodlark Street in Lismore.

There are three intersections with Lismore to Bangalow Road that require improvements to road safety and design standard, these are:

- Magellan Street in Lismore
- Carolina Street in Clunes.
- Stewarts Road in Clunes.

Other intersections will also be upgraded as opportunities arise. The most practical and cost effective approach would be to combine future upgrades with pavement rehabilitation and widening project.

Flooding

The Lismore to Bangalow corridor crosses a number of floodplains as well as waterways subject to flooding.

Flooding can result in corridor closures at multiple locations for hours and, at times, for several days.

The impacts of flooding on the Lismore to Bangalow corridor 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 water ways, 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.

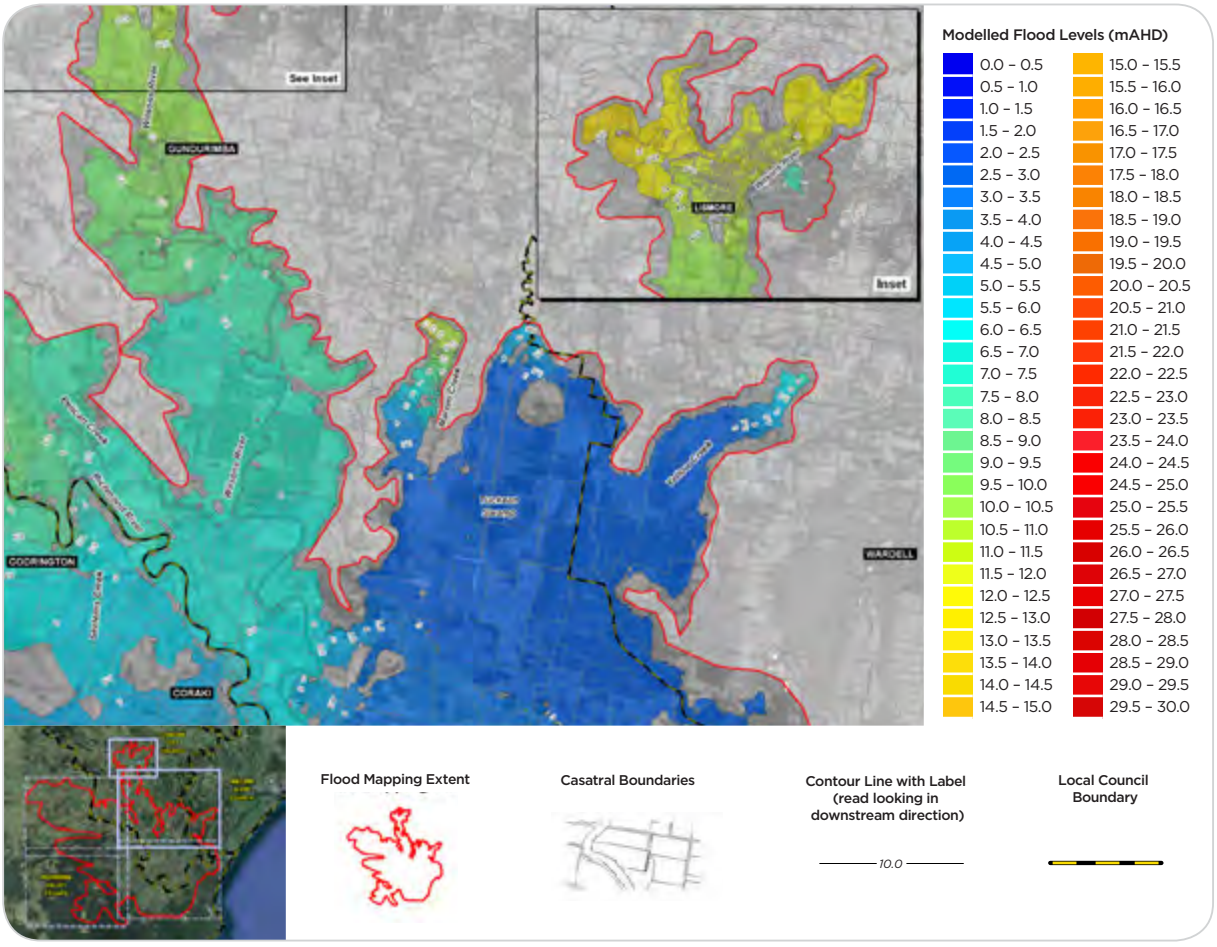
37 Roads and Maritime Services 2010, *Network Performance Measures and Network Planning Targets*, **RMS, Sydney, p. 49**

- Sheet flooding where landscape is flat – In places such as southern 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.

Several sections along the route are affected by flooding caused by the Wilsons River near Lismore and Byron Creek near Binna Burra. Both sections are cut intermittently, with Wilsons River and Byron Creek cutting road access on the average of one in five years. This can affect traffic movement for up to two days. Overall, around six per cent (two kilometres) of the corridor is subject to minor flooding (4.2 – 7.2 metre Australian Height Datum) and around 17 per cent (5.8 kilometres) of the corridor is subject to major flooding (above 9.7 metres Australian Height Datum)[38].

Overall reliability of the Lismore to Bangalow corridor is considered adequate in terms of journey times. However, low flood immunity at a number of key locations on the road reduces this reliability. In particular the frequency and severity of inundation between Lismore and Bexhill can impact on access to services within Lismore (Figure 5-24). Further long term assessments and analysis of solutions to address low flood immunity should be considered. Any improvements to flood immunity, particularly between Lismore and Bexhill should be considered in conjunction with any planned work or upgrades in the area.

Figure 5-24 Modelled Flood Levels around the Wilson River in Lismore



38 Lismore City Council 2011 lismore.nsw.gov.au/cp_themes/default/page.asp?p=DOC-LTF-21-44-70 viewed 22/07/13

Road slope risk rating

Earth embankments and cuttings are constructed to provide for a gradual rise or fall in the terrain around roads. Part of managing these embankments involves assessing measures necessary to mitigate against possible risk of slips. 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' Road Slope Management System (RSMS) database. The risk posed by a slope if considered unstable is measured in terms of an Assessed Risk Level (ARL). Slopes considered to have the highest risk of slippage are rated ARL 1, while slopes with the lowest perceived risk are rated ARL 5. Generally, the target rating for all slopes in a corridor should be ARL 3, 4 or 5.

There are five slopes with an ARL equal to or less than 3 on the corridor between Clunes and Bangalow (Table 5-25). Higher risk sections have been identified immediately to the north of Binna Burra, midway between Clunes and Binna Burra, and two kilometres south of Binna Burra. Moderate risk slopes have been identified at Binna Burra and immediately to the south of Binna Burra. These areas are prone to land slips in heavy rainfall and the management of these slopes is an ongoing process. As landslips can result in complete closure of the corridor for undisclosed periods of time, the management of drainage systems is imperative in the prevention and management of slope stability issues. Mangement plans for these high ranked slopes will need to be developed and implemented.

Table 5-25 Road slope risk rating

Section	Slopes less or equal to ARL = 3
Lismore	0
Lismore to Clunes	0
Clunes to Bangalow	5
Bangalow	0

Road culvert risk rating

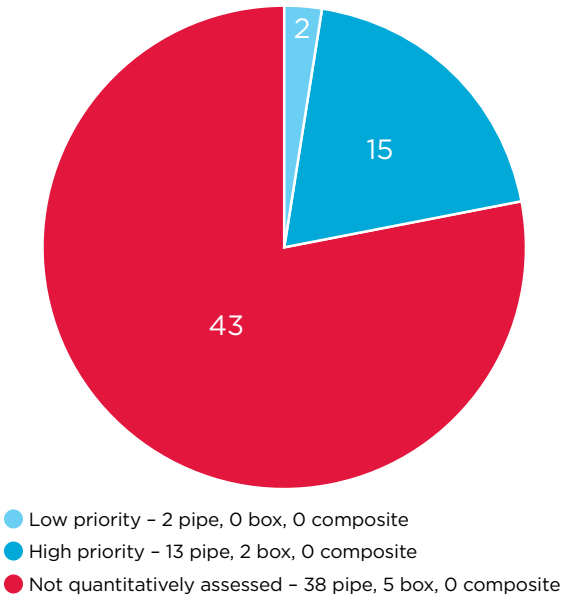
A culvert is one or more adjacent pipes or enclosed channels that allow water to flow under a road. There are 60 culverts along the Lismore to Bangalow corridor; 55 steel reinforced concrete pipe culverts and five concrete box culverts.

A road culvert risk rating is a systematic analysis of the risks associated with culvert condition on the State Road network. This is part of the culvert management framework policy which details the process of monitoring road culverts, including reference to the culvert inventory collection guideline and the culvert risk assessment guideline. If a culvert fails, under extreme conditions, the road surface above the culverts may collapse or be washed away.

All culverts under active management are assessed for risk by calculating the culvert's Assessed Risk Level (ARL). Culverts rated as 'High Risk' are those with a rating ARL 1 or 2. Culverts rated a 'Low Risk' are those with rating ARL 3, 4 or 5.

The overall number of culverts along with their risk levels is provided in Figure 5-25 below.

Figure 5-25 Culvert conditions on the Lismore to Bangalow Road Corridor



Of the 60 culverts along the corridor 17 have been assessed, 15 are considered 'high risk' culverts. Regular risk assessments are carried out on culverts to determine the appropriate ARL rating. A risk assessment has been completed on the 15 high risk culverts and remedial works have commenced on nine culverts recommended for treatment. The remaining high risk culverts along the corridor will continue to be assessed and any necessary work will be carried out in the short term. Monitoring of culvert condition is undertaken on a routine basis.

Bridge structural health

Bridge health is measured using the Roads and Maritime 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 per cent of all bridges across the route should have a BHI rating of 'poor'[39].

There are 13 bridges along the corridor, 8 out of the 13 are controlled by Roads and Maritime. The remaining five are controlled by the State Rail Authority. All bridges along the corridor are assessed every two years, Table 5-26 below shows the bridges controlled by Roads and Maritime and the BHI measure associated with each bridge.

Table 5-26 Bridge structural health

Bridge	Bridge number	Description type	Description at	Condition (Poor/fair/ good/as built)
Lagoon Creek	2280	Bridge	4.62km North Lismore	Fair
Boatharbour Bridge	2279	Widened Bridge	7.43km North Lismore	Good
Browns Creek	2238	Culvert	0.76km North Lismore	Good
0.53k North Lismore	9048	Pedestrian underpass	Trinity Highway School	As-built
Springvale Bridge	2277	Bridge	Springvale Hill	Good
Paddys Creek	2274	Culvert	0.47km South Bangalow	Fair
Maori Creek	2275	Culvert	North Dudgeons Lane	Good
	11215	Cattle underpass	7.9km South Bangalow	As-built

There are no bridges along the Lismore to Bangalow corridor with a 'poor' BHI. There are short term routine and rehabilitation works planned for:

- Paddys Creek
- Springvale Bridge
- Boatharbour Bridge (stage 1)
- Lagoon Creek (stage 1).

There are medium term routine and rehabilitation works planned for:

- Maori Creek
- Boatharbour Bridge (stage 2)
- Lagoon Creek (stage 2).

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

Demolition of the Binna Burra Rail Bridge (2014)

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.

The overhead railway bridge located at Binna Burra was part of the Country Regional Network (CRN), and owned by Transport for NSW. The CRN is operated and maintained under contract by John Holland Rail on behalf of Transport for NSW. The railway bridge at Binna Burra represented a major constraint on the corridor from both road efficiency and safety perspective. The low bridge had a vertical clearance of 4.3 metres which restricted access for over height vehicles, while the road alignment of the overpass approaches present a road safety risk to road users in general.

In 2012, Roads and Maritime conducted a Road Safety Audit and Safety Management Plan for the Binna Burra rail overpass. The studies found the road under the bridge to have poor delineation, low reflectivity and inadequate advance and at-site warning signage. These were considered to be a particular problem during darkness and for high and errant vehicles. The bridge structure itself projects into the clear zone creating an opening considered too narrow for the installation of road side barriers. The bridge piers were of timber construction and there is a history of crashes at the site. The bridge presents not only a constraint to network access, it is also a major safety and asset concern for both Roads and Maritime and Country Regional Network of collapse if impacted by a heavy vehicle.

The bridge formed part of the Casino to Murwillumbah rail line that has had suspended rail services since 2004. Transport for NSW completed in April 2013 the Casino to Murwillumbah Transport Study to determine the feasibility of reopening the line[40]. The report found that the Casino to Murwillumbah line was unlikely to have demand, and due to excessive costs involved with reinstating the line, that rail services remain suspended. The report also cited Binna Burra Bridge as being a safety and asset management risk. Subsequently, the report recommended that a safety assessment should be conducted for the Binna Burra bridge to determine whether it should be removed, maintained or replaced.

A safety assessment of the Binna Burra rail bridge was carried out by John Holland Rail in response to the safety concerns and recommendations of the Casino to Murwillumbah Transport Study. As a result, the Binna Burra rail bridge was found to be at the end of its functional life and was recommended for demolition. This work was completed on the 18 June 2014 during a night closure of the road due to the lack of alternative traffic routes around this location. The timber bridge span was removed back to the abutments, with the concrete trestle supports left in place. This presents an opportunity for investigation into the potential realignment of Lismore to Bangalow Road at this location in order to remove or improve the curves on this section of the corridor which has a poor road safety record.

40 Transport for NSW, 2013, Casino to Murwillumbah Transport Study

Summary of road design and geometry issues

- 38.7 per cent of Lismore to Bangalow Road consists of curves with radii of less than 460 metres.
- Lismore to Bangalow Road has grades of six per cent or more for 11.8 per cent of its length with the highest concentrations occurring within Lismore and between Clunes and Bangalow.
- Overall, there are a significant number of sections along Lismore to Bangalow Road with grades of six per cent or greater; the implications are enhanced when combined with tight curves. The road between Clunes and Bangalow is worst performing with the longest section of steep grades and tight curves.
- A review of lane widths for Lismore to Bangalow Road indicates that they are equal to or greater than 3.5 metres for about 29 per cent of its length, with 32.7 per cent ranging between 3.25 – 3.5 metres. Lane widths between Clunes to Bangalow meet the recommended lane width target for only 17.8 per cent. Generally these sub-standard locations are spread throughout each planning section.
- Only 11 per cent of the Lismore to Bangalow corridor has sealed shoulders at least two metres wide in both directions. The remaining 89 per cent of the corridor has sealed shoulders less than the desired minimum sealed shoulder width. There are approximately six kilometres of the corridor where there are shoulders less than 0.5 metres. These are located south of Binna Burra, north of Clunes and north of Bexhill. There are 8 kilometres where the shoulder widths are between 0.5 metres and 1.0 metre when combined is approximately 42 per cent of the route.
- Significant lengths of the corridor do not meet desired clear zone widths due to dense vegetation adjacent to the road, power poles, and fences lining the road.
- There are numerous intersections with drainage issues, loose gravel (from side streets), poor sight distance, poor pavement condition and inadequate signage. These will be addressed on a priority basis, with intersections that have a significant crash history, posing the greatest risk, and more highly trafficked being addressed first.
- Overall reliability of the Lismore to Bangalow corridor is considered adequate in terms of journey times. However, low flood immunity at a number of key locations on the road reduces this reliability. In particular the frequency and severity of inundation between Lismore and Bexhill can impact on access to services within Lismore.
- There are five slopes with an ARL equal to or less than 3 on the corridor between Clunes and Bangalow. Higher risk sections have been identified immediately to the north of Binna Burra, midway between Clunes and Binna Burra, and 2 kilometres south of Binna Burra. Moderate risk slopes have been identified at Binna Burra and immediately to the south of Binna Burra.
- Of the 60 culverts along the corridor 17 have been assessed, 15 are considered 'high risk' culverts. A risk assessment has been completed on the 15 high risk culverts and remedial works have commenced on nine culverts recommended for treatment. The remaining high risk culverts along the corridor will continue to be assessed and any necessary work will be carried out in the short term.
- The Binna Burra rail bridge was found to be at the end of its functional life and was recommended for demolition. This work was completed on the 18 June 2014.

5.4 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 is strong enough. The pavement material spreads the concentrated tyre load over a wider area and passes the load through to the natural earth. Upon

reaching the earth the load, now over a wider area, is at a lower stress level and is within the strength capabilities of the natural earth material.

Effectively managing the Lismore to Bangalow Road pavement condition for the long term is a key task that involves estimating the pavements remaining service life to ensure appropriate rates of pavement rebuilding.

With an inadequate rate of rebuilding the pavement, the network will deteriorate until eventually the road is compromised. Alternatively, if the pavement rebuilding rate is too high, resources are spent unnecessarily and inefficiently.

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

- Pavement types and seals
- Pavement age
- Road surface cracking
- Roughness
- Road smoothness
- Rutting.

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.

The factors that are considered in selecting pavement type include:

- Anticipated traffic loadings, including likely heavy vehicle use
- Environmental and construction constraints
- Material availability, familiarity with construction processes by the local industry, and cost
- The need to optimise lifecycle costs.

Table 5-27 summarises the pavement types along the Lismore to Bangalow corridor. The majority of the corridor is comprised of flexible pavement with granular seal. Pavement replacement work will need to be prioritised so that the sections in the worst condition are addressed first.

Table 5-27 Pavement types

Corridor planning section	Flexible	Composite			Bridge
	Granular sealed	Granular with asphalt	Bound granular with asphalt	Asphalt over lean mix	
1. Lismore	-	90%	-	-	10%
2. Lismore to Clunes	61%	11%	17%	-	-
3. Clunes to Bangalow	53%	34%	13%	-	-
4. Bangalow	67%	33%	-	-	-
Total (by length)	**97.1%**	**0.1%**	**1.4%**	**0.4%**	**0.2%**

The lower lying areas of the Lismore to Bangalow corridor consist of alluvial soils which have poor subgrade strength. A measure of subgrade strength is a California Bearing Ratio (CBR). A desirable CBR is around 6-10, and in general the lower lying areas on Lismore to Bangalow Road have a CBR of around 2-4. These areas are also prone to poor drainage and, in combination with high traffic volumes of up to 12,000 ADT (2015) in urban areas, require a thicker pavement. On the sections between Clunes and Bangalow, the subgrade consists of stronger materials with a CBR closer to 6. Due to the topography these sites have improved drainage and in combination require less extensive pavements.

Generally, the soils in the area have a high plasticity which causes the pavement to fail if water penetration occurs. Therefore the normal practice with these materials is to modify them by adding imported crushed basalt. Stabilisation through the addition of lime, cement or bitumen is another method used to improve the quality and longevity of the pavement material available in the area. Traditionally, the practice was to use higher percentages of cement to stabilise the material which resulted in a cemented base prone to cracking on the surface. The current practice in the area is reduced cement or use of lime to allow the pavement materials to be less rigid and more flexible.

For future pavement rebuilding works, selection of pavement type will aim to maximise whole-of-life benefits by selecting the most suitable materials, appropriate design thickness and composition of pavement, in order to provide a satisfactory level of service for anticipated traffic. Pavement type selection will vary from section to section along the route depending on a number of factors including current pavement condition, future traffic including heavy vehicles, environmental issues, availability of pavement materials and future maintenance strategy.

Pavement age

Road pavement is designed to provide satisfactory service over a specified period, typically 20 to 30 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 emergency repairs. Eventually the pavement will require full reconstruction to continue to support traffic.

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

Increasing freight traffic, population growth, economic prosperity and environmental sustainability all influence the need for continuing maintenance and rehabilitation of the Lismore to Bangalow corridor.

Table 5-28 summarises the age of pavements along the Lismore to Bangalow corridor. Pavement age on many parts of the Lismore to Bangalow Road corridor, particularly in rural areas, has its design life and the current pavement replacement rate lower than the required replacement rate. Nonetheless, the majority of the pavements are currently displaying ongoing structural serviceability and acceptable roughness.

The areas with the highest proportion of aged pavements exist between Lismore and Clunes where over a third of the pavements are more than 40 years old.

Table 5-28 Pavement age

Highway planning section	Length	< 20 years	20-40 years	> 40 years
1. Lismore	3.04	30%	70%	10%
2. Lismore to Clunes	14.11	33%	28%	39%
3. Clunes to Bangalow	13.34	13%	53%	33%
4. Bangalow	2.7	33%	67%	0%
Total (by length)		**26%**	**47%**	**28%**

* Where 'age' is given as age since pavement was last reconstructed, ignoring resurfacings of the pavement

Road surface cracking

The road surface plays an important role in providing both a safe running surface for traffic and a waterproofing layer to protect the underlying pavement from moisture that can seriously reduce the strength and durability of the road.

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.

The deterioration of a road may be accelerated significantly if the road is badly cracked allowing water ingress. Increased moisture in the pavement and formation leads to loss of strength and a shortened service life.

The extent of cracking indicates the risk of exposure to rapid deterioration of the road pavement due to water ingress. Granular road pavements are more susceptible to rapid deterioration while manufactured materials (asphalt) and heavier duty bound pavements are less susceptible. The typical asphalt pavement is more resilient to prolonged rainfall and cracking poses less of a risk to pavement durability.

As a guide, the network planning targets for class 4R roads indicate that[41]:

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

Figure 5-26 and 5-27 summarises pavement cracking along asphaltic concrete and spray pavement of Lismore to Bangalow Road. Overall the corridor sections with spray seal surfaces exceed the maximum cracking targets, while those with asphalt surfaces perform better.

Although much of the Lismore to Bangalow corridor exceeds the average cracking rates identified within the Network Planning Targets for both (asphalt and spray sealed sections), this does not rank higher than other asset-based distress modes and is therefore not considered a priority issue within the asset program. As indicated above, pavement cracking will continue to be monitored as it can be a precursor to more severe distress.

41 Roads and Maritime Services, *Network Performance Measures*, p. 29

Figure 5-26 Cracking levels on the asphaltic concrete sections of the Lismore to Bangalow Road Corridor

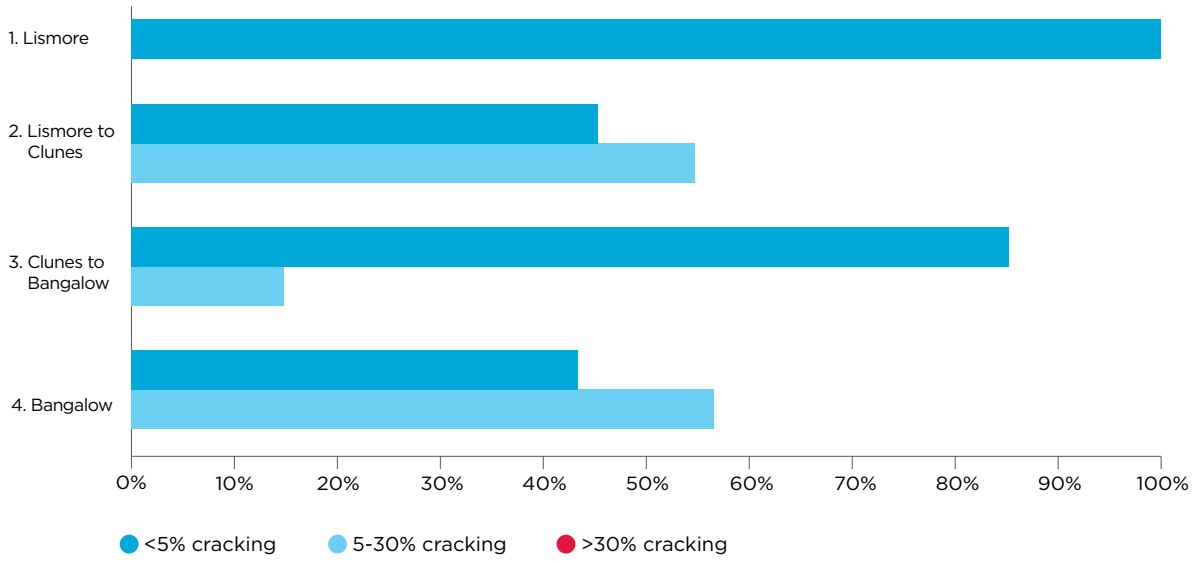
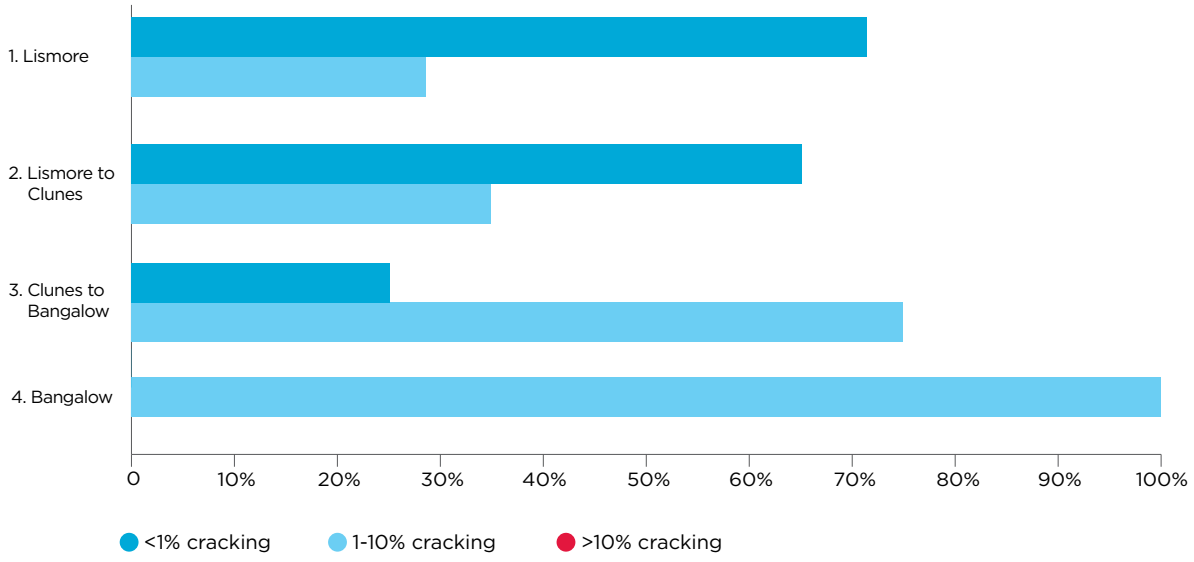


Figure 5-27 Cracking levels on the spray sealed sections of the Lismore to Bangalow Road Corridor



Road smoothness

Road smoothness is a travel weighted roughness measure. The NSW 2021 State Plan sets a target to improve the smoothness of State Roads. The target is 93 per cent of roads with a travel weighted International Roughness Index value of less than 4.2 metres per kilometre.[42] The Smooth Travel Exposure (STE) indicator forms one of a suite of Austroads National Performance Indicators (NPI) and is a travel weighted roughness measure that provides an indication of the proportion of total kilometres travelled on smooth roads.

An International Roughness Index (IRI) value of less than 4.2 metres per kilometre indicates a smooth ride quality. For NSW state roads of class 4R the percentage of the network with a IRI of less than 4.2 metres per kilometre is 76.8 per cent while the corresponding result for Lismore to Bangalow Road is 83 per cent (Table 5-29)

The roughness factor is less significant from a road safety perspective within the urban environment of Lismore than the rural sections of the corridor as speeds are slower.

Table 5-29 International Roughness Index value <4.2 metres per kilometre

	Lismore to Bangalow Road	Other Class 4R roads
Performance – Length of smooth road	83.0 %	76.8%

Overall Lismore to Bangalow Road does not satisfy the NSW 2021 State Plan smoothness target of 93 per cent. The smooth travel over the entire length is 83 per cent, which is marginally higher than the average for similar class 4 roads across the State.

Rutting

Rutting is regarded as a key distress mode and has a strong influence on Roads and Maritime 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. Rutting affects safety as water can pond or in cold areas ice patches can form in the depressions along the wheel paths.

High levels of rutting require investigation to determine 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), this stipulates 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).

Rutting measurements show 53 per cent of the Lismore to Bangalow corridor currently exhibits 'good' to 'slight' rutting, while 46 per cent exhibit rutting deficiencies with 'moderate' to 'extreme' rutting counts. As seen in Table 5-30 nearly half of the Lismore to Clunes section exhibits extreme rutting and 74 per cent of that section has rutting counts arranging from 'moderate' to 'extreme'. The Clunes to Bangalow section exhibits the lowest proportion of deficiencies at 36 per cent of 'moderate' to 'extreme' rutting counts.

Roads and Maritime Northern Region undertakes annual inspections of all roads it has a maintenance responsibility for. If a particular segment appears to have rutting that requires repair then this will be planned into a future program of works. The rehabilitation works will either target heavy patching to repair the rutting or heavy patching as pre works to a full re-seal of the segment.

The large proportion of the route with moderate rutting is a reflection of the long lengths with a natural gravel base layer and a thin bitumen surface, which have inadequate strength to support the increasing heavy vehicle tyre loads. Continuing rehabilitation works will be prioritised so that the sections in the worst condition are generally addressed first.

42 NSW Government 2011, NSW 2021: *A Plan to Make NSW Number One,* **NSW Government, Sydney, p. 38**

Table 5-30 Rutting deficiencies

Highway planning section	Good (<5mm)	Slight (5–10mm)	Moderate (10–20mm)	Extreme (>20mm)
1. Lismore	54%	6%	38%	2%
2. Lismore to Clunes	15%	12%	31%	43%
3. Clunes to Bangalow	23%	41%	13%	23%
4. Bangalow	8%	41%	19%	32%
Total (by length)	**35%**	**18%**	24%	22%

Summary of road pavement issues

- The majority of the corridor is comprised of flexible pavement with granular seal. Pavement replacement work will need to be prioritised so that the sections in the worst condition are addressed first.
- Pavement age on many parts of the Lismore to Bangalow Road corridor, particularly in rural areas, has its design life and the current pavement replacement rate lower than the required replacement rate. Nonetheless, the majority of the pavements are currently displaying ongoing structural serviceability and acceptable roughness. The areas with the highest proportion of aged pavements exist between Lismore and Clunes where over a third of the pavements are more than 40 years old.
- Although much of the Lismore to Bangalow corridor exceeds the average cracking rates identified within the Network Planning Targets for both (asphalt and spray sealed sections), this does not rank higher than other asset-based distress factors and is therefore not considered a priority issue within the asset program. As indicated above, pavement cracking will continue to be monitored as it can be a precursor to more severe distress.
- Overall Lismore to Bangalow Road does not satisfy the NSW State Plan smoothness target of 93 per cent. The smooth travel over the entire length is 83 per cent, which is marginally higher than the average for similar class 4 roads across the State.
- Rutting measurements show 53 per cent of the Lismore to Bangalow corridor currently exhibits 'good' to 'slight' rutting, while 46 per cent exhibit rutting deficiencies with 'moderate' to 'extreme' rutting counts. As seen in Table 5-30 nearly half of the Lismore to Clunes section exhibits extreme rutting and 74 per cent of that section has rutting counts arranging from 'moderate' to 'extreme'. The Clunes to Bangalow section exhibits the lowest proportion of deficiencies at 36 per cent of 'moderate' to 'extreme' rutting counts.
- The large proportion of the route with moderate rutting is a reflection of the long lengths with a natural gravel base layer and a thin bitumen surface, which have inadequate strength to support loads from the increasing number of heavy vehicles. Continuing rehabilitation works will be prioritised so that the sections in the worst condition are generally addressed first.

5.5 Environment

The Lismore to Bangalow corridor passes through ecologically diverse land with a wide range of uses and also a high number of threatened species.

Flora and fauna

There are threatened flora (hairy joint grass, durobby tree) and threatened fauna such as microbats (Myotis macropus), koalas and platypus, key fish habitat (Byron Creek), and heritage dry stone walls in the Stonerydge / Binna Burra area. Any bridge sized culverts and bridges are potential breeding habitat for the microbats. Remnant native vegetation on floodplains is potential habitat for threatened fauna and endangered ecological communities (EEC). Some larger figs in the area may have heritage value under Byron

Shire Local Environmental Plan (LEP). Noxious weeds are also present along the corridor including camphor laurel and lantana.

Details of threatened flora and fauna in close vicinity to the Lismore to Bangalow corridor are shown in Figure 5-28 and Figure 5-29:

- Hairy-joint grass (Arthraxon hispidus) recorded in grazed pasture and the margins of swampy depressions. The NSW Threatened Species Conservation Act 1995 (TSC Act) and the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) listed species.
- Durobby (Syzygium moorei) located within dense vegetation on North South side MR65. TSC Act listed species.
- Arrowhead vine.
- Rough Shelled Bush Nut.
- Vegetation along Byron Creek mapped as high conservation value under council's LEP.
- Large-footed Myotis (Myotis macropus) – known roost (including breeding roost) in culvert under road at Gaybrook Gulley that flows into Byron Creek. TSC Act listed species.
- Grey-headed Flying-fox (Pteropus poliocephaus) – foraging in fig trees. TSC Act & EPBC Act listed species.
- Byron Creek is also considered to be potential habitat for Eastern Freshwater Cod.TSC Act & EPBA Act listed species.
- Potential habitat was also identified for a number of threatened fauna species.

Figure 5-28 Map of threatened species locations for Atlas of NSW Wildlife records – Lismore LGA

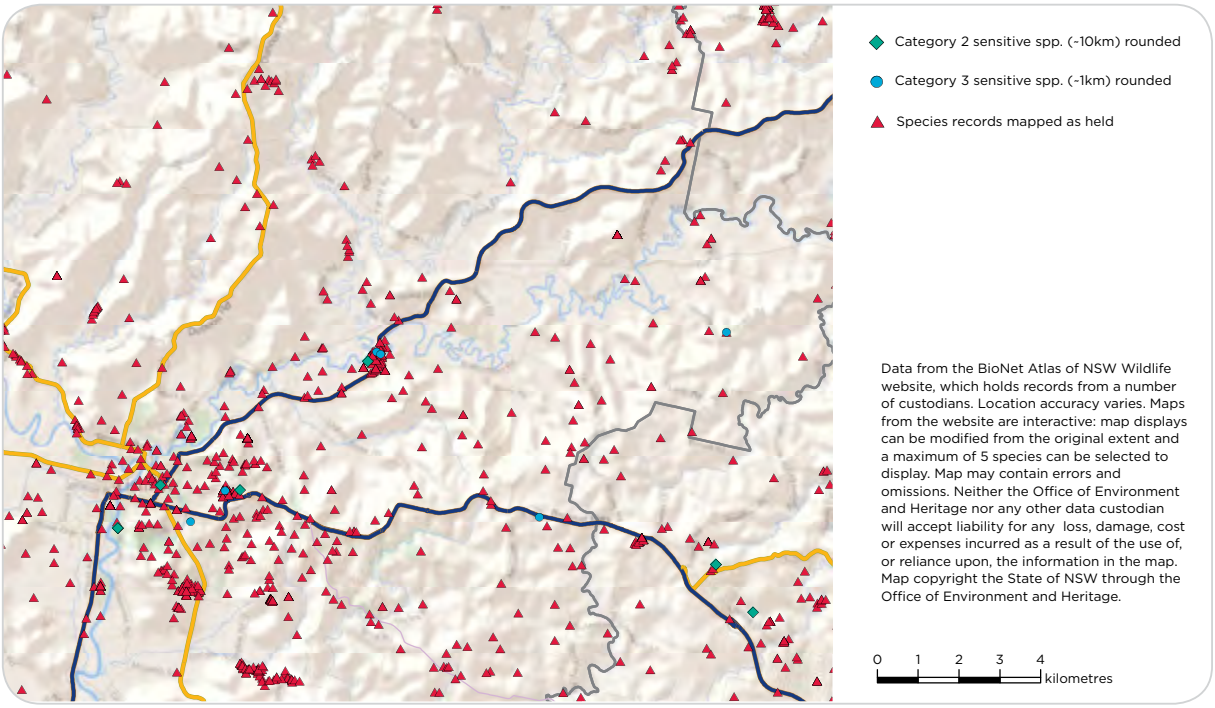
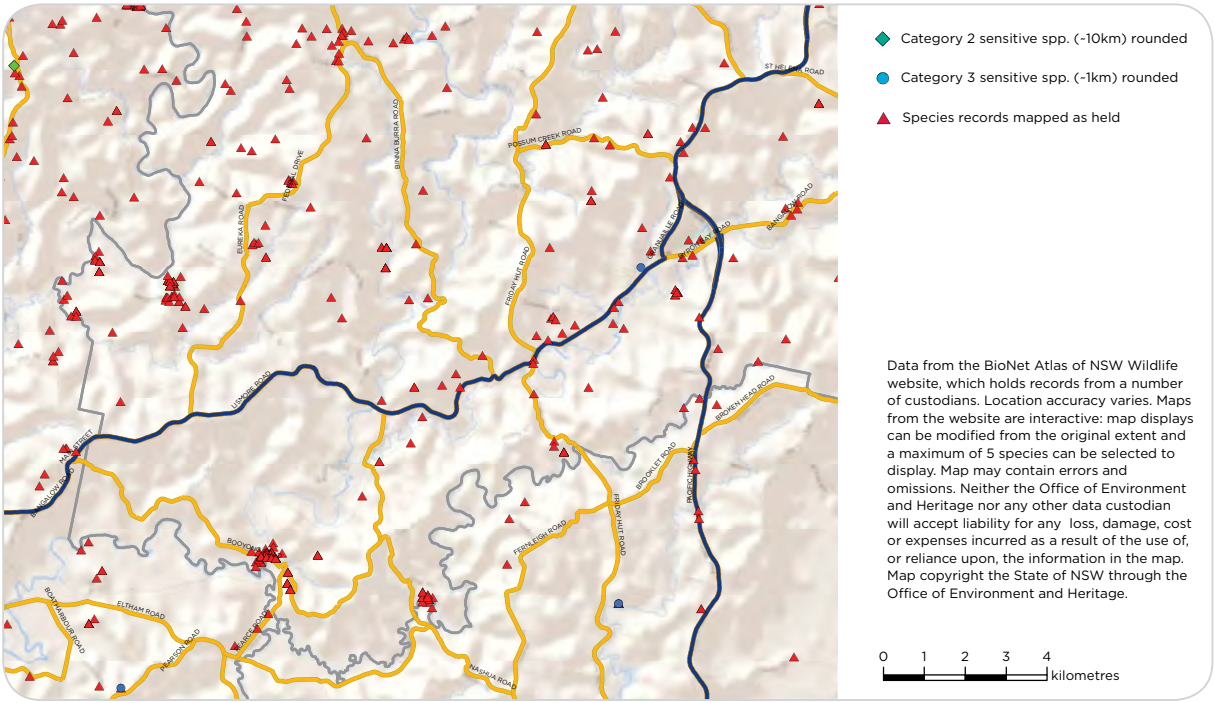


Figure 5-29 Map of threatened species locations for Atlas of NSW Wildlife records – Byron LGA



The Endangered Ecological Communities close to the Lismore to Bangalow corridor are:

- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast Bioregions (FWW)
- Swamp Sclerophyll Forest on Coastal Floodplains on the NSW North Coast Bioregions (SSF)
- Swamp Oak Floodplain Forest of the NSW North Coast Bioregions (SOFF)
- Sub-tropical Eucalypt Forest of the NSW North Coast Bioregion (STEF)
- Lowland Rainforest of the NSW North Coast Bioregion (LRF).

In 2013 Lismore Local Government Area published a Koala Plan of Management for the south-east of the Council area. The koala planning area includes parts of Lismore to Bangalow Road (from the intersection with the Bruxner Highway to where the Wilsons River crosses the road near Richmond Hill Road). The Plan aims to identify preferred koala habitat, to minimise any processes which may threaten koalas and their habitat, to allow for their safe passage and to provide transparent and consistent guidelines for development applications that may impact on the koala planning area.

Heritage

There is a dry stone wall marking property boundaries that runs parallel with the northern side of the Lismore to Bangalow Road south of Binna Burra. This wall falls under serial listing for stone walls in Byron LEP. The Statements of Heritage Impact have assessed this wall as possessing local cultural heritage significance.

An Aboriginal Heritage Information Management System (AHIMS) search of the area was conducted and revealed several sites of significance in the local area although there are none that impact directly on Lismore to Bangalow Road.

6 FUTURE CORRIDOR CHANGES

Heading north, bottom of Springvale Hill, Eureka

6.1 Population and demographics

Population forecasts

Across regional NSW, a range of changes will influence travel demands over the next two decades. In general, the annual average growth of the regional NSW population was 0.4 per cent per year from 2006 to 2011. This is expected to remain at an average 0.5 per cent per annum growth through to 2031[43]. Regional populations will continue to get older, with 27 per cent of the population expected to be over 65 years in 2031[44].

The NSW Department of Planning and Environment prepared population projections and growth rates for regional NSW in the *NSW Long Term Transport Master Plan*. These projections show regional NSW is likely to experience uneven population growth from 2011 to 2031. Some regions are expected to grow strongly, while other regions will experience a reduction in population.

The Lismore to Bangalow route is a significant link between Lismore, Bangalow and further north to Byron Bay. The total population of Lismore LGA is 44,350 while Byron LGA is 30,700 (2011). Lismore is projected to grow to 50,200 (13.2 per cent total increase), while Byron is projected to grow to 36,200 (17.9 per cent total increase) by 2031 as shown in Table 6-1[45].

Table 6-1 Population LGA and urban centre demographics

LGA	2011 LGA population	Localities	2011 localities population	Forecast 2031 population	% Change
Lismore	44,350	Lismore Bexhill Clunes	27,474 485 599	50,200	13.2%
Byron	30,700	Binna Burra Bangalow	188 1,520	36,200	17.9%
Total	**75,050**		**30,266**	**86,400**	
NSW Total	**7,211,500**			**9,193,900**	**27.8%**

The Far North Coast Regional Strategy 2006–31[46] sets out overall parameters for the future development of the Far North Coast region (Note: The North Coast Regional Growth and Infrastructure Plan is currently being developed by the Department of Planning and Environment and will replace the North Coast Regional Strategy 2006–31). The NSW Department of Planning and Environment's 2014 population projections[47] forecast that the total population of the Far North Coast region (Ballina, Byron, Kyogle, Lismore, Richmond Valley and Tweed Local Government Areas) will increase by 38,820 from 238,511 in 2011 to more than 277,331 by 2031, an increase of 14 per cent over the period[48].

The main growth areas are expected to be Tweed Shire, Byron Shire and Lismore City Local Government Areas. Most of the nominal population growth within the Lismore to Bangalow corridor is expected to occur within Lismore.

Land use changes

The NSW Department of Planning and Environment (DP&E) is currently reviewing the existing NSW Regional Strategies to prepare new Regional Growth and Infrastructure Plans for the Regional Areas within NSW to reflect the NSW Government's new integrated planning approach that incorporates land use planning, infrastructure planning and transport planning.

43 **Department of Planning and Environment, 2014,** *New South Wales in the future: 2014 population projections.* **Sydney, p. 3-4.**

44 **Ibid, p. 27.**

45 **Department of Planning and Environment, 2014,** *New South Wales State and Local Government Area Population Projections: 2013 preliminary revision* **planning.nsw.gov.au/population-and-housing-projections**

46 **NSW Department of Planning, 2006,** *Far North Coast Regional Strategy*

47 **Department of Planning and Environment – 2014** *New South Wales population projections data***. Sydney.**

48 **Ibid. p 48-63.**

The Far North Coast Regional Strategy 2006–31 developed in 2006 by the NSW Department of Planning, is among these strategies being reviewed and updated.

There is expected to be a greater demand for diversity in housing as household sizes decrease due to ageing populations and smaller family sizes. A high proportion of the additional dwellings forecast to be required in the Far North Coast region by 2031 will be one or two bedroom homes, many in higher density developments. The current Far North Coast Regional Strategy indicates that 35 per cent of future housing will be located in the regional centres of Tweed Heads, Ballina and Lismore[49]. These changes in the types of residential developments may change transport demand along the Lismore to Bangalow corridor because:

- Smaller dwellings typically generate fewer daily trips than large family homes
- Only one or two inhabitants per dwelling, many of them retirees
- Fewer vehicle trips are likely to be generated compared to developments on the fringes of the corridor's towns
- Higher density developments generally generate greater demands for public transport, cycling and walking
- There are safety issues for more frail older drivers and less mobile pedestrians.

The key drivers of growth in the Far North Coast include:

- In-migration from the Sydney Greater Metropolitan Region and other areas of NSW
- Population flow from South East Queensland
- Greater accessibility due to the upgraded Pacific Highway.

The proposed residential land release areas over the next 25 years in the Lismore to Bangalow corridor are shown in Figures 6-1 and 6-2.

North of Woodlark Street, Lismore

49 NSW Department of Planning, 2006, *Far North Coast Regional Strategy,* **Sydney**

Figure 6-1 Proposed residential land release areas over the next 25 years in Lismore

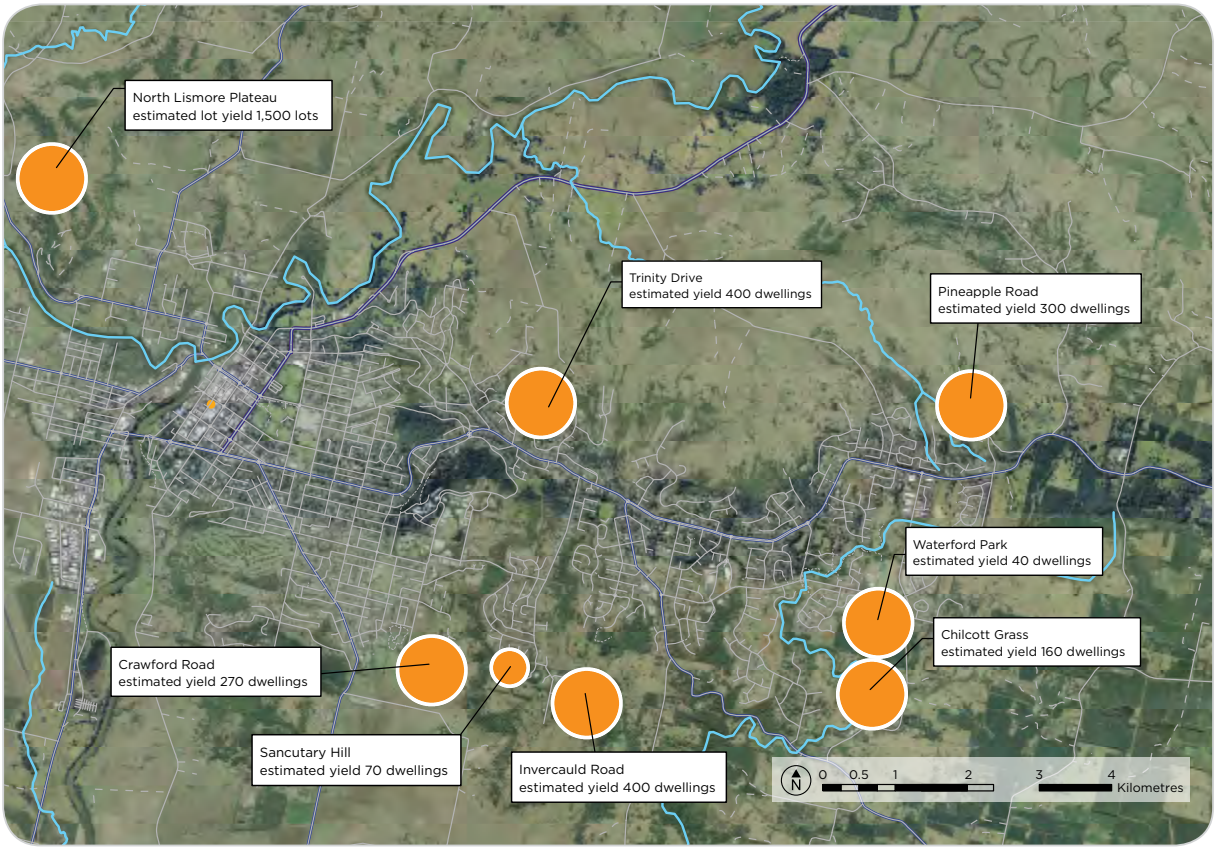
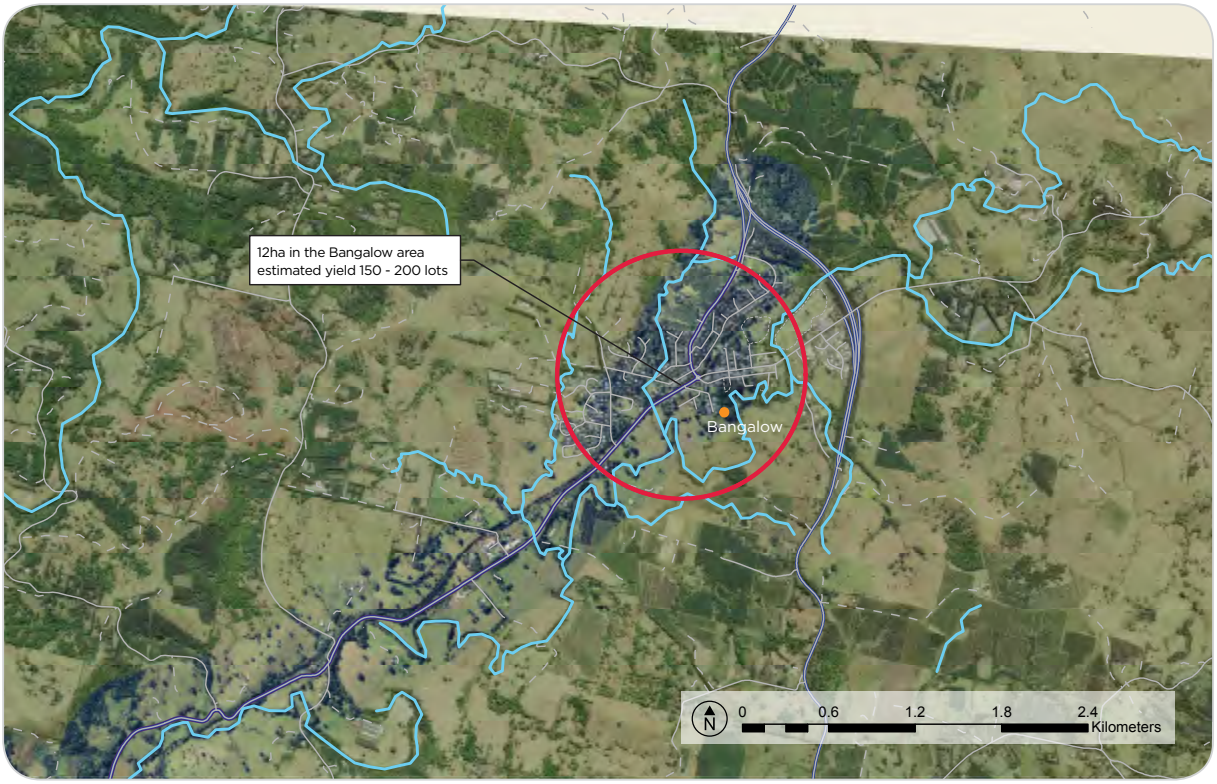


Figure 6-2 Proposed residential land release areas over the next 25 years in Byron



Lismore development

Lismore City Council's *Strategic Road Review 2013*[50], identify areas of potential future residential development within Lismore. The sites which are likely to have the largest impact on the corridor include those areas north of Lismore known as the Northern Ridges. The plan indicates that development in these areas could provide an additional 350 residential lots and 300 rural residential lots (Trinity Drive and Pineapple Road), plus a further 100 hectares of residential land in the long term.

These figures are in addition to the development occurring along the Bruxner Highway to the east and to north of Lismore. An extension to Pineapple Road, to link Lismore to Bangalow Road with the Bruxner Corridor, is proposed by Lismore Council to access new land release areas, potentially directing more local traffic onto the southern end of Lismore to Bangalow Road which could in turn lead to increased traffic congestion on the approach to Lismore.

Byron Shire development

Byron Council's *Bangalow Settlement Strategy 2003*[51] outlines the development of Bangalow over the 20 year period to 2023. Demand for land within Bangalow has increased since 1996 due to the comparative scarcity of land in nearby Byron Bay and due to the strategic location of Bangalow through its proximity to Lismore, Ballina and Byron Bay. Residential growth is, however, restricted due to local residents' desire to maintain the village atmosphere and the amount of regionally significant farmland.

The strategy identified three new residential release areas within Bangalow adjacent to Lismore to Bangalow Road.

All three areas are likely to generate traffic impacts on the Lismore to Bangalow corridor. The first identified area within Bangalow is at Corlis Crescent where up to 16 lots have the potential to be developed. Secondly, around 45 lots have been earmarked for urban development potential at Thomas Street. Thirdly, around 10 to 15 lots may be developed at Parrot Tree Place. In total, including two potential low-priority long-term residential landreleases, Bangalow is planned to have the capacity to increase from 1308 residents (2011 census figures) to around 2,100 by 2023.

In 2015 these three land releases had reached the following:

- Corlis Crescent – 2 lots
- Parrot Tree Place – 25 lots
- Thomas Street – 16 lots.

The latest zoned residential release areas equate to about 12ha in total and will potentially yield between 150-200 lots, this covers the whole Bangalow area.

Influences of growth in South East Queensland

The Northern Rivers region of NSW is increasingly influenced by South East Queensland, and especially by its very rapid population growth, as economic and social linkages between NSW and Queensland grow. The Northern Rivers region economy is closely linked with South East Queensland's, with many northern NSW residents relying on South East Queensland for employment and services and many Queensland residents using the Northern Rivers for recreation and short holidays. Intensifying land demands in the South East Queensland area may also see people moving to the Northern Rivers for lifestyle, affordability and business opportunities.

The Queensland Government's *South East Queensland Regional Plan 2005-2026* predicts that South East Queensland's overall population will grow by about 50,000 residents per year and, more specifically, that the Gold Coast region's population will increase from 475,500 people in 2004 to about 719,000 people by 2026, a rise of more than 50 per cent. Robina and Southport are identified as the Gold Coast's 'principal activity centres', with key employment concentrations and regionally significant health, education, cultural and entertainment facilities.

50 Lismore City Council 2013, Strategic Road Review 2013, Lismore City Council, Lismore

51 Byron Shire Council 2003, Bangalow Settlement Strategy 2003, byron.nsw.gov.au/files/publications/Bangalow_Settlement_Strategy_2003.pdf

The *South East Queensland Regional Plan* acknowledges the importance of northern NSW to the Gold Coast region. Improved transport access to Queensland, such as the Tugun Bypass, has made facilities in the South East Queensland region more accessible, and increasing development within the region will generate increased demands for freight transport, with a forecast doubling of freight movements into South East Queensland by 2020. Much of this freight will travel into the region through northern NSW, placing pressure on NSW transport infrastructure.

Although the strong growth within Queensland will have major impacts on the NSW Northern Rivers region as a whole, the direct impacts in the Lismore to Bangalow corridor will probably be significantly less, and largely confined to tourism related travel. The majority of the pressure will be on the Pacific Highway; it is the major route for leisure, commuter and freight travel between Sydney and Brisbane and is progressively being upgraded to dual carriageway.

Demographic changes and trends

Population growth in Regional NSW will be accompanied by a significant change in demographic structure. The number of people 65 and over will increase from 18 per cent of the regional population in 2011 to 27 per cent of the population in 2031[52]. The Lismore to Bangalow corridor is already experiencing this demographic trend. The number of young people and people of working age living in the corridor has increased only slightly, compared with the number of older residents. During the period 2006 to 2011[53], the number of people of working age (15-64 years) in the corridor increased only slightly by 3.1 per cent. For the same period the number of older residents in the corridor increased more significantly. For example, the number of residents in the corridor aged between 55 and 64 increased by 18 per cent and the number of residents aged over 85 increased by 14 per cent from 2006 to 2011.

In Lismore LGA the number of people aged 65 and above is predicted to increase by 86 per cent between 2011 and 2031. Similarly to the period between 2006 and 2011, the number of young people and people of working age living in the corridor is predicted to decrease between 2011 and 2031 by 3.8 per cent[54].

Table 6-2 Demographic changes along the corridor

Lismore	Number of people		Age distribution (% of total population)		Growth 2011-31	
Age	2011	2031	2011	2031	No.	%
<15	8,700	8,950	19.7%	17.8%	250	2.9%
15-64	29,250	29,500	66.1%	58.8%	250	0.9%
65+	6,300	11,750	14.2%	23.4%	5,450	86.5%

As the population ages, demand for public and community transport connections between towns and larger regional centres will grow. High concentrations of older drivers can also present road safety challenges, particularly around high speed intersections.

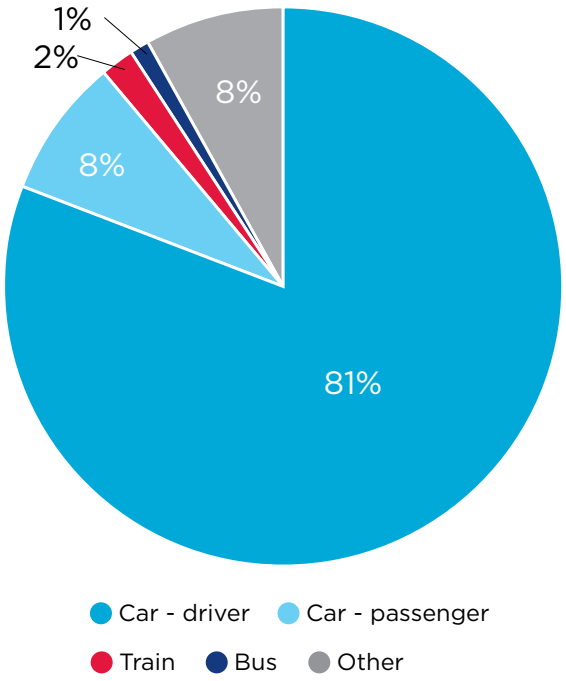
Every day, people in regional NSW make around 7.5 million trips. Most journeys to work are made by car and this trend is likely to continue into the future. As illustrated in Figure 6-3, journey to work trips by train or bus account for only three per cent of regional travel.

52 Ibid. p. 27.

53 Department of Planning and Infrastructure – 2008 *New South Wales population projections data*. Sydney.

54 Department of Planning and Infrastructure, 2013 *New South Wales in the future: Preliminary 2013 population projections.* Sydney, p. 56.

Figure 6-3 Journey to work trips in regional NSW in 2006[55]



In regional areas, levels of car ownership are very high and motor vehicles are the main way people choose to move around. For example around 36.5 per cent of households in the Lismore LGA own two motor vehicles; a higher rate than the NSW State average of 34 per cent[56]. This reflects the general trend in regional NSW with a heavy reliance on car travel and will remain a very important mode of transport.

6.2 Traffic growth

Traffic growth can be forecast by considering historical average annual daily traffic (AADT) data. However consideration should also be given to significant changes in regulation or land use or industry that may change the forecast growth rate.

Roads and Maritime has been collecting traffic data on the Lismore to Bangalow Road Corridor since 1967, during this time there has been growth and development within the urban centres of Lismore and Bangalow, coastal areas of Byron Bay and improvements to the Pacific Highway and Bruxner Highway. As Lismore becomes more accessible from an increasing number of areas and the development along Lismore to Bangalow Road continues this has potential to increase traffic volumes in the future. A linear calculation was use based on historical traffic data to calculate traffic growth it is forecasted that the urban area of Lismore will have a growth rate ranging between 1.3 per cent and 3 per cent. The 3 per cent takes into consideration possible future land development in the areas. The rural areas between Lismore and Bangalow are forecasted to have a traffic growth between 1.6 – 1.7 per cent. These forecast future traffic volumes and levels of service in the "do nothing" scenario are shown in Table 6-3 and Table 6-4.

Table 6-3 Forecast traffic volumes – Lismore to Bangalow Road

Corridor planning sections	Site	Description	2015 ADT	2025 ADT	2035 ADT	% Traffic growth
1	1	90m North of Conway Street in Lismore	12366	17,800-21,368	19,994-28,717	1.3-3
2	4	650m South of Eltham Road at Bexhill North	7782	10,332	11,933	1.7
3	6	1.75km North of Booyong Road near Binna Burra	6892	9,398	10,783	1.6
4	8	710m North of Bangalow roundabout	8382	10,696	11,901	1.2

55 **TfNSW,** *Long Term Transport Master Plan*, **p. 216**

56 **ABS,** *2011 Census Data* **censusdata.abs.gov.au/census_services/getproduct/census/2011/quickstat/LGA14850 viewed 22/07/13**

Table 6-4 Lismore to Bangalow Road future corridor performance

Corridor section	% time spent following			Average speed (km/h)			Level of service		
	AM peak hour	PM peak hour	Day time	AM peak hour	PM peak hour	Day time	AM peak hour	PM peak hour	Day time
Section 2 – Lismore to Clunes	85.1	80.5	72.0	59.6	63.2	66.4	E	D	D
Section 3 – Clunes to Bangalow	76.8	74.6	65.0	60.2	61.3	64.0	D	D	C

Future corridor performance was calculated using rural road modeling software. Comparing the current and future analysis, the level of service along a route will deteriorate as traffic volumes increase. Road and Maritime has a target of maintaining level of service along rural corridors. The per cent time spent following deteriorates for both sections of the corridor. The worst section is between Lismore and Clunes where the deterioration in the per cent time spent following lowers the Level of Service in the AM from a D to E and during the day from a C to a D. In the short term, with two additional overtaking lanes (one in each direction) the Level of Service in the AM will maintain a Level of Service D.

The existing demands on the intersections analysed in chapter 4.2 were projected forward for 10 years to produce a future demands model for both AM and PM peak. The analysis showed that Zadoc Street, Magellan Street and Granuaille Street continue to perform in good operation but Ballina Street and Woodlark Street performance drops to satisfactory.

6.3 Future public transport and active transport

In regional NSW, the provision of good public transport services requires careful planning to account for long travel distances and dispersed demand. The Lismore to Bangalow corridor is part of the *Northern Rivers Regional Transport Plan*. *Regional Transport Plans* will be integrated with land use planning and other NSW Government initiatives, such as Regional Action Plans and Department of Planning & Environment regional land use strategies. This will ensure transport services and infrastructure are provided in a timely way, particularly in regions and centres with strong growth.

The *Northern Rivers Regional Transport Plan* identifies specific challenges to region's transport network and prioritises actions to address these challenges. The broad actions are under three themes: better transport services, ensuring effective regulation and improving transport infrastructure. The plan provides a detailed assessment of local transport needs and priorities and responds to issues raised during the regional consultation that took place in the development of the *Long Term Transport Master Plan*.

The *Northern Rivers Regional Transport Plan* identifies actions to improve regional bus services, NSW TrainLink and coach services, and improve public transport interchanges throughout the region, by developing a future NSW TrainLink servicing plan for the region, introducing a more robust contractual framework and working with operators to improve routes and timetables including the realignment of rail and coach timetables, investing in fleet improvements, and continuing work to investigate a future rail corridor to the Gold Coast via Tweed Heads.

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 that connect residents with different land uses in an integrated and accessible fashion is a key part of achieving this objective.

Transport for NSW is also preparing a *NSW Long Term Plan for Regional Rail* that will include regional rail and connecting road coaches. The NSW Trains Strategy will enhance rail passenger services through timetable, fleet and targeted track improvements. The strategy will also address issues in relation to more convenient timetables, slow travel speeds and service frequency and devise solutions for a modernised regional rail service.

Casino-Murwillumbah rail line

The NSW Government has completed the Casino to Murwillumbah Transport Study in 2013[57]. The study investigated the strategic needs and benefits of public transport within the Northern Rivers, with a particular focus on the Casino to Murwillumbah rail line corridor. Considerations included the current condition of the rail line and the feasibility of reinstating services relative to other transport modes that could meet the current and future needs of the corridor region. The Transport Study included an investigation of the feasibility, benefits and costs of reinstating services on the Casino-Murwillumbah Rail Line. The line was suspended in 2004 due to the high cost of ongoing maintenance.

The transport study found that the rail line would not meet current or future transport needs and there were no significant opportunities with freight or tourism that could improve its viability. It determined that the rail infrastructure has deteriorated significantly, and more than $900 million would be needed to carry out all the work required to ensure the system fully complied with current safety and operating standards for frequent and reliable train services.

The study recommends investigating improving bus services to provide more people with frequent, cost-effective public transport to key destinations, rather than reinstating the rail line. The study also recommended that a safety assessment be conducted on three bridges over public roads that have been identified as a potential safety hazard. As a result of the safety assessment the bridge at Binna Burra over the Lismore to Bangalow Road was removed in 2014. The study informed the development of the *Northern Rivers Regional Transport Plan,* which guides the provision of public transport services to meet transport needs.

Rail trail

The *Regional Transport Plan* for the Northern Rivers supported the investigation into the feasibility of a walking and cycling trail along the disused sections of the Casino-Murwillumbah rail line to the north-south of Byron Bay. The investigation conducted by ARUP Pty Ltd on behalf of the Department of Premier and Cabinet in May 2014 is subject to community and business interest in advancing the proposal[58].

In other States, this type of unused rail corridor has been utilised for recreational purposes such as cycling, walking and horse riding. These activities can provide many benefits to the surrounding communities by generating tourism and encouraging physical activity and active transport use. Rail trails are becoming extremely popular and are an excellent use of rail corridors for low impact, environmentally-friendly tourism mainly involving cycling and walking. The study details the findings relating to each term of reference below and is expected to form the basis of determining the case for conversion of the Casino to Murwillumbah Rail Line into a rail trail in the near future:

- Assess the potential economic benefits of developing a rail trail on the Casino to Murwillumbah rail line, including its potential to enhance the regional tourism industry and generate employment and business.
- Assess the environmental and social benefits and impacts of a rail trail on the Casino to Murwillumbah rail line.
- Assess the cost of developing a rail trail on the entire Casino to Murwillumbah rail line, as well as developing the project in stages. For example from Byron Bay to Bangalow initially. This should include information on existing bridges and other alternatives for crossing creeks and gullies etc.
- Identify and outline potential funding sources for the initial development and long term maintenance of a rail trail on the Casino to Murwillumbah rail line.

57 Transport for NSW, 2013, *Casino to Murwillumbah Transport Study*

58 Department of Premier and Cabinet 2014, *Casino to Murwillumbah Rail Trail Study: Final Report,* **Department of Premier and Cabinet, Sydney**

- Consult with stakeholders about the development of a rail trail, including local governments in the Northern Rivers, the regional tourism organisation, community groups and tourism operators about the potential benefits, limitations and impacts of a rail trail.
- Take into account information from previous reports and studies (including the Casino to Murwillumbah Transport Study), to determine technical and other important issues relevant to the development of a rail trail on the Casino to Murwillumbah rail line.
- Ensure that the rail corridor is preserved for the re-introduction of rail services, should a viable economic model become available.
- Take into account the impact of a rail trail on the ability of private operators to run a light rail service in the Byron Bay area.
- Outline options for the consideration of the current legislative requirements for dealing with rail infrastructure on the Casino to Murwillumbah rail line.

The study identifies the potential that the proposed rail trail has to provide benefits to the local community and to recreational/visiting cyclists to support tourism development, and in turn, generate economic benefit for the region. It is also noted that the provision and use of additional cycle routes in the region will provide benefits in terms of sustainability. These benefits would come about through the following aspects:

- Community and Social
- Health and Fitness
- Environmental
- Economic.

The economic analysis presented in the study indicates that the cost of implementing the rail trail is influenced largely by the current condition of the rail assets and the safety requirements. The preliminary capital cost for the development of the rail trail is estimated at $75.5 million. The rail trail is expected to break even assuming visitors of around 35,000 per annum.

The study also covers the challenges and constraints that need to be considered, the implementation of the rail trail, the construction and maintenance, funding and the governance of the rail trail. It indicates that through consultation with communities and government authorities there is support for the use of the corridor as a rail trail, and that this support has been critical to the successful development of rail trails elsewhere.

The study demonstrates that the rail trail, subject to funding, will provide potentially strong benefits for the community and that it is likely to be a viable project.

6.4 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.

The NSW Office of Environment and Heritage (OEH) is developing 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 will include the Northern Rivers Region and Lismore to Bangalow corridor.

The North Coast is facing a reduction in winter rainfall and a decrease in soil moisture during winter and spring. Sea levels are predicted to rise which will change flood patterns and affect the coast. Minimum temperatures across all seasons are projected to be warmer, with winter maximum temperatures rising more than summer maximum temperatures.[59]

It is likely an increase in the frequency and intensity of storms would lead to more frequent short and long term closures to the corridor. Climatic conditions will continue to be monitored for potential road impacts.

59 Department of Environment and Climate Change NSW environment.nsw.gov.au/resources/climatechange/08501NorthCoast.pdf viewed 22/07/2013

6.5 Road corridor changes

Tintenbar to Ewingsdale Pacific Highway upgrade

The Tintenbar to Ewingsdale section of the Pacific Highway upgrade is approximately 17 kilometres in length starting at the northern end of the Ballina bypass at Ross Lane and extending to the Ewingsdale interchange. The project was approved for construction in January 2010. The Tintenbar to Ewingsdale project is anticipated to be opened to traffic in the second half of 2015 (weather permitting) and will complete the Pacific Highway upgrade between Ballina and the Queensland border.

As a result of the Tintenbar to Ewingsdale Pacific Highway upgrade, Lismore to Bangalow Road will be extended to the north by approximately four kilometres along the existing (Old) Pacific Highway between Bangalow North and Ewingsdale. The extended corridor will connect with the upgraded Ewingsdale interchange (Figure 6-4).

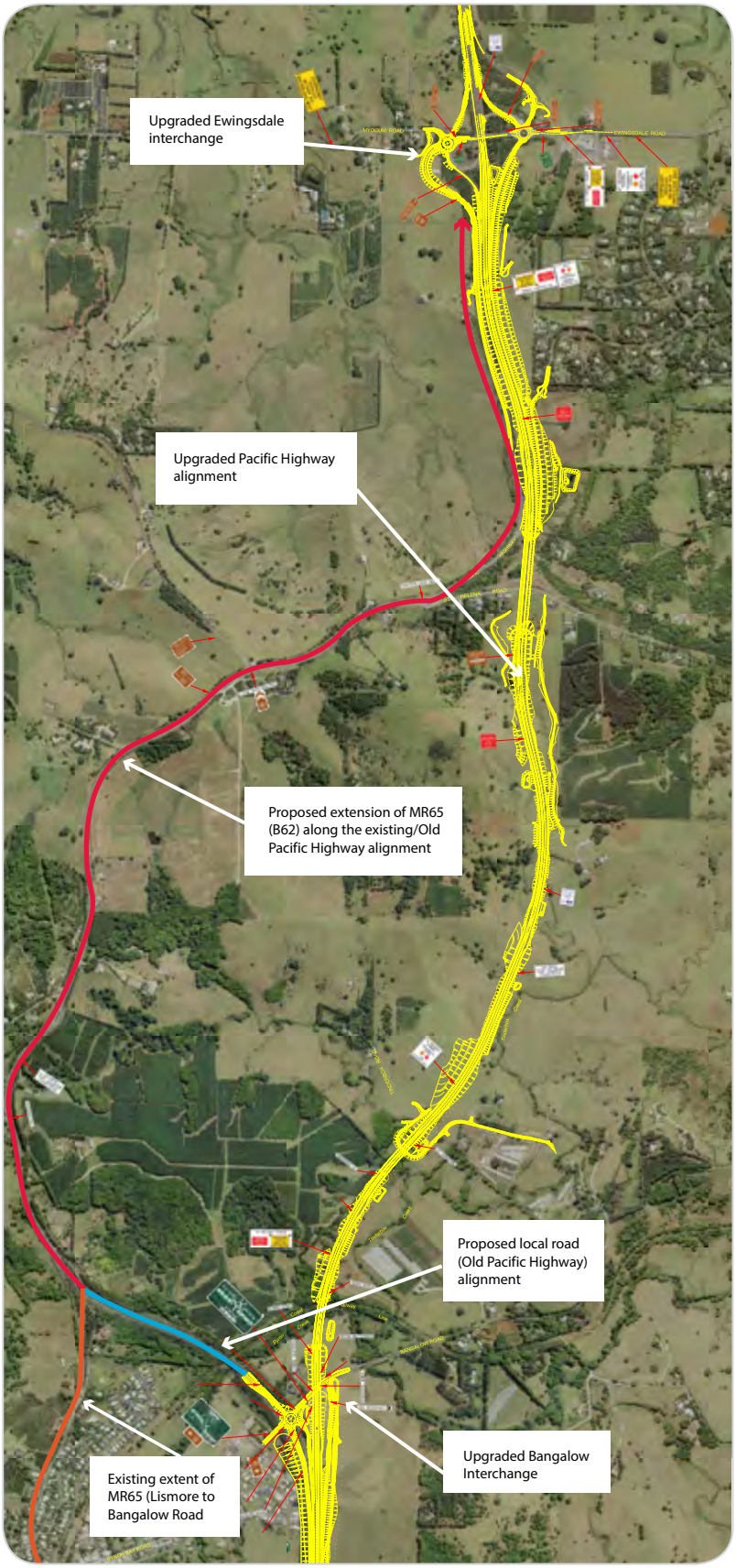
This section of the current highway is generally of a higher standard than the remaining Lismore to Bangalow corridor and is likely to present challenges different to those experienced by the majority of the corridor. The safety and access issues surrounding Coolamon Scenic Drive are likely to lessen due to a significant decrease in through traffic. Commuter and tourist traffic volumes on this section will still be moderate and safety improvements (particularly intersection related) will remain a priority.

Given the topography, however it is considered that the maintenance of the pavement and access for adjoining properties are likely to be the most significant issues arising from this section.

It is anticipated that the existing (Old) Pacific Highway between the current Bangalow north interchange (Granuaille Road) and the new Bangalow interchange would be reclassified as a State Road (MR65 Lismore to Bangalow Road) following the completion of the upgrade. The remainder of the (Old) Pacific Highway south of Bangalow would be available as a local/tourist road (The Hinterland Way).

Binna Burra rail bridge prior to demolition in 2014

Figure 6-4 Pacific Highway upgrade – Tintenbar to Ewingsdale (Bangalow to Ewingsdale section)



7 CORRIDOR CHALLENGES AND PRIORITIES

Dawson Street and Uralba Street, Lismore

Corridor challenges are the main issues that need to be overcome to maintain or improve transport roles and services that the Lismore to Bangalow Road provides for the community. They include challenges already evident and others that are expected to emerge as the result of future changes in land use and demographics. These challenges have been mapped below in Table 7-1, Table 7-2 and Table 7-3 against broader *NSW Long Term Transport Master Plan* objectives.

NSW Government priorities for responding to the Lismore to Bangalow Road corridor challenges are also 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.

Implementing these actions will improve road safety, whole-of-life economic benefits and traffic efficiency.

The strategy identifies infrastructure (engineered) and operational (non-engineered) initiatives to improve road user safety, reduce travel times and increase reliability along the Lismore to Bangalow Road corridor.

A number of improvement projects identified during the study can be considered as routine maintenance activities such as pavement repairs and line marking for which an annual budget allocation and program is already in place. This section focuses on addressing concerns specific to the Lismore to Bangalow Road corridor.

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 Lismore to Bangalow Road corridor are being considered.

The Strategy will be targeted for review every five years. Implementation of the final strategy will be a shared responsibility with NSW Government and Councils in collaboration with other state agencies.

7.1 Key challenges and short-term priorities (0-5 years)

LTTMP objectives linkage	Specific challenges	Specific actions	Strategic response reference
Improve liveability Reduce social disadvantage	Inadequate road alignment and narrow shoulders to accommodate active transport users along the corridor	Support opportunities for a cycleway to promote recreational travel needs of cyclists between Lismore and the Byron Bay coast. This may include a rail trail.	4.4 Public transport, walking and cycling in the corridor Cycling and Walking
Safety and security	Increasing number of vulnerable road users, including the elderly, pedestrians and cyclists	Improve and prioritise cyclist connectivity within Lismore city centre including the below. • Safe crossing sites across Dawson Street to support pedestrian desire lines, particularly north of Woodlark Street. • Connectivity between Lismore Base Hospital Precinct, Lismore Shopping Square, Lismore Park and the CBD. • At Woodlark Street and Magellan Street.	4.4 Public transport, walking and cycling in the corridor Cycling and Walking

LTTMP objectives linkage	Specific challenges	Specific actions	Strategic response reference
Economic growth/ productivity	Constraints around intersection capacity within Lismore in peak traffic	Work with Lismore City Council to develop a strategic traffic model focusing on the Bruxner Highway and Lismore to Bangalow Road through Lismore to determine whole of network approaches to addressing traffic movements and congestion within Lismore CBD	5.2 Traffic Traffic Volumes
Economic growth/ productivity	Limited overtaking opportunities north of Lismore	Develop and implement two overtaking opportunities along the corridor considering sites such as; • Northbound overtaking lane north of Clunes • Southbound overtaking lane south of Clunes	5.2 Traffic Level of Service and Overtaking Opportunities
Economic growth/ productivity	Poor pavement condition due to low subgrade strength, particularly in lower lying areas of the corridor between Lismore and Clunes	Continue to assess whole of life costs for pavement maintenance to ensure value for money and identify opportunities to strengthen pavement and carry out pavement repair work along the corridor on a priority basis.	5.4 Road pavement condition
Safety and security	Management of surface friction where wet weather crashes and speed related crashes occur on curves, in particular between Clunes and Bangalow	Continue to implement the annual skid resistance monitoring process to ensure appropriate skid resistance for Lismore to Bangalow Road	1.1 Road Safety Surface friction and skid resistance
Economic growth/ productivity	• Road alignment at Binna Burra where the railway bridge existed restricts safe and efficient movement for general access vehicles • Realignment opportunities within the existing corridor that have minimal impact on adjacent landowners	Minor road realignments including but not limited to: • Binna Burra • Springvale Hill	5.3 Road design and geometry Horizontal curves Speed on curves

LTTMP objectives linkage	Specific challenges	Specific actions	Strategic response reference
Regional development/ accessibility	High risk slopes prone to land slips in heavy rainfall	Continue to assess slope stability and develop and implement management plans for slopes considered to be at high risk. These may include: • North of Booyong Road. • Springvale Road	5.3 Road design and geometry Road slope risk rating
Regional development/ accessibility	High risk culvert prone to flooding in heavy rainfall	Continue to develop and implement management plans for culverts with an assessed risk level (ARL) rating less than three for high priority culverts • Booyong Road • Robar Stud • South of Stewarts Road • Kirklands Road • Hill Top • Rail underpass • Friday Hut Road • Burradale	5.3 Road design and geometry Road culvert risk rating
Safety and security	Dense vegetation and topographical constraints limiting ability to achieve required clear zones across the corridor	Implement clear zone and safety barrier improvements, taking into consideration the road geometry and environmental/ land use constraints along the corridor. • Binna Burra to Bangalow • Clunes to Binna Burra • Bexhill to Clunes • Approaching Bexhill northbound • North of Lismore • Southbound toward Bexhill	5.3 Road design and geometry Clear zones and safety barriers
Safety and security	The reduction of safety risks associated with lengths of narrow lanes and shoulder width, poor clear zones and tight curves	Continue to develop road safety improvements to address existing and emerging crash cluster locations. Including but not limited to: • Eureka Road to Kirkland Lane • Springvale Road to Taylors Road • James Gibson Driver to Eureka Road	5.1 Road Safety

LTTMP objectives linkage	Specific challenges	Specific actions	Strategic response reference
Safety and security	The reduction of safety risks associated with lengths of narrow lanes and shoulder width, poor clear zones and tight curves	Complete a speed zone review of the Clunes to Bangalow section and further investigate the high incidence of speed related and off curve crashes in this section.	5.1 Road Safety
Safety and security	The reduction of safety risks associated with lengths of narrow lanes and shoulder width, poor clear zones and tight curves	Develop and implement road safety initiatives, informed by the recommendations of the speed zone review.	5.1 Road Safety
Economic growth/ productivity Safety and security	Constraints around intersection capacity within Lismore in peak traffic The prevalence of intersection crashes within Lismore	Develop options to improve traffic efficiency, road safety and design standard at various intersections including but not limited to: • Ballina Road and Dawson Street, Lismore • Woodlark Street and Dawson Street, Lismore • Magellan Street and Dawson Street, Lismore • Carolina Street and Bangalow Road, Lismore • Stewarts Road and Bangalow Road, Clunes	5.1 Road Safety 5.2 Traffic
Safety and security	The reduction of safety risks associated with lengths of narrow lanes and shoulder width, poor clear zones and tight curves	Improve the formation width by widening sealed shoulders and improve lane width on a priority basis including: • Booyong Road to Burradale • Clunes to Springvale Hill • Wilson Creek to Eltham Road • Hindmarsh St to Lagoon Grass West • Dudgeons Lane to the Pacific Highway	5.3 Road design and geometry Sealed Shoulder Lane widths
Safety and security	Narrow bridges along the corridor (Lagoon Creek, Springvale Bridge over Wilsons Creek, Maori Creek and Paddys Creek)	Complete an audit on the safety and standard of the four narrow bridges and investigate options to improve safety on a priority basis	5.3 Road design and geometry Lane widths

LTTMP objectives linkage	Specific challenges	Specific actions	Strategic response reference
Improve transport integration process	Different location and regional transport needs within the urban centres and villages along the corridor	Continue to support the needs of public transport users through appropriate facilities and infrastructure along the corridor	4.4 Public transport and active transport in the corridor
Improve liveability Reduce social disadvantage	Conflicting local and through traffic needs within the villages of Bexhill, Clunes, Binna Burra and Bangalow	Continue to maintain the local amenity of Bexhill, Clunes, Binna Burra and Bangalow	5.2 Traffic Regional centres and town bypasses
Improve sustainability	• Management of threatened flora and fauna, local cultural heritage and significant Aboriginal sites in the vicinity of the road corridor. • Balancing the need to protect high value conservation environments with improvements along the corridor. • Impacts on micro bats that reside in culverts along the corridor when carrying out improvements to carriageway widths	Continue to minimise and balance any impacts to the natural and build environment when carrying out work along the Lismore to Bangalow Road corridor	5.4 Environment

7.2 Key challenges and medium-term priorities (5-10 years)

LTTMP objectives linkage	Specific challenges	Specific actions	Strategic response reference
Safety and security	Increasing number of vulnerable road users, including the elderly, pedestrians and cyclists	Continue to improve cyclist connectivity within Lismore town centre (ongoing)	4.4 Public transport, walking and cycling in the corridor Cycling and Walking
Regional development/ accessibility	Low flood immunity resulting in road closures for more than 24 hours, particularly around the Wilson's River at Lismore and Byron Creek near Binna Burra	Identify cost effective solutions to improve flood immunity along the corridor	5.3 Road design and geometry Flooding

LTTMP objectives linkage	Specific challenges	Specific actions	Strategic response reference
Economic growth/ productivity	Poor pavement condition due to low subgrade strength, particularly in lower lying areas of the corridor between Lismore and Clunes	Continue to monitor pavement condition in regards to road smoothness, rutting and cracking	5.4 Pavement condition
Regional development/ accessibility	High risk culvert prone to flooding in heavy rainfall	Continue to develop and implement management plans for culverts with an assessed risk level (ARL) rating less than three for medium priority culverts	5.3 Road design and geometry Road culvert risk rating
Regional development/ accessibility	High risk slopes prone to land slips in heavy rainfall	Continue to assess slope stability and develop and implement management plans for slopes considered to be at medium risk	5.3 Road design and geometry Road slope risk rating
Safety and security	The reduction of safety risks associated with lengths of narrow lanes and shoulder width, poor clear zones and tight curves	Progressively address sections with poor alignment, narrow lanes and shoulder widths on a priority basis, particularly south of Clunes	5.3 Road design and geometry
Safety and security	Dense vegetation and topographical constraints limiting ability to achieve required clear zones across the corridor	Continue to implement clear zone and safety barrier improvements, taking into consideration the road geometry and environmental/ land use constraints along the corridor	5.3 Road design and geometry Clear zones and safety barriers
Safety and security	The prevalence of intersection crashes within Lismore	Implement safety and design standard improvements at intersections	5.1 Road Safety
Safety and security	Narrow bridges along the corridor (Lagoon Creek, Springvale Bridge over Wilsons Creek, Maori Creek and Paddys Creek)	Implement improvement works for high risk narrow bridges along the corridor on a priority basis	5.3 Road design and geometry Lane widths
Safety and security	The reduction of safety risks associated with lengths of narrow lanes and shoulder width, poor clear zones and tight curves	Continue to develop road safety improvements to address existing and emerging crash cluster locations	5.1 Road Safety

LTTMP objectives linkage	Specific challenges	Specific actions	Strategic response reference
Improve transport integration process	Different location and regional transport needs within the urban centres and villages along the corridor	Continue to support the needs of public transport users through appropriate facilities and infrastructure along the corridor in particular by improving regional bus travel	4.4 Public transport and active transport in the corridor
Improve liveability Reduce social disadvantage	Conflicting local and through traffic needs within the villages of Bexhill, Clunes, Binna Burra and Bangalow	Continue to maintain the local amenity of Bexhill, Clunes, Binna Burra and Bangalow	4.2 Current population and employment in the corridor
Improve sustainability	• Management of threatened flora and fauna, local cultural heritage and significant Aboriginal sites in the vicinity of the road corridor • Balancing the need to protect high value conservation environments with improvements along the corridor • Impacts on micro bats that reside in culverts along the corridor when carrying out improvements to carriageway widths	Continue to minimise and balance any impacts to the natural and build environment when carrying out work along the Lismore to Bangalow Road corridor	5.4 Environment
Economic growth/ productivity	Limited overtaking opportunities north of Lismore	Continue to monitor the level of service and investigate the need for additional overtaking lanes	5.2 Traffic
Economic growth/ productivity	Constraints around intersection capacity within Lismore in peak traffic	Develop and implement traffic efficiency initiatives, informed by the Lismore traffic study	5.2 Traffic

7.3 Key challenges and long-term priorities (10-20 years)

LTTMP objectives linkage	Specific challenges	Specific actions	Strategic response reference
Safety and security	Increasing number of vulnerable road users, including the elderly, pedestrians and cyclists	Continue to improve cyclist connectivity within Lismore town centre (ongoing)	4.4 Public transport, walking and cycling in the corridor Cycling and Walking
Regional development/ accessibility	Low flood immunity resulting in road closures for more than 24 hours, particularly around the Wilson's River at Lismore and Byron Creek near Binna Burra	Implement cost effective solutions identified to improve flood immunity	5.3 Road design and geometry Flooding
Regional development/ accessibility	High risk culvert prone to flooding in heavy rainfall	Continue to develop and implement management plans for culverts with an assessed risk level (ARL) rating less than three for low priority culverts	5.3 Road design and geometry Road culvert risk rating
Regional development/ accessibility	High risk slopes prone to land slips in heavy rainfall	Continue to assess slope stability and develop and implement management plans for slopes considered to be at high risk	5.3 Road design and geometry Road slope risk rating
Safety and security	Dense vegetation and topographical constraints limiting ability to achieve required clear zones across the corridor	Continue to implement clear zone and safety barrier improvements, taking into consideration the road geometry and environmental/ land use constraints along the corridor	5.3 Road design and geometry Clear zones and safety barriers
Safety and security	The prevalence of intersection crashes within Lismore	Continue to implement safety and design standard improvements at intersections on rural sections of the corridor	5.1 Road Safety
Safety and security	Narrow bridges along the corridor (Lagoon Creek, Springvale Bridge over Wilsons Creek, Maori Creek and Paddys Creek)	Continue to implement improvement works for high risk narrow bridges along the corridor on a priority basis	5.3 Road design and geometry Lane widths
Economic growth/ productivity	Constraints around intersection capacity within Lismore in peak traffic	Increase lane capacity between Ballina Street and Woodlark Street, Lismore	5.2 Traffic

LTTMP objectives linkage	Specific challenges	Specific actions	Strategic response reference
Improve transport integration process	Different location and regional transport needs within the urban centres and villages along the corridor	Continue to support the needs of public transport users through appropriate facilities and infrastructure along the corridor	4.4 Public transport and active transport in the corridor
Improve liveability Reduce social disadvantage	Conflicting local and through traffic needs within the villages of Bexhill, Clunes, Binna Burra and Bangalow	Continue to maintain the local amenity of Bexhill, Clunes, Binna Burra and Bangalow	4.2 Current population and employment in the corridor
Improve sustainability	• Management of threatened flora and fauna, local cultural heritage and significant Aboriginal sites in the vicinity of the road corridor • Balancing the need to protect high value conservation environments with improvements along the corridor • Impacts on micro bats that reside in culverts along the corridor when carrying out improvements to carriageway widths	Continue to minimise and balance any impacts to the natural and build environment when carrying out work along the Lismore to Bangalow Road corridor	5.4 Environment

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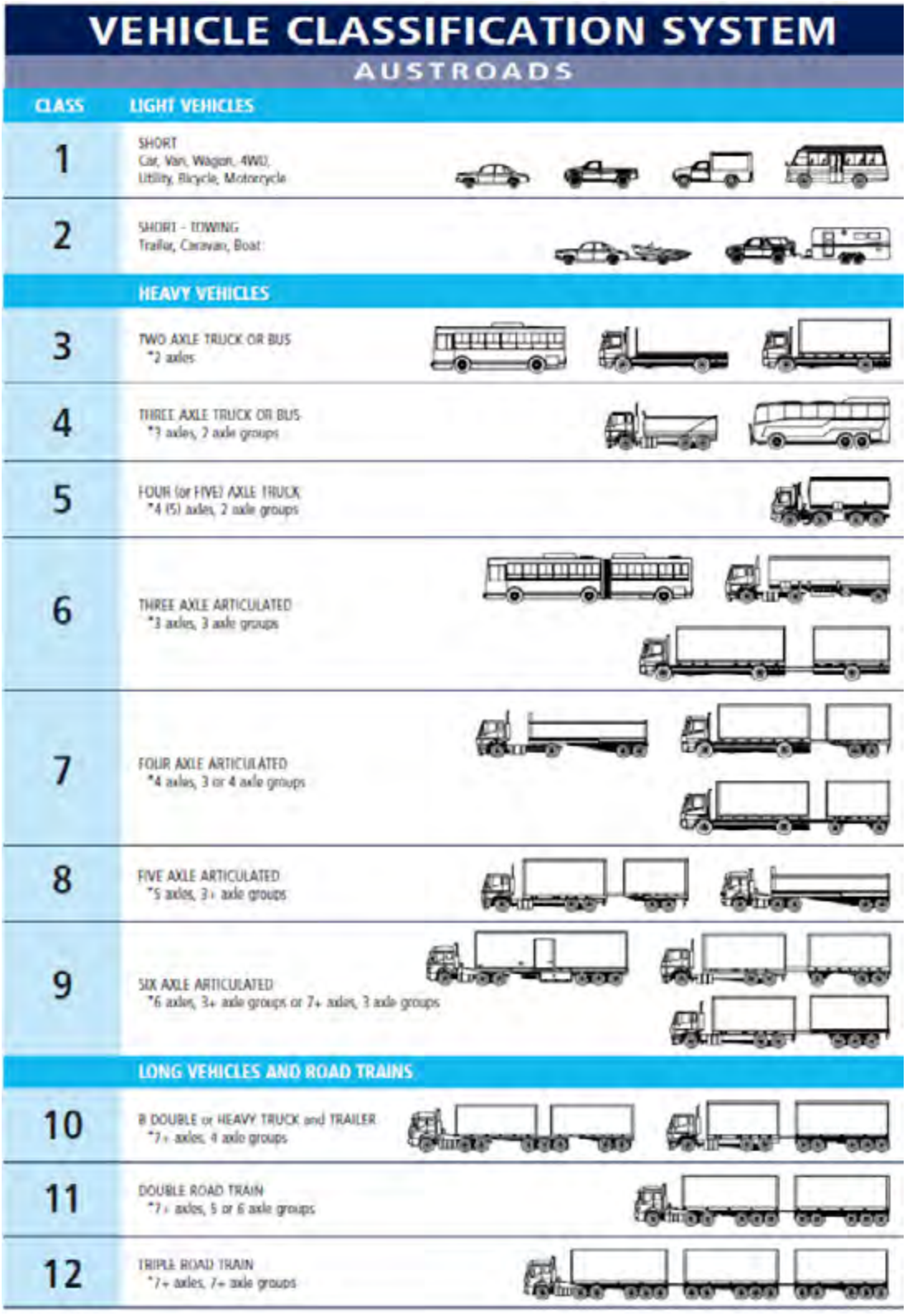
APPENDIX

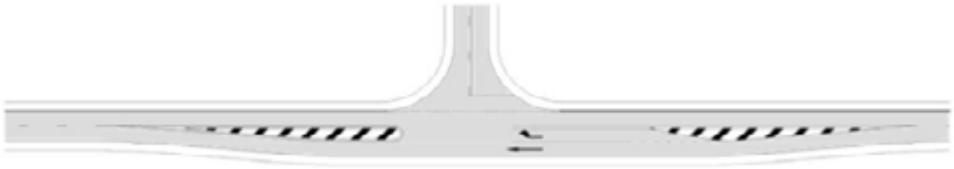
Appendix A – Austroads vehicle classification system



Appendix B – Glossary

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 purpose supplementary to through traffic movement.
AUL	Auxiliary intersection treatment left  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 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.
Bunching	A closely spaced group of vehicles on a carriageway, moving or stopped and ready to move, with relatively large spaces ahead and behind.
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.
Casualty crash	A crash in which at least one person was injured or killed.

Appendix B – Glossary cont'd

Term	Definition
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 Right Turn (CHL) on the Minor Road.
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.
Fatal crash	A crash in which at least one person was killed.
Fifth wheel coupling	See coupling.
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, limits being 2.5m wide, 4.3 metres high, 12.5m long for rigid vehicles and 19m long for single combinations and conforming axle groups.
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 **ntc.gov.au.**
Injury crash	A crash in which at least one person was injured but no person was killed.
IRI	International Roughness Index. Roughness measures the undulations in the road and provides an indication of ride comfort.

Term	Definition
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.
Pier	An intermediate support in a bridge having more than one span.
Road smoothness	A travel weighted measure of the smoothness of the road surface using IRI data.
Roadloc chainage	The name given to the Linear Referencing System used by Roads and Maritime Services in identifying locations along a road.
Roughness	The level of irregularity 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 outside of 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.
Tow away crash	A crash in which at least one vehicle was towed away but no person was injured or killed.
TRARR	Traffic on Rural Roads is a micro-simulation model of traffic flow on two-lane roads used to investigate the need for overtaking lanes.

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