

NSW Roads and Maritime
Nowra Bridge Project
Traffic and Transport Assessment

Final Report | August 2018

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 242129

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Executive Summary

Overview

Roads and Maritime Services (Roads and Maritime) proposes to construct a new bridge on the A1 Princes Highway over the Shoalhaven River at Nowra (the proposal). The Princes Highway currently crosses the Shoalhaven River with two independent bridges; an iron truss bridge constructed in the 1880s for southbound traffic and a concrete box girder bridge constructed in the 1980s for northbound traffic. The proposed bridge would replace the existing southbound bridge which currently has increasing maintenance difficulties, capacity issues with high volumes of traffic during peak periods and limitations for heavy vehicles due to overhead clearance allowance.

The new bridge would provide four lanes for northbound traffic. The existing northbound bridge will be reconfigured to carry three lanes of southbound traffic. The proposal also includes intersection upgrades at Bolong Road, Illaroo Road, Bridge Road and Pleasant Way. The existing southbound bridge would be retained and used for active transport (pedestrians and cycleway).

This traffic and transport report has been prepared to support the review of environmental factors (REF).

Strategic context

The Nowra Bridge is an important link for the Princes Highway. The Princes Highway is a classified State Highway (A1) and is the primary coastal route between Sydney and Melbourne. The crossing over the Shoalhaven River is also an important connection between the retail and commercial core of Nowra and the area north of the river including Bomaderry and North Nowra.

All public transport bus routes that service the area use the bridge as it connects Nowra town centre to other regional centres.

Existing bridge operation

There are currently two bridges across the Shoalhaven River which carry vehicular and pedestrian traffic, these being:

- Existing southbound bridge which carries two lanes of vehicle traffic, with a shared pedestrian/cycle path on the eastern side of the bridge
- Existing northbound bridge which carries three lanes of vehicle traffic, with a shared pedestrian/cycle path on the western side of the bridge.

Currently, the existing southbound and northbound bridges each carry about 26,000 vehicles per day, which increases during summer and school holiday periods. During the daily peak hours between 8.00 am-9.00 am and 3.30 pm-4.30 pm, the existing southbound and northbound bridges carry a combined traffic load of about 5000 vehicles.

There are several vehicle restrictions for heavy vehicles using the existing southbound bridge. Heavy vehicles with a height clearance between 4.3 m and 4.6 m are required to use the middle of the bridge to clear the truss structure.

Heavy vehicles with a clearance height of greater than 4.6 m and higher mass limit (HML) vehicles are not permitted on the existing southbound bridge, with a police escort across the northbound bridge or a detour via the Hume Highway, Federal Highway and Kings Highway required.

Traffic and transport benefits of the proposal

In the Do minimum scenario, the configuration of the existing road network would remain unchanged, including the existing two lane southbound bridge. Although traffic demands would continue to grow as development occurs in the region, there would be no additional road capacity and traffic congestion would increase significantly compared to current conditions.

The proposal would provide significant improvements to traffic capacity on both the Princes Highway and local roads. The proposal would improve performance at all intersections controlled by traffic lights from the projected level of service (LoS) F (under the Do minimum scenario) to LoS C or better up to the forecast year 2046.

The proposal would have benefits to the heavy vehicle network as restrictions would be removed. The existing southbound bridge is proposed to be adapted for use by pedestrians and cyclists: this would be a physically separated path significantly improving the active transport environment. The preferred design would reduce congestion along the Princes Highway and local road network, improve intersection performance, reduce travel times and improve journey reliability.

Construction traffic impacts and mitigation measures

The construction traffic assessment indicates that daily traffic movements would increase during the construction period. However, these increases would be small and would not have a material effect on the performance of local and regional roads.

The construction contractor would be responsible for consulting with Roads and Maritime and other key stakeholders including Shoalhaven City Council to ensure road closures and disruptions are managed safely and efficiently.

Public parking would be maintained where practicable; however, due to the requirement for construction compounds and work areas, up to 300 existing public car parking areas would be temporarily impacted at different stages and locations during the construction period. Roads and Maritime would continue to liaise with Council to mitigate impacts.

A Traffic Management Plan (TMP) would be prepared and implemented for traffic associated with the construction phase, and which would consider measures to reduce the impacts associated with the construction work. This would include measures to maintain access to affected properties, local roads and waterways, as well as ensure suitable access for pedestrians and cyclists is provided during the construction work.

Contents

	Page
Executive Summary	2
1 Introduction	6
1.1 Proposal identification	6
1.2 Purpose of the report	11
1.3 Structure of the report	11
1.4 Study approach	11
2 Existing environment	13
2.1 Road network	13
2.2 Road hierarchy and descriptions	13
2.3 Speed limits	16
2.4 Heavy vehicles	17
2.5 Traffic data	20
2.6 Crash data	24
2.7 Transport mode share	26
2.8 Public transport	26
2.9 Active transport	29
2.10 Maritime environment	30
2.11 Existing land uses	32
2.12 Parking	34
3 Existing road network performance	35
3.1 Traffic model development	35
3.2 Existing road network performance	39
4 Future traffic environment	41
4.1 Future traffic growth	41
4.2 Future traffic movements	43
5 Assessment of operational traffic impacts	47
5.1 Traffic modelling	47
5.2 Do minimum	48
5.3 The proposal	49
5.4 Intersection layout	51
5.5 Traffic performance of proposal	53
5.6 Heavy vehicles	61
5.7 Active transport	61
5.8 Public transport	61
5.9 Maritime environment	62
5.10 Parking	62

5.11	Impacts on road safety	63
6	Assessment of construction impacts	64
6.1	Construction impact summary	64
6.2	Construction staging	64
6.3	Ancillary sites	65
6.4	Construction traffic	66
6.5	Construction impacts	67
7	Management and mitigation measures	72
7.1	Construction	72
7.2	Operation	73
8	References	74

Tables

Table 1	Secondary proposal objectives	9
Table 2	Intersections in the study area.....	15
Table 3	Heavy vehicle volumes	17
Table 4	Existing traffic volumes	20
Table 5	Summary of crashes by type and severity	25
Table 6	Mode share from JTW data	26
Table 7	Rail and bus services between Bomaderry Station and Kiama Station.....	26
Table 8	Summary of bus services.....	27
Table 9	Existing car parking within the study area	34
Table 10	Model calibration results	36
Table 11	Level of service description.....	39
Table 12	Existing intersection operation.....	40
Table 13	Summary of forecast growth rates.....	43
Table 14	Intersection performance: Princes Highway / Bolong Road.....	54
Table 15	Intersection performance: Princes Highway / Illaroo Road	55
Table 16	Intersection performance: Princes Highway / Bridge Road	56
Table 17	Network wide performance: AM Peak hour	57
Table 18	Network wide performance: PM Peak hour	57
Table 19	Intersection performance: Princes Highway / Moss Street.....	60
Table 20	Intersections through which buses pass through	62
Table 21	Ancillary facilities.....	65
Table 22	Estimated construction vehicle movements.....	67
Table 23	Construction traffic movements on surrounding roads	68

Figures

Figure 1	Proposal location and study area	10
Figure 2	Posted speed limits within the study area.....	16
Figure 3	Approved 25 metre and 26 metre B-double routes.....	18
Figure 4	Higher mass vehicle (HML) network in the study area	19
Figure 5	Approved routes for 4.6 metre high vehicles.....	19
Figure 6	Average daily traffic volumes (2016) – Princes Highway at Shoalhaven River Bridge.....	21
Figure 7	Average daily traffic profile (2016) – Princes Highway at Shoalhaven River Bridge.....	22
Figure 8	2014 AM peak hour traffic flows.....	23
Figure 9	2014 PM peak hour traffic flows.....	23
Figure 10	Crash locations by injury severity within study area between 2012-2016.....	24
Figure 11	Bus network through the study area.....	28
Figure 12	Pedestrian and cycle network in the study area.....	29
Figure 13	Maritime environment on the Shoalhaven River at Nowra Bridge	31
Figure 14	Land zoning from Shoalhaven Local Environmental Plan 2014.....	33
Figure 15	AM peak hour queue validation.....	37
Figure 16	PM peak hour queue validation	38
Figure 17	Historical traffic growth on the Princes Highway	41
Figure 18	2026 forecast AM peak hour traffic flows	44
Figure 19	2026 forecast PM peak hour traffic flows.....	44
Figure 20	2036 forecast AM peak hour traffic flows	45
Figure 21	2036 forecast PM peak hour traffic flows.....	45
Figure 22	2046 forecast AM peak hour traffic flows	46
Figure 23	2046 forecast PM peak hour traffic flows.....	46
Figure 24	Traffic modelling methodology	47
Figure 25	Key features of the proposal.....	50
Figure 26	Unreleased vehicles at end of simulation	58
Figure 27	AM peak hour average travel time	59
Figure 28	PM peak hour average travel time.....	59

Glossary of Terms

Term	Definition
ADT	Average Daily Traffic; a measure of total volume of traffic along a section of highway/road for a specified period, divided by the number of days in the period.
AADT	Annual Average Daily Traffic; a measure of the total annual volume of traffic along a section of highway/road divided by 365.
AM	Morning peak hour
B-Double	A large heavy vehicle comprising a prime mover towing two semi-trailers
DOS	Degree of saturation; a measure of the level of demand (use) an intersection or section of road is experiencing compared to its total capacity (the maximum volume of traffic it is designed to accommodate). A DOS of 1.0 indicates that an intersection / roadway is operating at capacity.
Do minimum	Represents existing road network conditions
HML vehicle	Higher Mass Limits vehicle; refers to specific types of heavy vehicles. In NSW the vehicle types eligible to operate at HML are short combinations (standard six axle semi-trailer), B-doubles, Type 1 A-double road trains including modern road trains, B-triples, AB-triples, Modular B-triples, and vehicles operating under Performance Based Standards (PBS) schemes, including quad axle combinations.
HV	Heavy Vehicle(s)
km/h	Kilometres per hour
LGA	Local Government Area
LoS	Level of service; a measure of effectiveness used to determine the operational conditions and efficiency of a roadway or intersection. The definition of LoS generally describes the operating conditions in terms of delays experienced by vehicles. There are six Levels of Service, A to F, with LoS A representing optimum operating conditions (free flow) and LoS F the poorest conditions (forced or breakdown in flow).
LV	Light Vehicle(s)
Max Queue (m)	The length of the maximum queue of vehicles (measured in metres) waiting at an intersection
NB	Northbound
NSW	New South Wales
Paramics	Integrated transport modelling software
PM	Afternoon peak hour
Proposal	Nowra Bridge project
Roads and Maritime	NSW Roads and Maritime Services
RUM	Road User Movement
SIDRA	Traffic Intersection Analysis software
SB	Southbound

Term	Definition
TCS	Traffic Control Signals
TMP	Traffic Management Plan
Veh	Vehicle
Veh/h	Vehicles per hour
VHT	Vehicle Hours Travelled; a measure of the total travel time for all vehicles in the network being modelled/investigated
VKT	Vehicle Kilometres Travelled; a measure of the total number of vehicles in the network being modelled/investigated and the collective distance travelled
WB	Westbound

1 Introduction

1.1 Proposal identification

Roads and Maritime Services (Roads and Maritime) proposes to construct a new bridge on the A1 Princes Highway over the Shoalhaven River at Nowra (the proposal).

This would include the construction of a new four lane bridge to the west (upstream) of the existing bridge crossings. The proposal would also include the upgrade of the Princes Highway in the vicinity of the bridge, as well as key intersection upgrades and modifications to the local road network. The proposal would improve access to Nowra and the surrounding areas, improve southbound access for larger vehicles and reduce traffic delays.

The proposal would include the upgrade of about 1.6 kilometres of the Princes Highway from about 150 metres north of the Bolong Road intersection to about 75 metres north of the Moss Street intersection. The new bridge over the Shoalhaven River would be about 360 metres long and would accommodate four lanes of northbound traffic and a shared path for cyclists and pedestrians.

1.1.1 Proposal location and setting

The proposal is located at the Princes Highway in Nowra, NSW within the Shoalhaven Local Government Area (LGA), about 120 kilometres south of Sydney and 30 kilometres south-west of Kiama (refer Figure 1).

On the northern side of the Shoalhaven River are the suburbs of North Nowra and Bomaderry. The land to the north of the river is primarily residential, with a golf course to the west and a restaurant and agricultural land to the east. Bomaderry Creek drains in a northwest to southeast direction, crossing under the Princes Highway between the Bolong Road and Illaroo Road intersections before joining the Shoalhaven River about 800 metres downstream of the existing southbound bridge.

On the southern side of the Shoalhaven River is Nowra's central business district. The land to the south of the river is used for tourism and recreational activities such as kayaking, river cruises, boating, fishing and swimming. The land to the south also includes East Willows Caravan Park and Pleasant Way River Lodge as well as restaurants such as the Wharf Road Restaurant and Bar, Thai Riverside Restaurant and Dish and Spoon Café.

There are 13 heritage items located within the proposal study area and listed on the Shoalhaven Local Environment Plan (LEP). One of these items, Graham Lodge, is also listed on the State Heritage Register (SHR). The existing southbound Nowra Bridge is also listed on Roads and Maritime Services Section 170 Heritage and Conservation Register (s170) as having significance at a State level for its historic value, its landmark aesthetic qualities, its ability to contribute to research questions relating to the construction of Whipple truss bridges.

The Shoalhaven River and its tributary Bomaderry Creek are the two main waterways within the proposal area. The Shoalhaven River is a wide, tidal river that is popular for recreational and commercial activities as well as the fishing and aquaculture industries. The Shoalhaven River is a major community resource and hosts a range of recreational activities such as kayaking, river cruises, boating, fishing and swimming. The river is known for kayaking with a launch point at Grey's Beach just northwest of the existing bridge. Shoalhaven River Cruises leaves from Wharf Road and rock climbing is also popular on the cliffs that line the river banks.

1.1.2 Key features of the proposal

Key features of the proposal include:

- Construction of a new bridge to the west (upstream) of the existing bridge crossings over the Shoalhaven River including:
 - Four northbound lanes including a dedicated left turn only lane from Bridge Road to Illaroo Road
 - A 3.5 metre wide shared use path on the western side of the bridge connecting the Illaroo Road intersection to the Bridge Road intersection
- Widening of the existing bridge over Bomaderry Creek
- Minor lane adjustments on the existing northbound bridge to convert it to three lanes of southbound traffic
- Removal of vehicular traffic from the existing southbound bridge. Additional work would be provided under a separate project to convert the existing southbound bridge for adaptive reuse i.e. pedestrian and cycle access
- Upgrading of the Princes Highway to provide three northbound and three southbound lanes from Bolong Road through to about 75 metres north of Moss Street
- Widening of Illaroo Road over a distance of about 270 metres
- Upgrading of the Princes Highway and Illaroo Road intersection to provide:
 - Two southbound right turn lanes from the Princes Highway into Illaroo Road
 - Three dedicated right turn lanes and one dedicated left turn lane from Illaroo Road to Princes Highway
 - Acceleration and merge lane for northbound traffic turning into Illaroo Road from the Princes Highway
- Upgrading of the Princes Highway and Bridge Road intersection to provide:
 - Two southbound right turn lanes from the Princes Highway into Bridge Road
 - One left turn lane from Bridge Road to the Princes Highway
- Local road adjustments including:
 - Closing the access between Pleasant Way and Princes Highway

- Restricting turning movements at the intersection of Bridge Road and Scenic Drive
- Construction of a new local road connecting Lyrebird Drive to the Princes Highway about 300 metres south of the existing Pleasant Way intersection
- Provision of pedestrian facilities at all intersections
- Dedicated off road shared paths and footpaths along the length of the proposal
- Urban design and social amenity improvements, and landscaping including foreshore pedestrian links to the truss bridge
- Relocation and/or protection of utility services within the affected road corridor
- Drainage and water quality management infrastructure along the road corridor
- Property works including acquisition, demolition, and adjustments to accesses
- Temporary ancillary facilities during construction including site offices, construction compounds and stockpile sites

1.1.3 Proposal background

The Princes Highway is the main north-south regional road corridor from Sydney to Victoria. It passes through the Illawarra region and the south coast of NSW. It connects Nowra with important commercial centres in the region, and the local towns of Bomaderry and North Nowra. The highway is subject to relatively high traffic volumes including commercial and freight traffic. There are also seasonal increases in traffic due to recreational and tourism values in the area.

The current crossing of the Shoalhaven River at Nowra comprises two independent bridges. The southbound bridge has two lanes while the northbound bridge has three lanes. The southbound bridge was constructed in 1880 and is historically significant as a regional landmark because of its unique iron truss design. This bridge carried two-way traffic until a concrete box girder bridge was constructed to the west of it in 1980.

The southbound bridge requires costly maintenance due to its age. The high volume of traffic using the river crossing makes carrying out any maintenance difficult. In addition, the truss structure is a constraint to HML, freight and oversized vehicles. Any impact with the structure would require a prolonged closure of the bridge, presenting a risk and inconvenience to road users. A new crossing structure is, therefore, required. The existing southbound bridge could then be closed as a vehicular bridge to minimise risks.

A new crossing structure provides the opportunity to address a number of issues associated with the current twin-bridge arrangement including the opportunity to improve traffic capacity and amenity for local and through traffic.

1.1.4 Proposal objectives

The primary objectives of the proposal are to:

- Reduce crash rates on the Princes Highway between Bolong Road and Bridge Road
- Support future traffic growth accessing the Princes Highway associated with planned land use in the Nowra Bomaderry area
- Provide southbound access for over height vehicles and HML freight on the Princes Highway across the Shoalhaven River
- Reduce delays and queuing on the Princes Highway between Bolong Road and Bridge Road
- Enable safe and efficient maintenance activities on the Shoalhaven River crossings without causing extended delays to the road network.

Roads and Maritime has also worked to achieve high quality proposal outcomes across customer service, time management, budget, environmental and work health and safety. These factors are fundamental to enable the design development, options evaluation and option selection for the proposal, and are reflected and described in Table 1.

Table 1 Secondary proposal objectives

Objectives	Comment
Provide the best benefit to Roads and Maritime's customers	Nowra Bridge serves a wide variety of customers with a diverse set of requirements. The proposal is to investigate these requirements and identify a preferred option which provides the best balance and overall benefit to Roads and Maritime's customers, the community and stakeholders.
Delivering the proposal within an acceptable timeframe	To provide a proposal that can be completed within a short term timeframe.
Delivering the proposal within budget	To deliver a sustainable and innovative solution which achieves the proposal objectives and presents good value for money.
Prioritising the safety of Roads and Maritime's workers and customers	The safety of Roads and Maritime's people and customers is to be a priority during the planning, construction and operational phases.
Minimise environmental impact	To identify a proposal that best balances the overall environmental impact.
Deliver a proposal which fits sensitively with the built, natural and community environment	The existing southbound bridge is an important landmark within the local and regional context of Nowra and the south coast of NSW. Options were identified and developed appreciating its heritage significance and its role as the original bridge crossing of the Shoalhaven River.



Figure 1 Proposal location and study area

1.2 Purpose of the report

The project is subject to assessment under a review of environmental factors (REF) under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This report has been prepared to support the review of environmental factors (REF) for the proposal. This report has been prepared in accordance with relevant traffic assessment guidelines and consideration of relevant policies.

The purpose of this report is to describe the proposal, to document the likely impacts of the proposal on traffic and transport, and to detail management measures to be implemented.

1.3 Structure of the report

This report has been divided into the following sections:

- **Section 1 Introduction** provides an overview of the proposal
- **Section 2 Existing environment** provides the regional and local transport context of the proposal area. This section provides an overview of the road network, traffic trends and profiles, crash data, current transport mode share, public transport and maritime transport
- **Section 3 Existing road network performance** describes the existing transport network performance in the study area
- **Section 4 Future traffic environment** provides an overview of the future traffic growth across the study area network
- **Section 5 Assessment of operational traffic impacts** provides an assessment of the resulting traffic and transport impacts which are anticipated to occur from the operational stage of the proposal
- **Section 6 Assessment of construction impacts** assessed potential traffic impacts during the construction stage of the proposal
- **Section 7 Management and mitigation measures** summarises all measures included in the proposal to manage traffic and transport impacts.

1.4 Study approach

For the purpose of the traffic and transport assessment, the following key steps were undertaken:

- Collation of existing traffic data
- Review of previous traffic modelling of the study area
- Understanding of the existing transport networks serving the study area
- Identification of the future traffic growth based on expected land use changes in the region

- Assessment of performance of the existing road network under current and future traffic demands
- Assessment of the proposal under current and future traffic demands.
- Assessment of proposed construction activities and their associated traffic impacts
- Development of management measures for construction and operational traffic and transport impacts.

2 Existing environment

The existing traffic and transport conditions in the study area are described in the following section by mode.

2.1 Road network

The key roads within the study area are:

- Princes Highway (including Nowra Bridge)
- Bolong Road
- Illaroo Road
- Fairway Drive
- Bridge Road
- Scenic Drive
- Pleasant Way
- Lyrebird Drive
- Hawthorn Avenue
- Wharf Road
- Moss Street.

2.2 Road hierarchy and descriptions

2.2.1 Arterial roads

A1 Princes Highway

The A1 Princes Highway at Nowra forms part of the main north-south transport corridor that connects Sydney to north east Victoria via the coast.

Within the study area, the Princes Highway comprises dual carriageway with a minimum of two lanes in each direction and localised widening for turning traffic at intersections. All key intersections in the study area are controlled by traffic signals.

Shoalhaven River bridges

The Shoalhaven River crossing has two independent bridges which are about 340 metres in length. The southbound “Whipple” truss bridge has two lanes and is a constraint to overheight and HML heavy vehicles as described in Section 2.4. The northbound concrete bridge has three lanes with one lane being a dedicated left turn lane between Bridge Road and Illaroo Road.

Bomaderry Creek bridge

The Bomaderry Creek crossing comprises two independent bridges which were upgraded during the construction of the existing northbound concrete bridge over the Shoalhaven River. The bridges consist of three spans and are about 48 metres in total length.

2.2.2 Regional roads

Bolong Road

Bolong Road is a regional road located north of the Shoalhaven River and provides access to locations east of the Princes Highway via a signalised T-intersection. The road is predominately a single lane in each direction with additional lanes provided at intersections for turning movements. It is the main route to Shoalhaven Heads and provides an alternative route to towns north of Nowra including Gerroa and Gerringong. This road is used by bus services and it provides heavy vehicle access (including for B-Doubles) to the Bomaderry industrial area.

2.2.3 Local roads

Illaroo Road

Illaroo Road provides a key link between the Princes Highway and the suburbs of North Nowra and Bangalee located north of the Shoalhaven River. The road is generally two lanes in each direction and forms a signalised T-intersection with the Princes Highway at the northern end of the Shoalhaven River crossing. This road is used by local bus services.

Fairway Drive

Fairway Drive is a local road with one lane in each direction on the northern side of the Shoalhaven River. It generally runs south from an unsignalised intersection with Illaroo Road and provides access to Grey's Beach boat ramp and public reserve as well as Nowra Golf and Recreation Club.

Bridge Road

Bridge Road is a local road that extends from a signalised intersection with the Princes Highway to Nowra CBD south of the Shoalhaven River. The road comprises one northbound lane and two southbound lanes from the Princes Highway to Hyam Street, where it then has one lane in each direction and kerbside parking. Bridge Road provides access to Shoalhaven Entertainment and Visitors Centre, Nowra town centre and emergency vehicle access to Shoalhaven District Memorial Hospital. The intersection provides left turn only travelling northbound from Bridge Road onto the Princes Highway.

Scenic Drive

Scenic Drive is a local road west of the Princes Highway and south of the Shoalhaven River. Scenic Drive forms an unsignalised intersection with Bridge Road immediately

south of the Princes Highway and Bridge Road intersection. The road generally consists of one lane in each direction, is used by bus services and provides access to the river foreshore, Nowra Aquatic Park and an alternative route to Shoalhaven District Memorial Hospital.

Pleasant Way

Pleasant Way is a local road that provides access to the Shoalhaven River foreshore, accommodation and residences east of the Princes Highway. The road connects to the Princes Highway at a signalised intersection, is generally unmarked, and comprises one lane in each direction to the intersection with Hawthorn Avenue.

Hawthorn Avenue

Hawthorn Avenue is a local street that provides direct access to residential dwellings and a connection through to the river foreshore.

Lyrebird Drive

Lyrebird Drive is a local road that provides access to residential dwellings on the eastern side of the Princes Highway. It is one way in each direction and provides access to local residents and businesses.

Wharf Road

Wharf Road is a local street that provides access to the Nowra Sailing Club, boat ramp and wharf located on the southern foreshore adjacent to the old southbound bridge.

Moss Street

Moss Street is a local road which forms a signalised cross road with the Princes Highway at the southern extent of the study area. Moss Street provides alternative access to the Nowra CBD as well as the residential precinct and Nowra High School east of the Princes Highway.

2.2.4 Intersections

The key intersections within the study area are summarised in Table 2.

Table 2 Intersections in the study area

Intersection	Current controls
Princes Highway / Bolong Road	Traffic lights
Princes Highway / Illaroo Road	Traffic lights
Illaroo Road / Fairway Drive	Unsignalised T
Princes Highway / Bridge Road / Pleasant Way	Traffic lights
Bridge Road / Scenic Drive	Unsignalised T
Princes Highway / Moss Street	Traffic lights

2.3 Speed limits

Posted speed limits within the study area are shown in Figure 2. The Princes Highway speed limit within the study area is 70 km/h. Illaroo Road and Bolong Road both have posted speed limits of 60 km/h, while all other local roads have a posted speed limit of 50 km/h. There are no school zones within the study area.

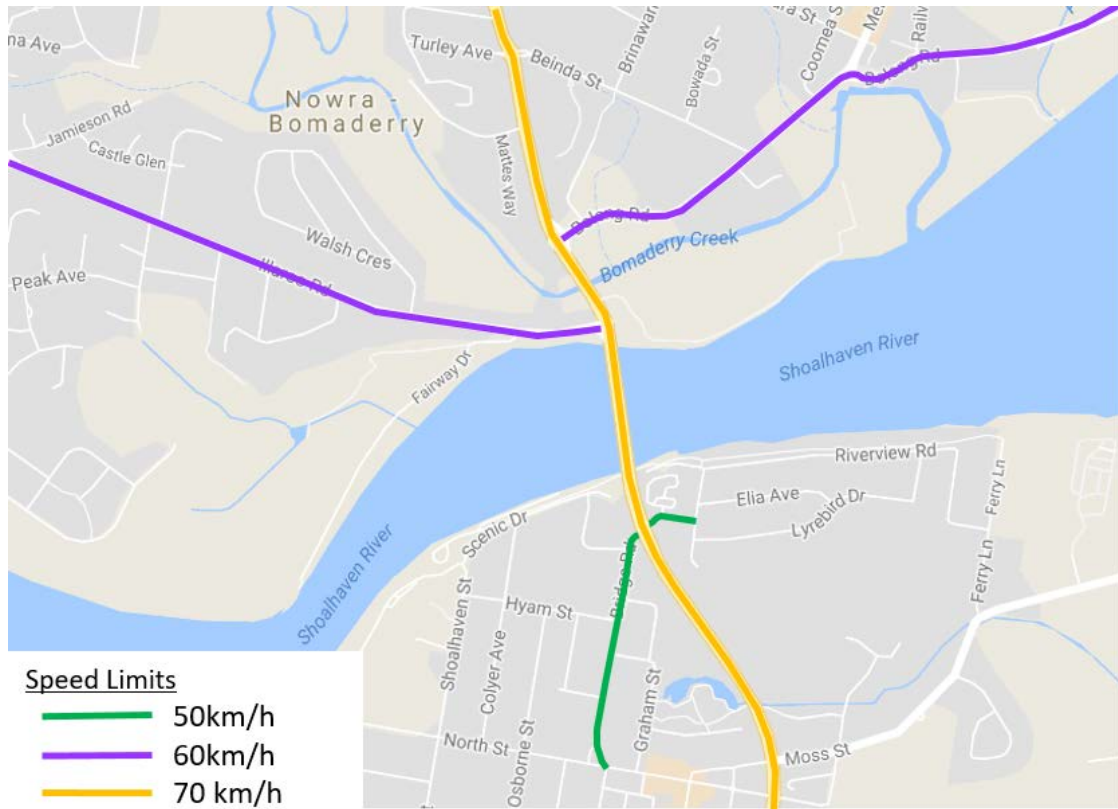


Figure 2 Posted speed limits within the study area

2.4 Heavy vehicles

2.4.1 Volumes

Table 3 summarises the volume and proportion of heavy vehicles (including long vehicles such as B-Doubles) that travel through key roads in the study area, based on traffic counts undertaken in December 2017 in the study area.

Table 3 Heavy vehicle volumes

Location	Light Vehicles	Heavy Vehicles	Long Vehicles (e.g. B-Doubles)	Total	% HV
Princes Highway (NB Nowra Bridge)	22,201	2,882	95	25,179	12%
Princes Highway (SB Nowra Bridge)	23,597	3,608	116	27,321	14%
Illaroo Road	16,646	983	2	17,631	6%
Bridge Road	12,102	1,018	1	13,121	8%

2.4.2 Heavy vehicle network

There are a number of constraints to heavy vehicle freight traffic movement through the study area. The freight vehicle movements are summarised as follows:

- A1 Princes Highway and Bolong Road are approved for use by heavy vehicles up to 25 metre and 26 metre B-doubles as shown in shown in green in Figure 3. The Shoalhaven River crossing provides no current constraint to these vehicles
- HML short combination, HML 25 metre and 26 metre B-doubles and HML A-double Type 1 road trains are prohibited on the southbound bridge as shown in Figure 4
- The A1 Princes Highway is a 4.6 metre high vehicle route north of the Shoalhaven River crossings
- The A1 Princes Highway is a 4.6 metre high vehicle route with conditions across the Shoalhaven River and further south
- Vehicles with a height clearance between 4.3 metres and 4.6 metre travelling southbound must straddle both lanes and travel down the centre of the southbound bridge to prevent striking the truss structure
- No freight vehicles are approved for Illaroo Road, Bridge Road or Pleasant Way.

These restrictions are shown in Figure 3 to Figure 5.

In May 2018 the NSW Government announced it would invest \$40 million to upgrade 13 kilometres of the South Coast railway line between Berry and Bomaderry, allowing heavier trains carrying up to 25 tonne axle loads to use the track. It is estimated that

this project would remove more than 10,000 trucks from roads each year, shifting 350,000 tonnes of freight onto rail.

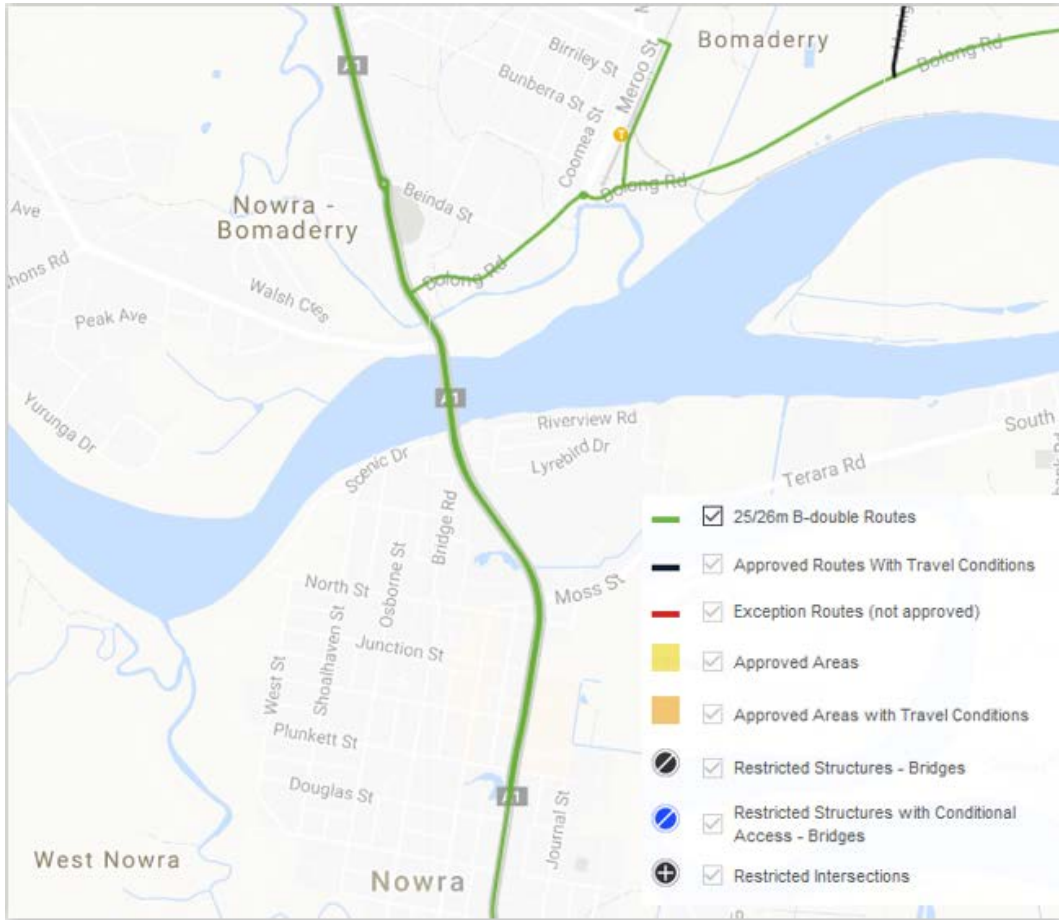


Figure 3 Approved 25 metre and 26 metre B-double routes

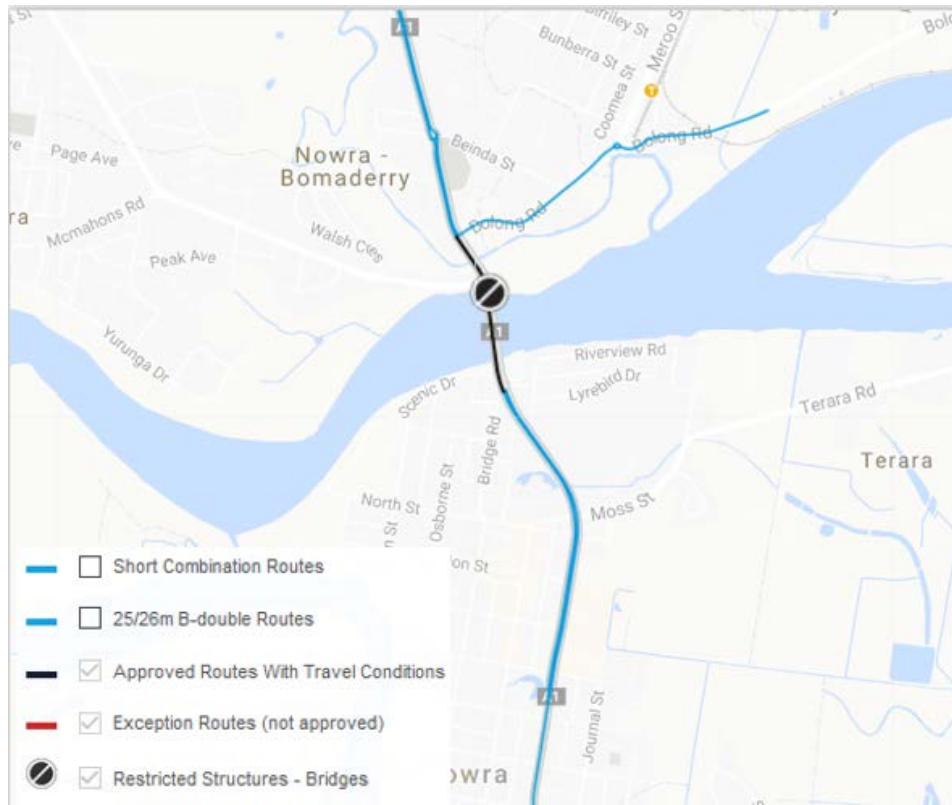


Figure 4 Higher mass vehicle (HML) network in the study area

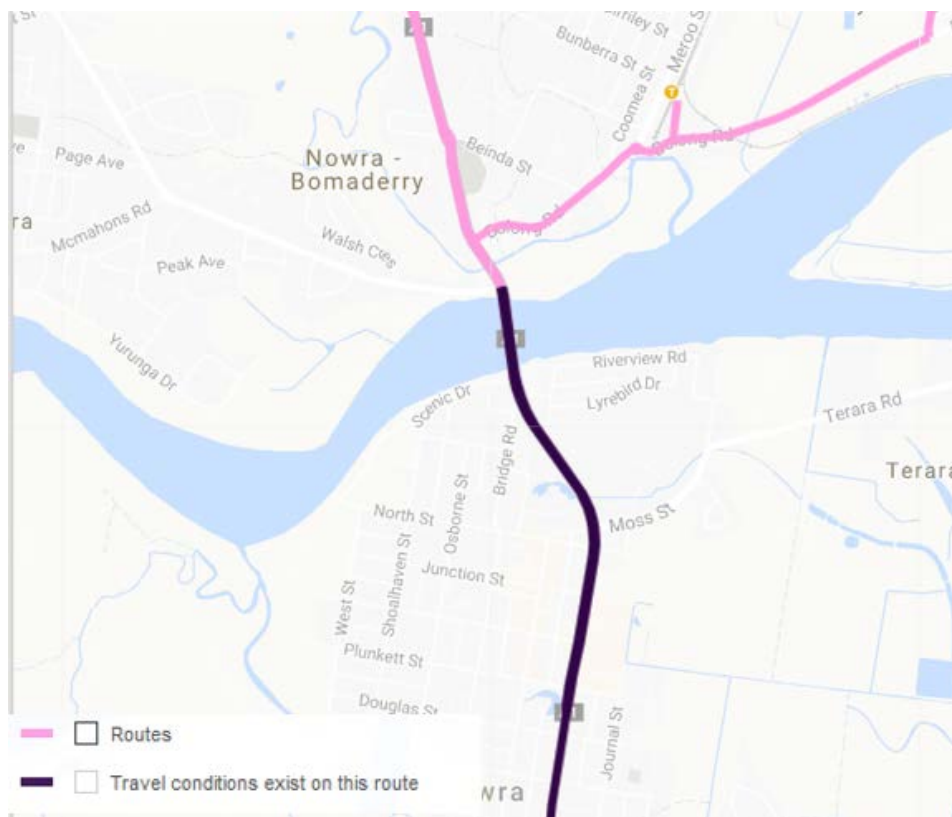


Figure 5 Approved routes for 4.6 metre high vehicles

2.5 Traffic data

2.5.1 Current traffic volumes

Traffic volume data has been collated from the following sources:

- Roads and Maritime permanent traffic counter 07.051
- Seven day, 24 hour automated traffic counts undertaken in November and December 2017
- Origin destination traffic surveys undertaken in 2013, 2014 and 2018
- Intersection count survey undertaken in March 2014.

Based on traffic counts undertaken in November and December 2017, Table 4 provides a summary of the existing two-way weekday daily traffic flows at different locations within the study area. Recent trends in traffic flows are described in Section 4 of this document.

Table 4 Existing traffic volumes

Road	Existing two-way weekday daily traffic volumes
State and regional road network	
Princes Highway south of Bolong Road	37,900
Princes Highway across Shoalhaven River	51,300
Princes Highway south of Bridge Road	42,500
Bolong Road	15,300
Local road network	
Illaroo Road	17,600
Bridge Road	13,100
Pleasant Way	1,500

2.5.2 Traffic trends and profiles

The Roads and Maritime permanent counter provided traffic data for the Princes Highway at the Shoalhaven River crossing from 2016 and includes the peak summer and Easter seasonal periods. From this data the following is noted:

- The average daily weekday traffic on this section of road is about 52,400 vehicles, and ranges between 50,700 vehicles per day in low season and 53,500 vehicles per day in high season
- High season for traffic appears to run from September through to March with lower volumes generally experienced between April and August
- Public holiday traffic is substantially lower than average daily weekday traffic with about 39,000 vehicles per day.

- The PM peak accounts for about 30% of daily traffic movements with about 15,500 vehicles movements (55 per cent of which is travelling northbound and 45 per cent is travelling southbound)
- The AM peak accounts for about 24 per cent of daily traffic movements with about 12,800 vehicle movements (41 per cent of which is travelling northbound and 59 per cent is travelling southbound)
- During 2016 on average, daily traffic on Fridays was about 11 per cent higher than the average daily movements for Monday to Thursday.

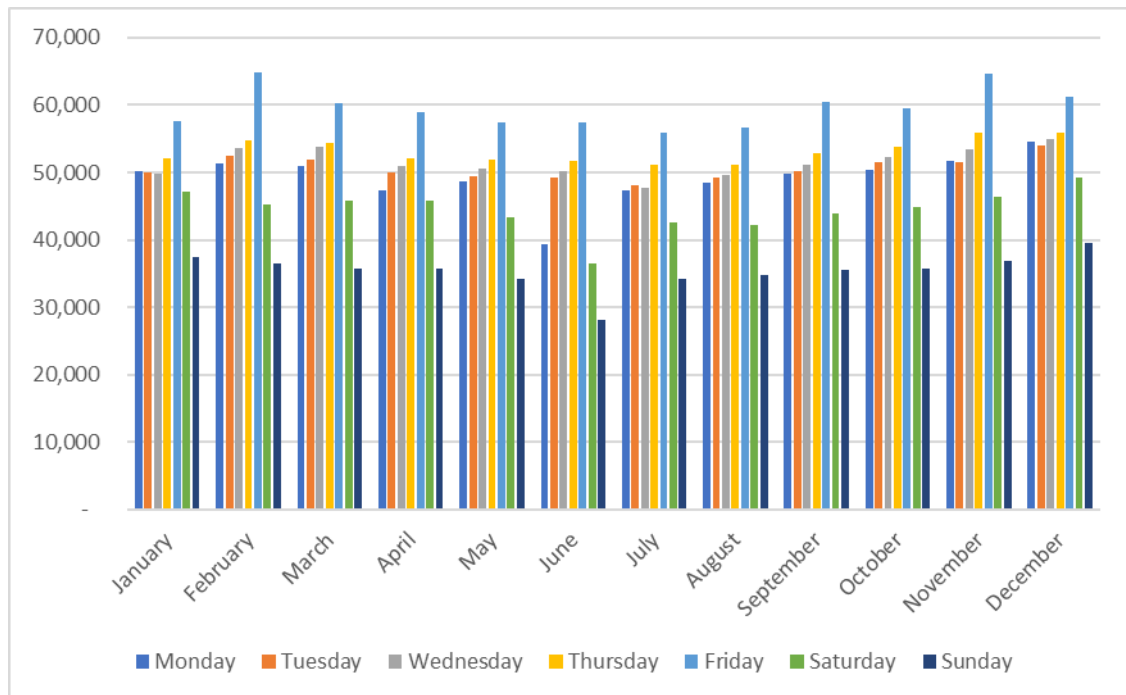


Figure 6 Average daily traffic volumes (2016) – Princes Highway at Shoalhaven River Bridge

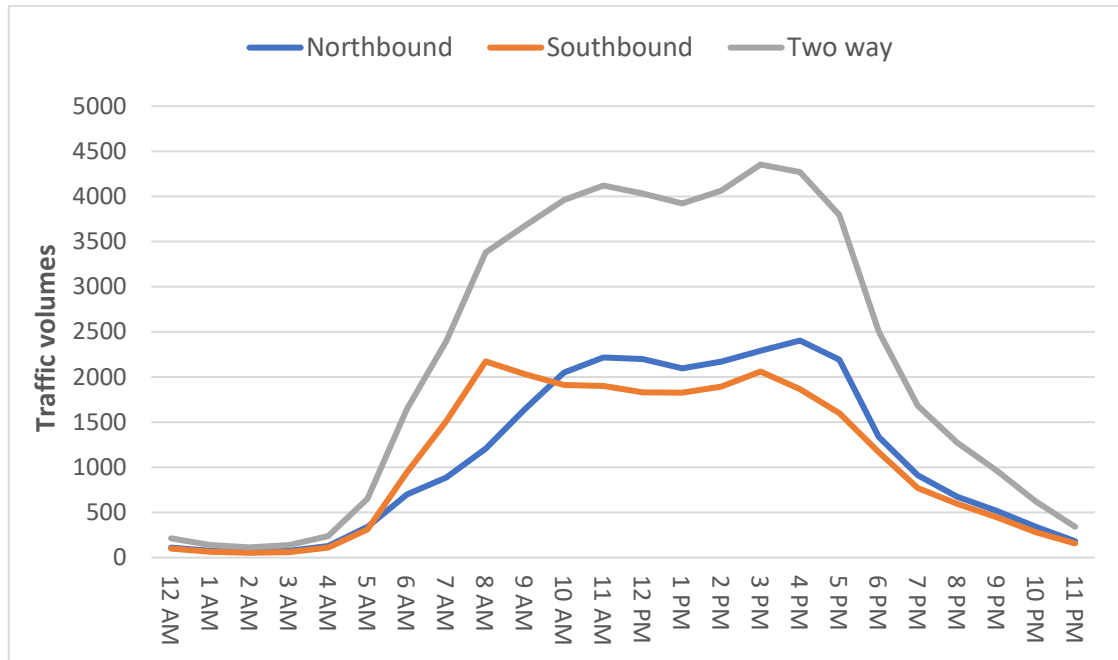


Figure 7 Average daily traffic profile (2016) – Princes Highway at Shoalhaven River Bridge

For areas which experience highly seasonal traffic fluctuations, such as the Princes Highway at Nowra, it is accepted practice (according to Austroads guidelines) that the design does not target the highest hourly traffic flows experienced during the year. Instead the preferred methodology is to adopt the 100th highest annual hour of traffic flow as the target design hour.

As such, intersection count surveys at key intersections were undertaken on Friday 14 March 2014 to assess peak hour traffic flows across the study area. The specific date was selected by Roads and Maritime in consultation with Shoalhaven City Council as it occurs within the shoulder peak period, is the day of the week (Friday) with the highest daily traffic flows and is therefore considered to be representative of the 100th highest annual hour for the area.

The surveyed traffic volumes are presented in Figure 8 and Figure 9.

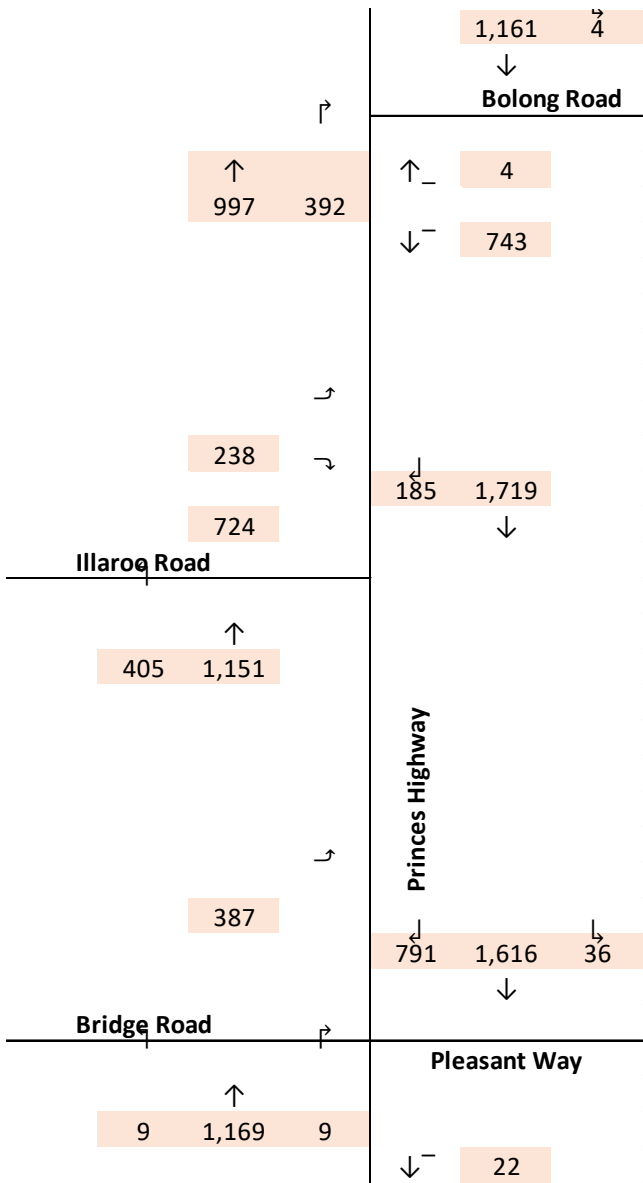


Figure 8 2014 AM peak hour traffic flows

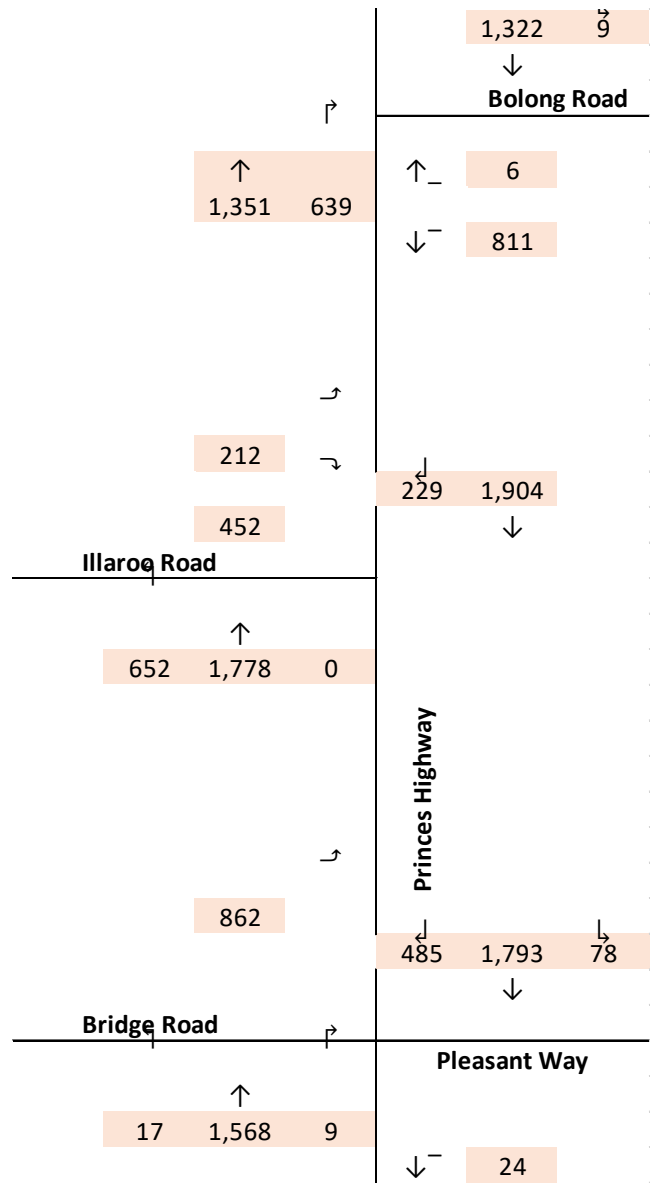


Figure 9 2014 PM peak hour traffic flows

2.6 Crash data

The crash data analysis has been undertaken using crash data obtained from the TfNSW Centre for Road Safety for a five year period between 2012 and 2016. Crash data was provided for the Princes Highway, Bolong Road, Illaroo Road and Bridge Road. Figure 10 shows crash locations on key roads within the study area.



Figure 10 Crash locations by injury severity within study area between 2012-2016

Between 2011 and 2016, 52 crashes were reported in the upgraded corridor study area. One fatality was recorded due to a fatal head on (not overtaking) collision on the Princes Highway between Bolong Road and Illaroo Road.

The type of crashes is summarised in Table 5.

Table 5 Summary of crashes by type and severity

RUM Code Description	Fatal	Minor	Moderate Injury	Non-casualty	Serious Injury	Grand Total	% of Total Crashes
Accident			1			1	2%
Cross traffic			2			2	4%
Emerging from drive			1			1	2%
From footpath			1			1	2%
Head on	1					1	2%
Lane change right			1	1	1	3	6%
Left near				1		1	2%
Off left/left bend				1		1	2%
Off left/right bend into object			1		1	2	4%
Off left/left bend into object			1	1		2	4%
Off road left into object					2	2	4%
Off road right into object				1		1	2%
On road-out of control					1	1	2%
Other curve			1			1	2%
Other same direction				2		2	4%
Pedestrian far side			1			1	2%
Rear end		2	9	10	2	23	44%
Right far			1			1	2%
Right rear			1			1	2%
Right through			1	3		4	8%
Grand Total	1	2	22	20	7	52	100%

In the analysis period 2012 to 2016, 62 per cent of crashes occurred along the Princes Highway at or within 50 metres of an intersection.

Rear end crashes were the most common crash type within the study area with 23 incidents recorded which accounted for 44 per cent of all crashes. These were located predominantly along the Princes Highway.

Nine crashes were recorded on the existing bridges with eight incidents being rear end collisions and one incident due to a lane change manoeuvre.

One crash involving a pedestrian occurred at the intersection of Bridge Road and the Princes Highway while the pedestrian was crossing at the intersection.

2.7 Transport mode share

To gauge modal share for traffic movements around Nowra Bridge 2016 Journey to Work (JTW) data from the Australian Bureau of Statistics was reviewed. Travel patterns were reviewed to identify high level modal choice patterns in the area, as summarised in Table 6.

Table 6 Mode share from JTW data

Work trip modal share	Private Transport		Public Transport		Active Transport	
	Car as driver	Car as passenger	Bus	Train	Walk	Cycle
Nowra residents work trips	79%	8%	1%	1%	7%	1%
Nowra as a place of work	86%	7%	1%	-	3%	<1%

The data shows driving in a private vehicle is the preferred mode to get to work. Public transport for residents and workers is low (about two per cent), while there are a higher proportion of people walking for their journey to work (seven per cent). It was found that about 1 per cent of trips by Nowra residents to work were made by bicycle.

2.8 Public transport

2.8.1 Rail network

Bomaderry Station is located about two kilometres north-east of Nowra town centre. Bomaderry is the last station on the South Coast Rail Line and has services to Kiama via Berry and Gerringong, as summarised in Table 7. At Kiama, passengers may change trains for services to Wollongong and Sydney. In July 2017, Transport for NSW introduced a new trial bus service running between Bomaderry and Kiama train stations aimed at improving connecting services between the two stations.

Table 7 Rail and bus services between Bomaderry Station and Kiama Station

Mode	Direction	Number of daily services	Frequency
Train	Bomaderry Station to Kiama Station	13	Peak: Approx. every 45min Off Peak: hourly
	Kiama Station to Bomaderry Station	14	
Bus (Route 737)	Bomaderry Station to Kiama Station	6	Every couple of hours, inconsistent throughout the day. Weekday services only.
	Kiama Station to Bomaderry Station	5	Every couple of hours, inconsistent throughout the day. Weekday services only.

2.8.2 Bus network

The A1 Princes Highway is a key corridor for all the bus services in the region as it connects Nowra town centre to other regional centres. There are several bus operators that provide services through Nowra, including Nowra Coaches, Shoal Bus and Kennedy's Bus and Coaches. These operators all service Nowra Bus Terminal located on Stewart Place in the town centre.

Kennedy's Bus and Coach run three routes (728, 729 and 809) which provide a service to local regional towns including Pyree, Brundee, Culburra Beach, Numbaa, Terara, Cambewarra and Bomaderry. Bus routes 721 and 722 are both loop services operated by Shoal Bus which connect the residential areas of Bomaderry and North Nowra to Nowra town centre.

Figure 11 shows the bus routes through the study area and a summary of services is provided in Table 8.

Table 8 Summary of bus services

Route No.	Description	No. of daily weekday services*	No. of daily weekend services*	Operator
705	Gerringong/ Gerroa/Berry to Nowra	3	2	Shoal Bus
705	Nowra to Gerringong/Gerroa/Berry	5	2	Shoal Bus
709	Shoalhaven Heads to Nowra	4	2	Shoal Bus
709	Nowra to Shoalhaven Heads	5	2	Shoal Bus
721	Nowra to Bomaderry (Loop service)	10	3	Shoal Bus
722	Nowra to North Nowra (Loop service)	6	3	Shoal Bus
724	East Nowra	7	4	Nowra Coaches
724	West Nowra	7	3	Nowra Coaches
729 (Bus 2/5/4)	Orient Point/ Culburra to Nowra	5	-	Kennedys Bus and Coaches
729 (Bus 2/5/4)	Nowra to Orient Point/Culburra	5	-	Kennedys Bus and Coaches
732 (Bus 17/21)	Nowra to Bay and Basin	6	2	Nowra Coaches
732 (Bus 17/21)	Bay and Basin to Nowra	7	2	Nowra Coaches
733 (Bus 12)	Hyams Beach to Bomaderry	2**	-	Nowra Coaches
735	Nowra to Sussex	3	-	Shoal Bus
735	Sussex to Nowra	3	-	Shoal Bus

*Some services only stop if required and do not pick up passengers at all stops, stopping patterns may vary according to the school terms.

**Only operates on Tuesdays and Fridays. AM service Hyams Beach Village to Nowra Commonwealth Bank and PM service runs from Nowra Commonwealth Bank to Hyams Beach Village.

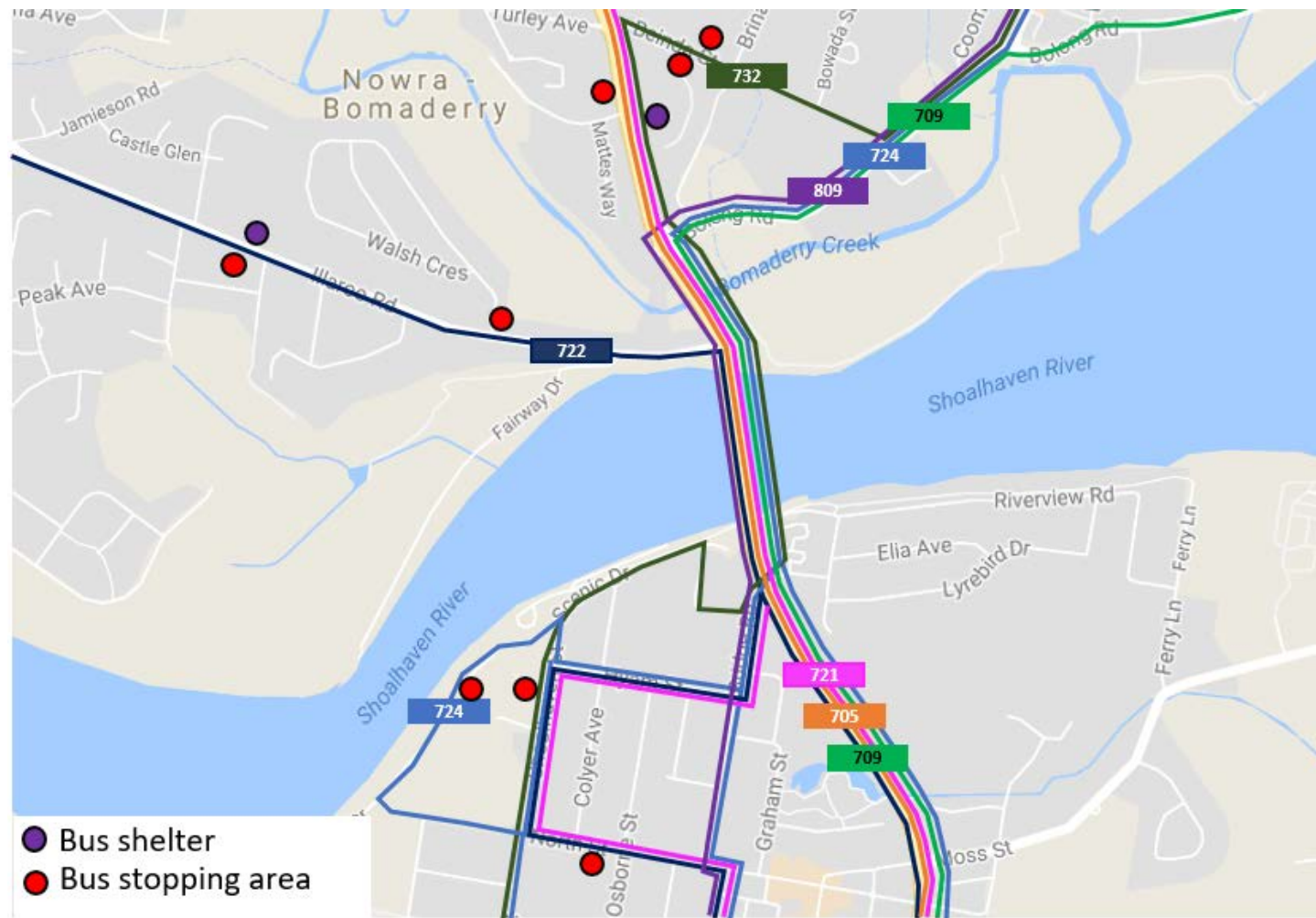


Figure 11 Bus network through the study area

2.9 Active transport

There are shared paths for pedestrians and cyclists on the east side of the existing southbound bridge and the west side of the existing northbound bridge. These shared paths do not meet the recommended width for a shared path of 2.5 meters, based on Austroads design guidelines. These shared paths connect to shared paths along Bolong Road, provide access to the Bomaderry residential area, and along Illaroo Road, providing access to the North Nowra residential area. Footpaths are provided along the majority of streets within Nowra town centre.

The Shoalhaven Bike Plan identifies a number of proposed improvements to the bicycle network serving the LGA. These proposed routes, as well as existing facilities within the study area are shown in Figure 12.

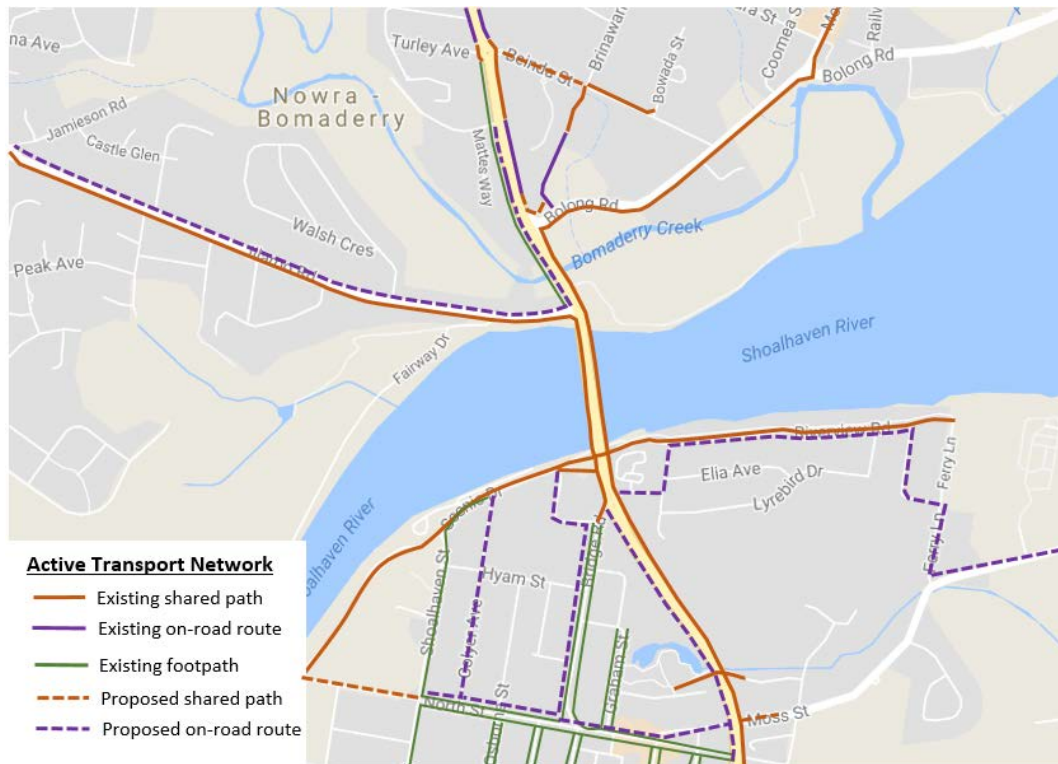


Figure 12 Pedestrian and cycle network in the study area

2.10 Maritime environment

The *Shoalhaven Estuary Safe Boating Plan 2009-2013* (Roads and Maritime) identifies the use of Shoalhaven River around Nowra Bridge as moderate to high. Common types of usage in the area are fishing, sailing, rowing, kayaking, swimming and river cruises and also commercial activities such as charters and hire operations. Nowra Sailing Club (identified in Figure 13) which has two boat ramp facilities at the wharf on the south side of the Shoalhaven River is located off Wharf Road. There are about five spaces for cars with trailers and another five parking spaces for cars on Wharf Road.

On the northern side of the bridge, Grey's Beach boat ramp is located off Fairway Drive, accessed via Illaroo Road, where there is an unmarked unsealed gravel area for cars and trailers to park and public toilet facilities.

There is a current maximum navigational clearance of 7.3 metres for all maritime vessels under the existing bridge. There are nine piers across the river for the bridge which are about 35-40 metres apart. There is a four knot speed limit for vessels in the area.

Figure 13 shows the general maritime environment on the Shoalhaven River near Nowra Bridge.

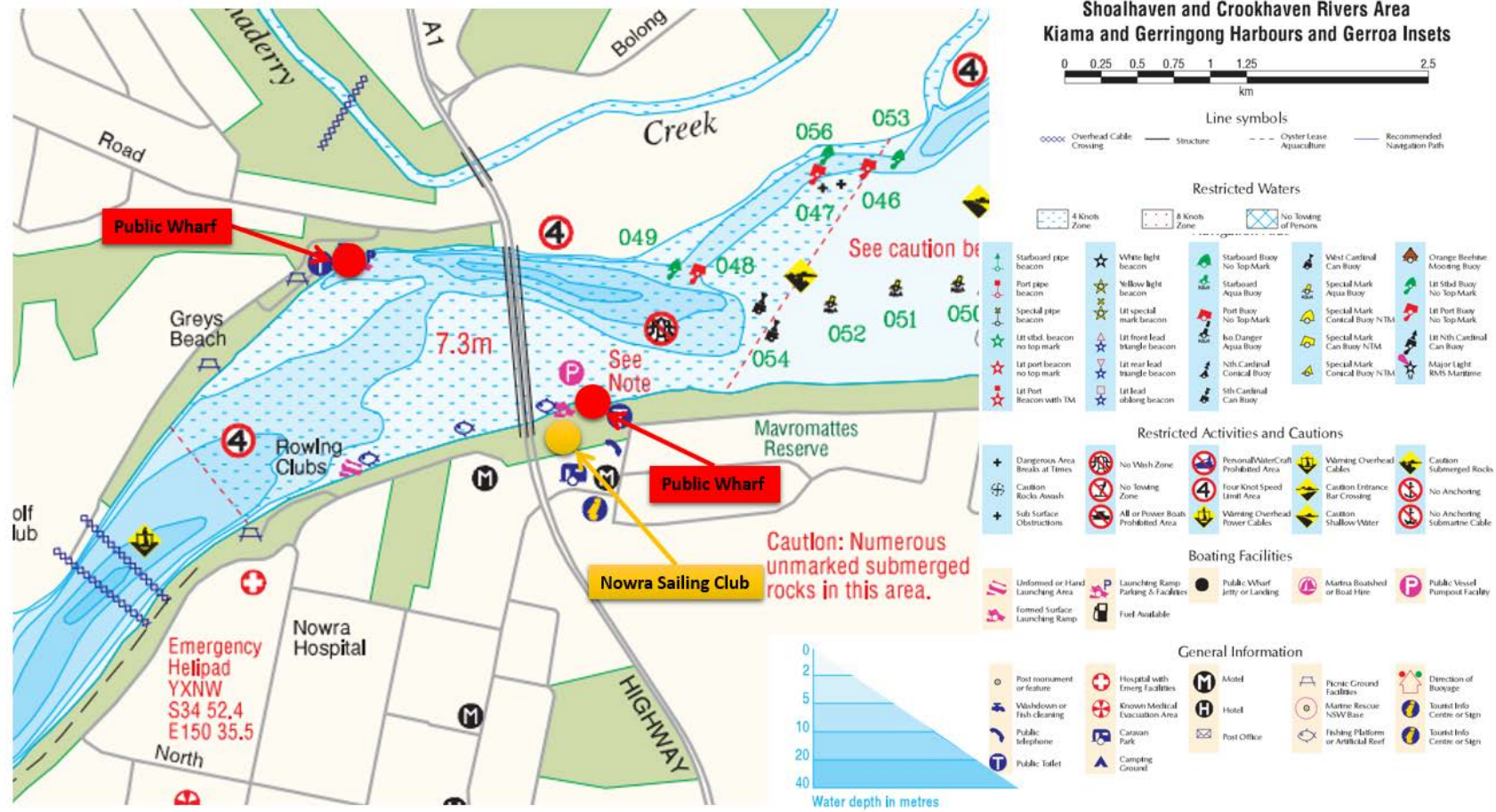


Figure 13 Maritime environment on the Shoalhaven River at Nowra Bridge

Source: <http://www.rms.nsw.gov.au/documents/maritime/usingwaterways/maps/boating-maps/11a-shoalhaven-crookhaven-culburra.pdf>

2.11 Existing land uses

The land uses within and surrounding the study area influence the type and volume of traffic that use Nowra Bridge. The general land zoning within the study area is provided within the Shoalhaven Local Environment Plan 2014.

Key features of land uses surrounding Nowra Bridge include:

- Uses on the northern side of the river to the west of the Princes Highway are predominantly low density residential with pockets of higher density
- Adjacent to the river on the northern and southern side are areas zoned for public recreation
- Commercial core is located on the southern side of the river
- Surrounding the commercial core, it is zoned as mixed land use
- There is a pocket of light industrial zoning on the north side of the river, east of Princes Highway.

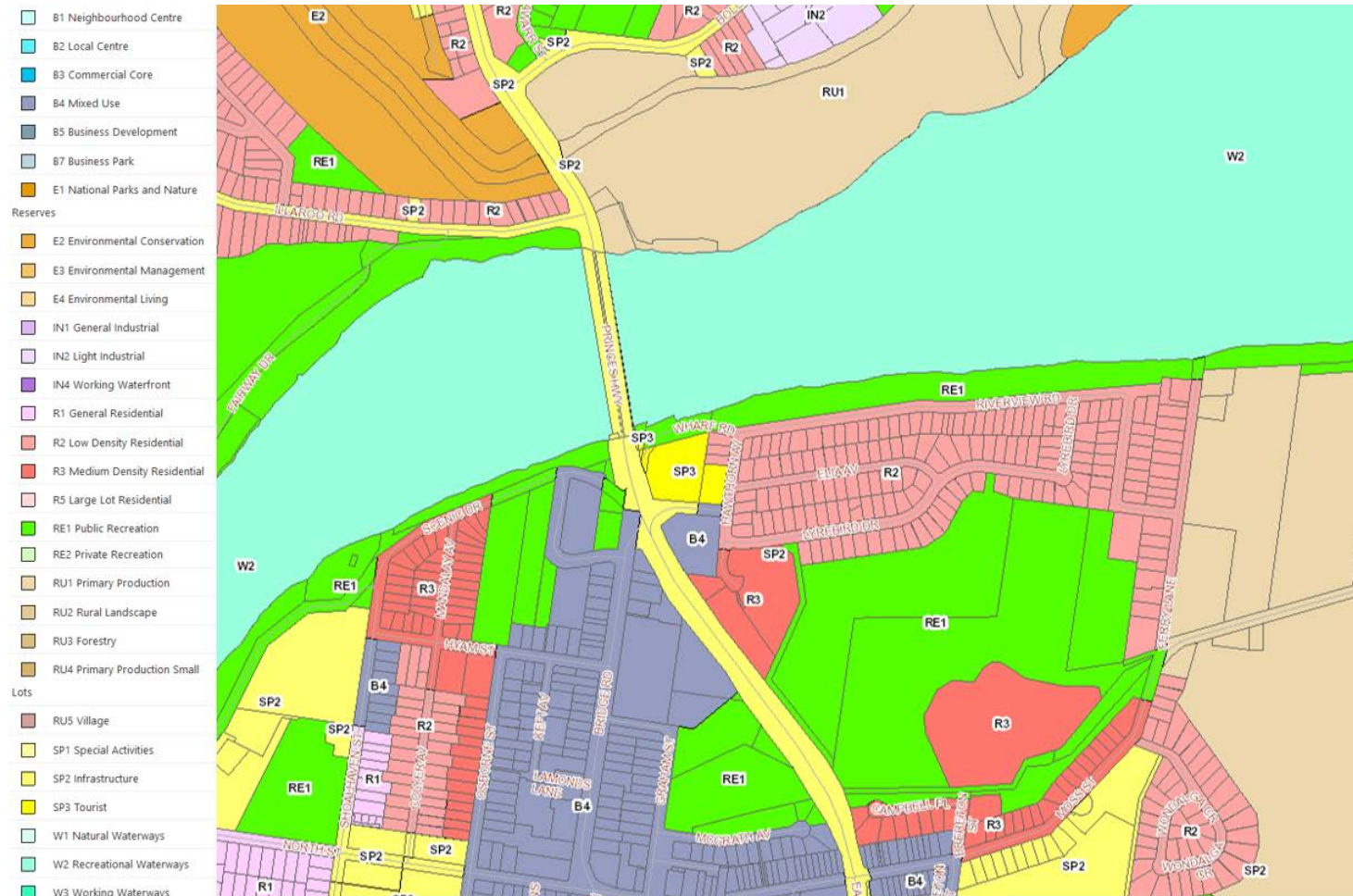


Figure 14 Land zoning from Shoalhaven Local Environmental Plan 2014

2.12 Parking

A mix of on-street car parking and off-street formal car parks are provided in the study area. The majority of parking available is unrestricted parking (i.e. no time limits) however in the Nowra CBD a number of on and off street car parking areas are subject to time limits of between five minutes and three hours. A summary of the existing parking environment in key locations within the study area is shown in the table below.

Table 9 Existing car parking within the study area

Location	Available spaces*
On-street car parking	
Princes Highway – Bolong Road to Moss Street	No parking permitted
Illaroo Road – between Princes Highway and Fairway Drive	No parking permitted
Fairway Drive	No parking permitted
Bolong Road	No parking permitted within 200m of intersection with Princes Highway
Pleasant Way – Princes Highway to Hawthorn Avenue	6
Bridge Road – Princes Highway to North Street	44
Scenic Drive – Bridge Road to Mandalay Avenue	65
Hawthorn Avenue – Wharf Road to cul-de-sac	60
Lyrebird Drive – Hawthorn Avenue to Elia Avenue	90
Wharf Road - Hawthorn Avenue to cul-de-sac	No parking permitted
Moss Street – Princes Highway to Brereton Street	25
Off-street car parking	
Illaroo Road – 70m west of Princes Highway (Rotary Park)	14
Fairway Drive boat ramp car park	100
Nowra Golf and Recreation Club	80
Nowra Aquatic Park	38
Pleasant Way near Graham Lodge	75
Shoalhaven Entertainment Centre	105
Shoalhaven City Council (staff & visitors)	105
Shoalhaven City Council -Overflow grass parking area	144

* Indicative only

3 Existing road network performance

3.1 Traffic model development

Base (existing) year traffic models for the study area were previously developed by Bitzios Consulting and have been utilised in this assessment.

3.1.1 Peak hours

The base models for the AM and PM weekday periods were developed for the following one hour periods which were determined from intersection surveys undertaken in March 2014. The identified peak hours were as follows:

- 2014 AM Base model: 8.00am to 9.00am; and
- 2014 PM Base model: 3.30pm to 4.30pm.

3.1.2 Model calibration

A key part of the calibration of a micro-simulation model involves an adequate correspondence of modelled turning movements to observed turning movements. The statistic most commonly used to measure modelled turning movement counts against observed turning movement counts is the GEH (Geoffrey E. Havers) statistic. GEH is a standard statistic used in traffic modelling to compare two sets of traffic data, and can be expressed by the following formula:

$$GEH = \sqrt{(M-C)^2 / (\frac{1}{2}(M+C))},$$

Where M is the modelled flow and C is the observed flow.

Roads and Maritime Traffic Modelling Guidelines notes that the criteria generally required to achieve appropriate model calibration is as follows:

- For 85 per cent of all turning movements, the comparison of modelled flow to observed flow will have a GEH less than five.
- For all turning movements, the comparison of modelled flow to observed flow will have a GEH less than 10.

The AM and PM peak hour calibration results are given below.

Table 10 Model calibration results

Peak Period	Total turn movements	GEH < 5		GEH > 10	
		Number	%	Number	%
AM	19	19	100%	0	0%
PM		19	100%	0	0%

The calibration process yielded a GEH value of five or less for 100 per cent of turning movements in both peak hours, therefore meeting the adopted calibration criteria.

3.1.3 Model validation

Model validation provides an independent check of the calibrated model to assess its accuracy and confirm that the calibrated model is fit for purpose. The validation process for this project was undertaken once the model was calibrated satisfactorily.

This model was validated on the basis of queue lengths observed over Nowra Bridge in 2015, and compared back to the modelled queues in the Paramics model.

As illustrated in Figure 15 and Figure 16, the modelled queues were found to accurately reflect the observed on-site level of queuing.



Figure 15 AM peak hour queue validation

Source: Nowra Bridge Traffic Modelling Final Options Assessment Report (Bitzios, 2016)



Figure 16 PM peak hour queue validation

Source: Nowra Bridge Traffic Modelling Final Options Assessment Report (Bitzios, 2016)

3.1.4 Summary

The base models developed for the AM and PM peak hour periods (developed by Bitzios) are considered to be appropriately calibrated and validated to base traffic network conditions and are considered fit-for-purpose.

3.2 Existing road network performance

The existing road network performance is described in the sections below, and has generally been assessed against the level of service (LoS) rating as shown in Table 11. Level of service values are based on the average delay time for vehicles at intersections. The degree of saturation (DOS) measure has also been used to assess the performance of key intersections in the study area.

Table 11 Level of service description

Level of Service (LoS)	Average delay time (seconds)	Description
A-C	< 42	Considered to represent good to acceptable levels of service. Where traffic is still within the limits of stable flow with most vehicles being able to travel at the desired speed.
D	42 to 56	Still within capacity. Close to the limit of stable flow with desired speed and manoeuvring restricted. Small increases in traffic flows could cause operational problems.
E	56 to 70	Traffic volumes are close to capacity and queuing and delays can be considered significant.
F	> 70	Traffic flows generally exceed capacity and / or average delays are significant for the type of intersection or road.

3.2.1 Capacity of existing bridges

During the AM peak period the existing southbound bridge carries up to 2400 vehicles per hour, which equates to 1200 vehicles per lane. Relevant Austroads guidelines notes that the capacity of roads in urban environments is generally between 1100-1200 vehicles per lane – which confirms the existing southbound bridge currently operates at capacity during peak hours. Therefore irrespective of the intersections either side of the bridge, the existing bridge design (two southbound lanes) is insufficient to accommodate current traffic flows.

The existing three lane northbound bridge carries about 2400 vehicles during the PM peak hour – equivalent to 800 vehicles per lane. This is less than the capacity specified in Austroads.

3.2.2 Capacity of intersections

The existing operation of key intersections in the study area is summarised in Table 12. Anecdotally, it is understood that queues and delays can be significantly longer than modelled however these tend to be due to seasonal peaks or traffic incidents that have occurred during the peak hours.

Princes Highway / Bolong Road intersection

The Princes Highway / Bolong Road intersection generally operates at an acceptable level of service during the AM and PM peak hours. Long queues can develop however at the northern approach of the intersection for vehicles travelling south towards the Nowra CBD.

Princes Highway / Illaroo Road intersection

During the morning peak, the traffic modelling indicates the intersection is operating with a poor level of service and is nearing its operational capacity. The Illaroo Road approach is particularly poor, operating at a LoS F, and significant delays are experienced. The intersection generally operates at a higher level of service during the afternoon peak period.

Princes Highway / Bridge Road / Pleasant Way intersection

Traffic modelling indicates that the Princes Highway / Bridge Road intersection currently operates close to capacity during the AM and PM peak hours. A particular issue is the delays experienced for vehicles travelling over the existing southbound bridge during the morning peak and turning right into Bridge Road – with long delays often experienced due to the high traffic volumes and only two southbound lanes available over the bridge.

Table 12 Existing intersection operation

Intersection	Approach	AM Peak Hour			PM Peak Hour		
		DoS	LoS	Max Queue (m)	DoS	LoS	Max Queue (m)
Princes Highway / Bolong Road	Princes Hwy (N)	0.73	B	177	0.73	B	157
	Bolong Rd (E)	0.47	C	115	0.68	D	142
	Princes Hwy (S)	0.27	A	39	0.5	A	91
	Total	0.73	B	177	0.73	B	157
Princes Highway / Illaroo Road	Princes Hwy (N)	0.84	D	94	0.79	A	108
	Princes Hwy (S)	0.64	B	118	0.93	B	366
	Illaroo Rd (W)	0.95	F	294	0.81	E	168
	Total	0.95	E	294	0.93	B	366
Princes Highway / Bridge Road	Princes Hwy (N)	0.97	E	296	0.96	E	263
	Pleasant Way (E)	0.01	A	1	0.02	A	1
	Princes Hwy (S)	0.88	D	169	0.93	C	146
	Bridge Rd (W)	0.24	A	17	0.53	A	55
	Total	0.97	E	296	0.96	D	263

4 Future traffic environment

4.1 Future traffic growth

Historical traffic data and Shoalhaven City Council’s strategic (TRACKS) model were reviewed to determine the appropriate growth rates for the future traffic demands on the road network in the vicinity of the proposal. The model considers potential for future land use changes in the surrounding area that would influence the volume of traffic.

4.1.1 Princes Highway

Traffic growth can be forecast by considering historical average annual daily traffic (AADT) data. Roads and Maritime has been collecting traffic data on the Princes Highway for many years and during this time traffic volumes have continued to grow steadily, with higher growth recorded to the north of the study area and lower average growth towards the south of the study area.

Historical growth rates from the Roads and Maritime permanent count stations 07.051 (Princes Highway 190m south of Illaroo Road) and 07.800 (north of Rose Valley Road near Gerringong) were used to determine the future growth rates for the Princes Highway. Station 07.051 shows a growth rate of 1.21 per cent per annum using a 2014 base year, while station 07.800 has growth rate of 1.71 per cent using a 2014 base year. The change in annual traffic flows on the Princes Highway at these count stations is shown in Figure 17.

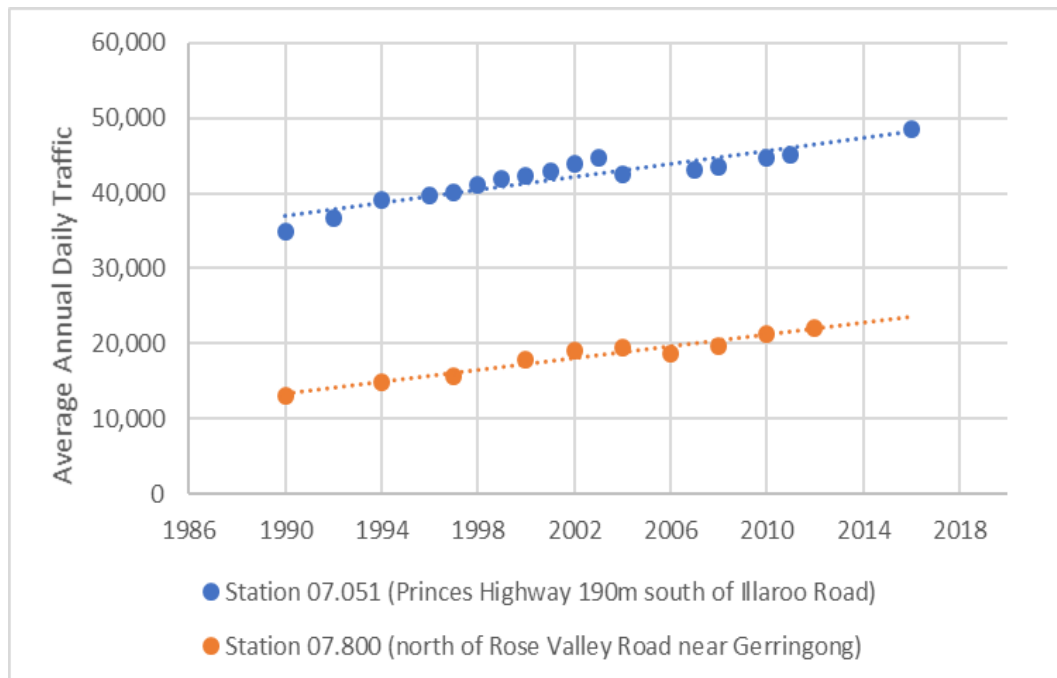


Figure 17 Historical traffic growth on the Princes Highway

The Shoalhaven City Council strategic (TRACKS) model forecasts traffic on the Princes Highway to grow at an average of 2.3 per cent per annum compared to

2006 flows. This rate would be equivalent to 1.8 per cent per annum using base (2014) traffic flows. Despite the most recent traffic data indicating growth to be in the order of 1.2 per cent per annum, a more conservative growth rate of 1.7 per cent per annum has been adopted for the analysis. This aligns with historical traffic growth for the permanent count station near Gerringong, considers traffic growth that would arise from future development in the area (as forecast in the TRACKS model) and aligns with the rate identified in the Princes Highway Corridor Strategy document for the Princes Highway between Gerringong and Falls Creek.

4.1.2 Illaroo Road

A review of the TRACKS model for the region indicates traffic to grow on Illaroo Road by 2.7 per cent per annum between 2006 and 2046. Although historical traffic volumes on Illaroo Road have declined in recent years, it is understood there are significant levels of urban development planned in the North Nowra area. Therefore, the council TRACKS model has been utilised to determine an appropriate growth rate to forecast future traffic demands. The model forecasts a rate of growth of 2.7 per cent per annum between 2006 and 2046, which is equivalent to 2.3 per cent per annum using base (2014) traffic flows.

4.1.3 Bolong Road and Bridge Road

The TRACKS model was relied upon to forecast traffic growth along Bolong Road and Bridge Road. Growth rates were found to be 1.8 per cent and 1.3 per cent per annum on Bolong Road and Bridge Road respectively.

Consistent with previous strategies for the Princes Highway corridor, it was assumed some of the traffic growth along Bolong Road would divert to the Princes Highway following completion of the Berry Bypass project and Berry to Bomaderry upgrade. This diverted traffic from Bolong Road was assumed to comprise of trips between the north and south of the study area (i.e. between Bolong Road and Moss Street). Trips from Bolong Road into Bridge Road and Illaroo Road were assumed to largely comprise local traffic movements and would not divert onto the Princes Highway. For consistency however with the Princes Highway, and as a conservative measure, a rate of 1.7 per cent per annum was adopted for the analysis.

4.1.4 Summary

A summary of the growth rates adopted for the traffic modelling is provided in Table 13.

Table 13 Summary of forecast growth rates

Location	Forecast Annual Growth Rate*
Bolong Road	1.7%
Princes Highway	1.7%
Illaroo Road	2.3%
Bridge Road	1.7%
Pleasant Way	1.7%

* Linear growth rate based on 2014 traffic flows

4.2 Future traffic movements

The 2026, 2036 and 2046 future year Do minimum scenario traffic movements are presented in the following figures.

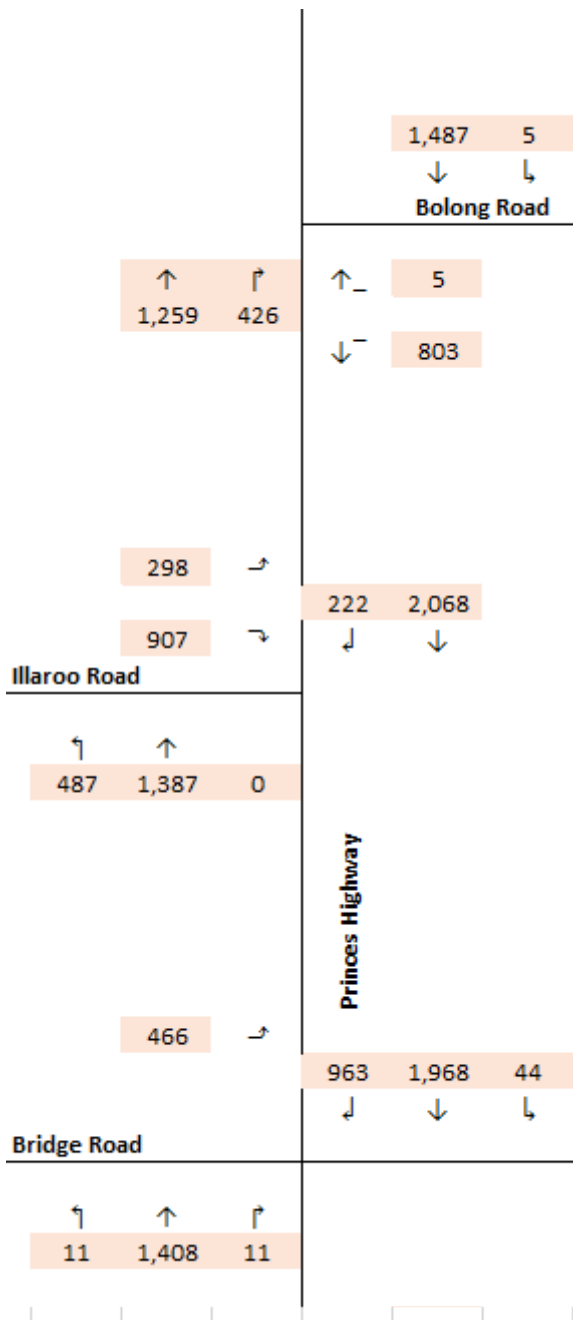


Figure 18 2026 forecast AM peak hour traffic flows

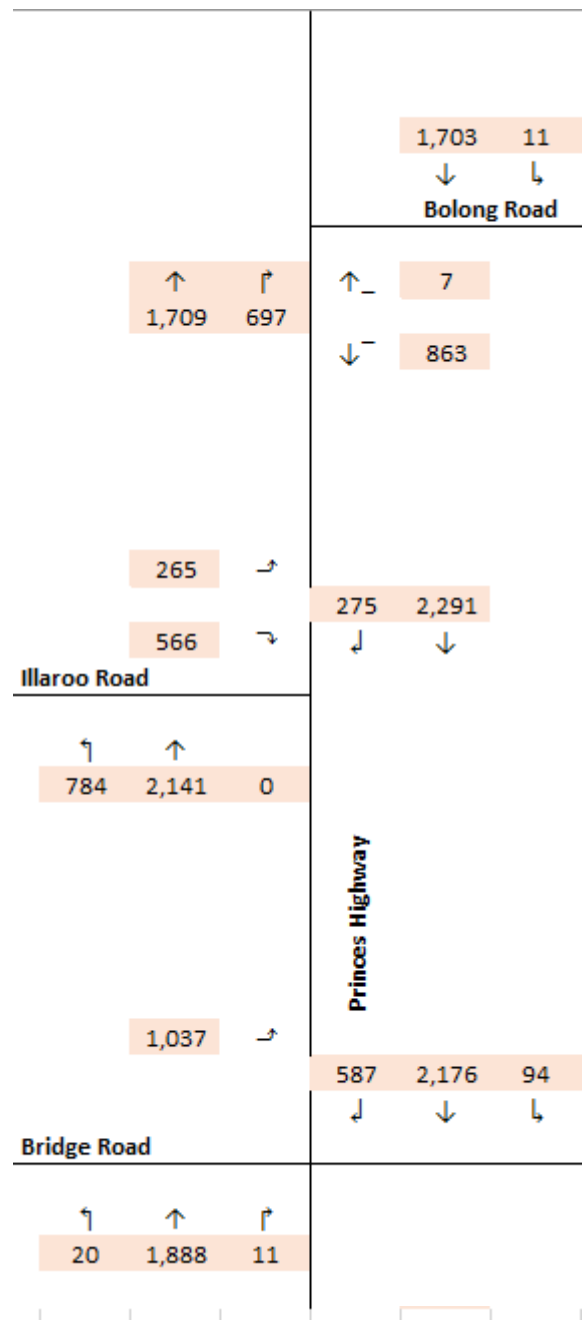


Figure 19 2026 forecast PM peak hour traffic flows

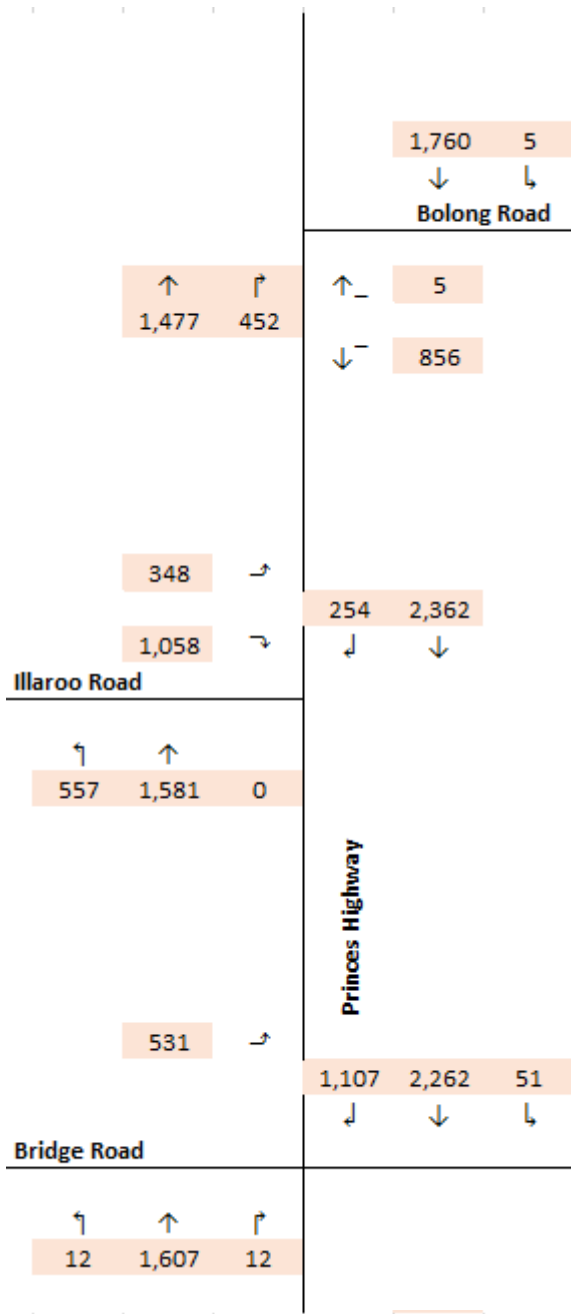


Figure 20 2036 forecast AM peak hour traffic flows

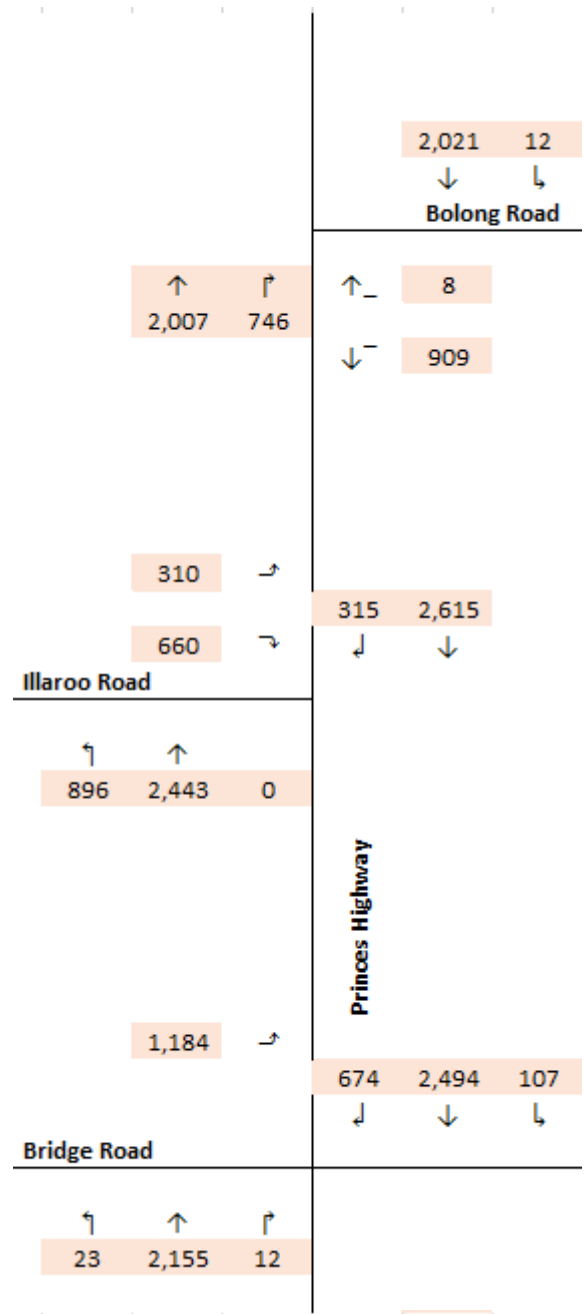


Figure 21 2036 forecast PM peak hour traffic flows

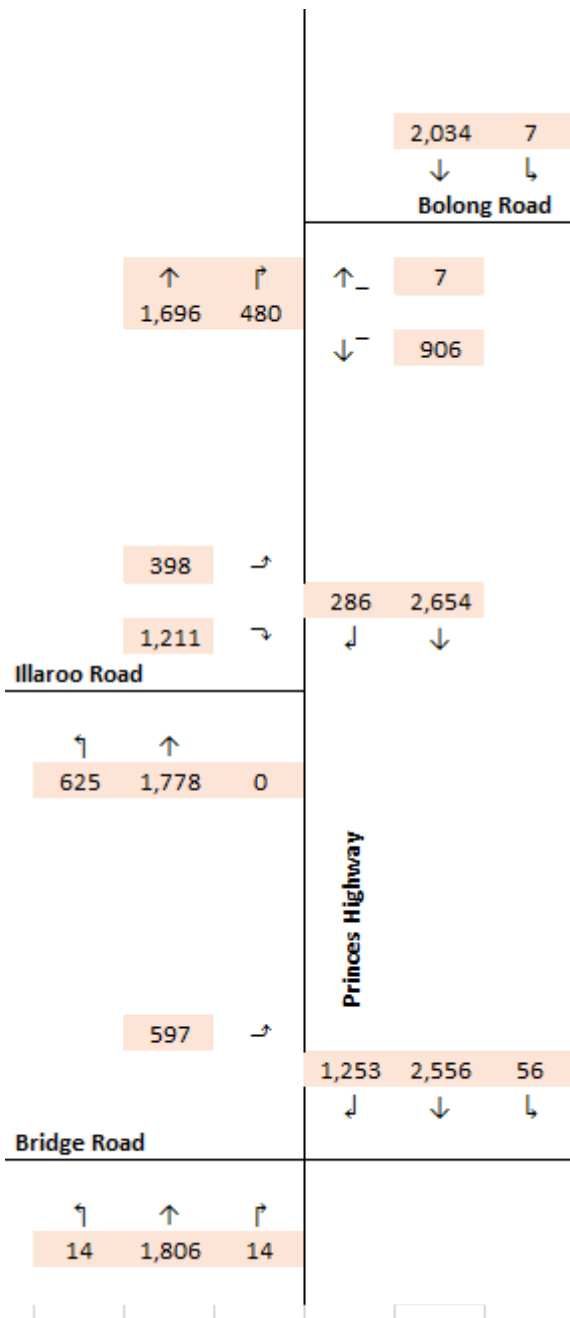


Figure 22 2046 forecast AM peak hour traffic flows

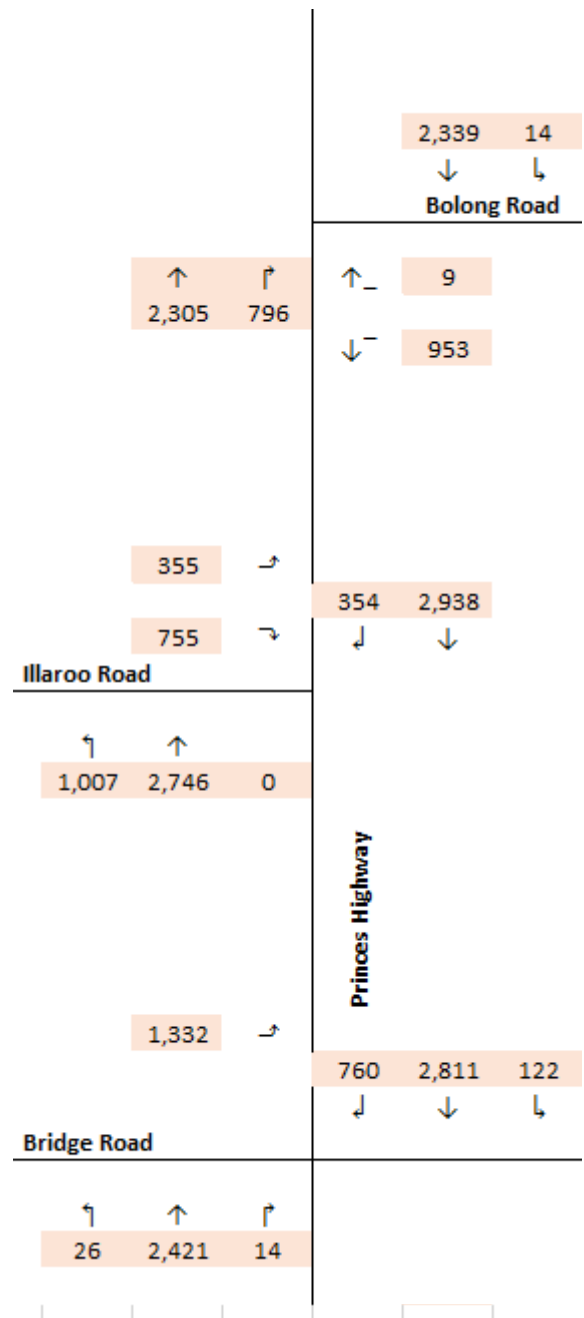


Figure 23 2046 forecast PM peak hour traffic flows

5 Assessment of operational traffic impacts

5.1 Traffic modelling

5.1.1 Methodology

Figure 24 illustrates the modelling methodology used to assess the future performance of the road network in the vicinity of the proposal. The base year Paramics models were updated to reflect the increased traffic demands in future years resulting from growth in the study area. The network wide results were generated from the future year Paramics models, while intersection performance was assessed using SIDRA Network models. SIDRA Network was utilised to consider the impacts of vehicle queues extending back from one intersection to another.

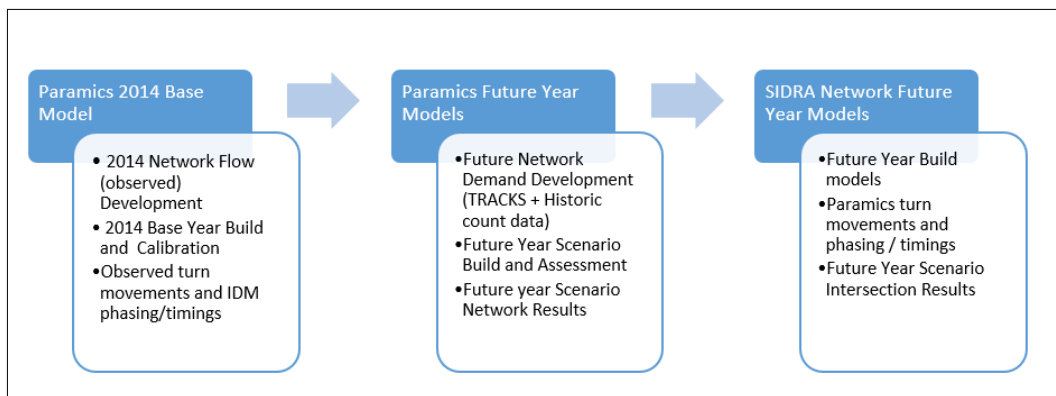


Figure 24 Traffic modelling methodology

5.1.2 Assumptions

The following assumptions were made (following consultation with Roads and Maritime) in carrying out the traffic modelling:

- In the Do Minimum scenario there were no changes made to the existing road network layout
- All existing pedestrian crossings on slip lanes were converted to traffic lights
- All options were modelled with all existing pedestrian crossings in place (pedestrian crossings to run in every cycle)
- An additional scenario was modelled which considered the inclusion of all possible pedestrian movements. Pedestrian movements were assumed to run every cycle. These changes involved the addition of the following pedestrian crossings controlled by traffic lights:
 - Princes Highway / Bolong Road (north and south approaches)
 - Princes Highway / Illaroo Road (south approach)
 - Princes Highway / Bridge Road (north approach)

- All current permitted turning movements at intersections have been retained, although they may be provided at separate intersections.
- Heavy vehicle demand was determined based on the surveyed traffic data collected for the study.

Traffic modelling was undertaken for the following years based on the future traffic demands arising from the predicted growth rates as previously outlined in Section 4.1 of this document:

- 2014 (current traffic volumes)
- 2026
- 2036
- 2046.

5.2 Do minimum

In the Do minimum scenario, the configuration of the existing road network would remain unchanged, including the existing two lane southbound bridge. Although traffic demands would continue to grow as development occurs in the region, there would be no additional road capacity and traffic congestion would increase significantly compared to current conditions.

Traffic modelling of the corridor indicates that by 2046, vehicles under the Do minimum option would (on average) spend over double the amount of time on the road network compared to existing conditions. Despite an increase in traffic demand greater than 55 per cent by 2046, the amount of vehicle kilometres travelled would only increase by 16 per cent - indicating significant traffic congestion issues across the network.

Some key findings of the modelling with respect to the operation of intersections in the study area are as follows:

- The modelling indicates that by 2026 the Bolong Road / Princes Highway intersection would perform at LoS F under the Do minimum option. This is the result of significant queues that build up on Bolong Road on the approach to the Princes Highway.
- The Illaroo Road / Princes Highway intersection currently experiences significant congestion issues, in particular long queues and delays for vehicles travelling from Illaroo Road to the Princes Highway in the AM peak hour. Traffic modelling indicates that as traffic demands increase in future years, the intersection performance would significantly deteriorate without intervention – with queues of over two kilometres forecast at Illaroo Road by 2036 and the intersection performing at LoS F.
- Under the Do minimum option, the Bridge Road / Princes Highway intersection is forecast to operate at LoS F by 2026.

5.3 The proposal

The proposal includes the replacement of the existing southbound bridge with a new four lane bridge to the west (upstream) of the existing northbound bridge. The proposal also includes the upgrade of about 1.6 km of the Princes Highway in the vicinity of the bridge, as well as providing key intersection upgrades and modification to the local road network. The key features of the proposal are described in Section 1.1 and changes to intersections are illustrated in Figure 25.

The traffic modelling considered the inclusion of additional (signalised) pedestrian crossings at the following intersections:

- Princes Highway / Bolong Road (south approach)
- Princes Highway / Illaroo Road (south approach)
- Princes Highway / Bridge Road (north approach)

Providing additional pedestrian crossings reduces the available capacity for vehicular traffic, as vehicles must wait for pedestrians to clear the intersection before being able to depart the traffic lights. Given the long distances pedestrians have to travel to cross the road, in particular across the Princes Highway, these crossings can significantly reduce capacity for certain traffic movements.

The traffic modelling determined that, due to the significant future traffic volumes forecast in the study area, the provision of these additional crossings would result in unacceptable levels of delays in future years under the proposal. For this reason, the existing number and location of signalised pedestrian crossings are retained under the proposal.

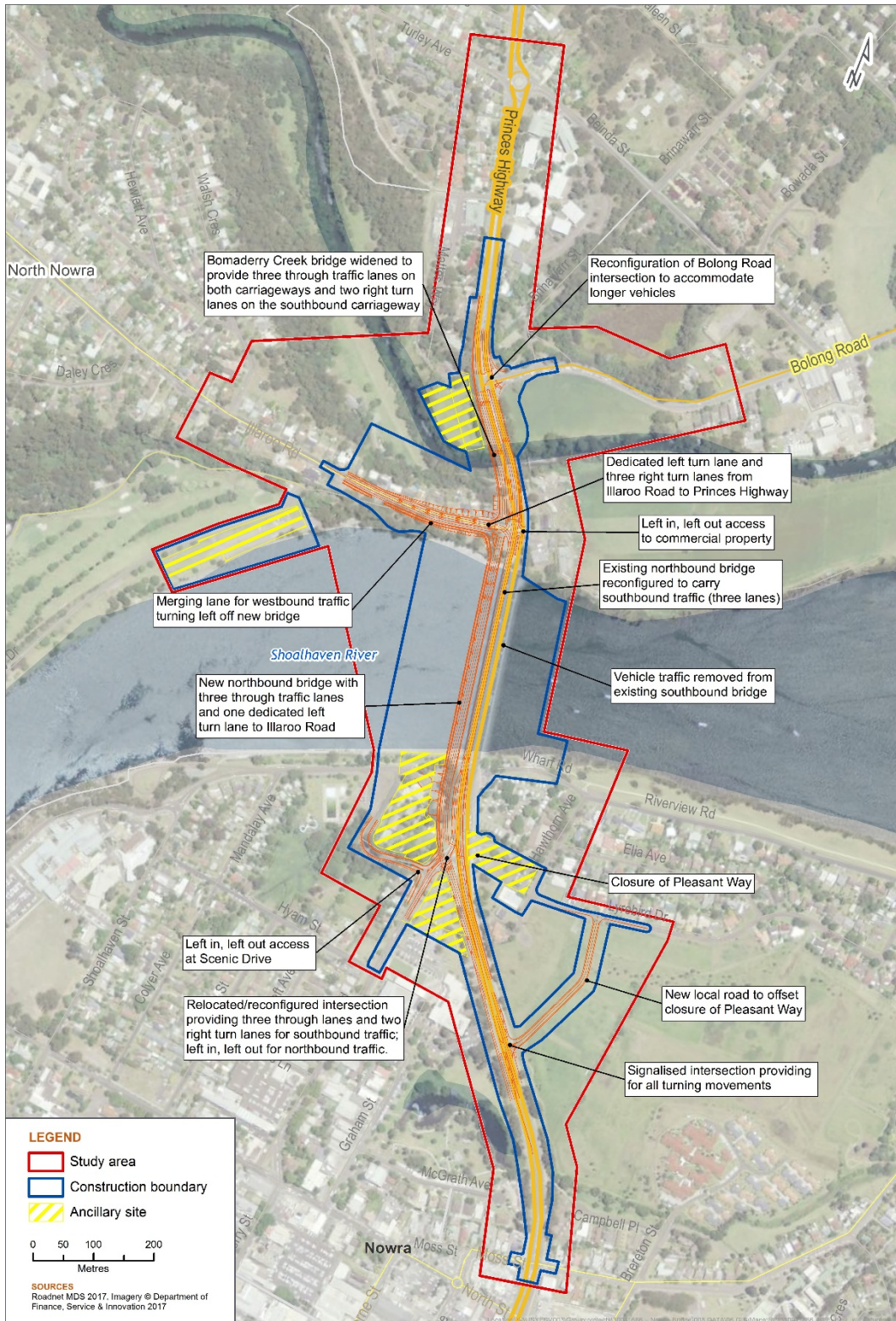


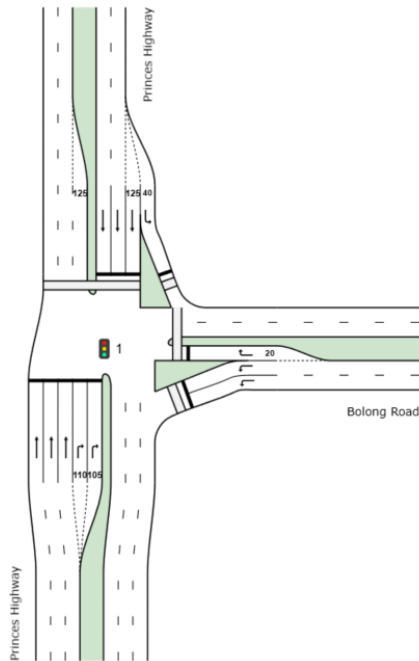
Figure 25 Key features of the proposal

5.4 Intersection layout

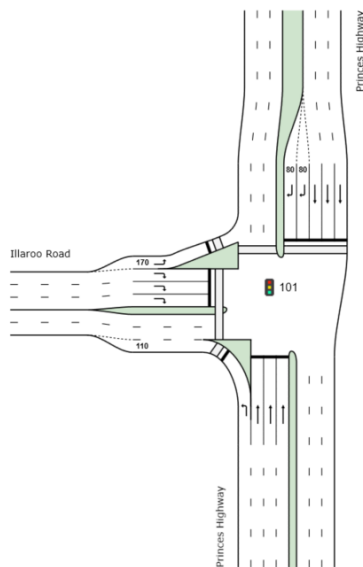
The extent of proposed intersection works and upgrades under the proposed option are summarised below.

Intersection	Changes from existing
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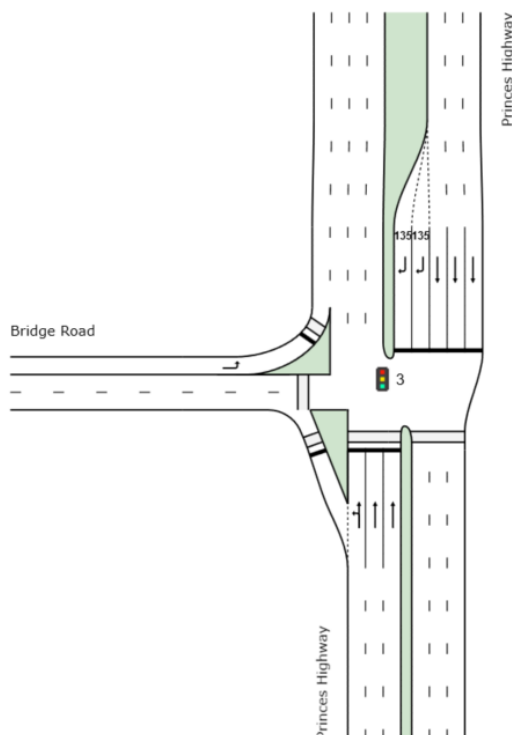
Princes Highway / Bolong Road



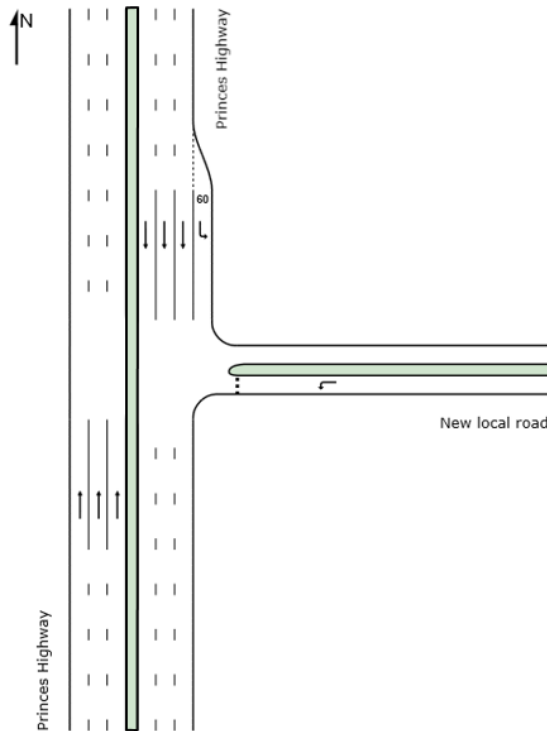
- Additional through traffic lane on the Princes Highway (three through lanes in each direction)
- Staged east-west pedestrian crossing provided on northern approach of intersection

Intersection**Changes from existing****Princes Highway / Illaroo Road**

- Lane reconfiguration on the northern approach of the intersection to provide for three continuous through lanes onto Nowra Bridge.
- The single right turn bay into Illaroo Road is upgraded into 60 m dual right turn bays.
- Additional right turning lane and dedicated left turning lane at the Illaroo Road (west) approach

Princes Highway / Bridge Road

- Pleasant Way realigned south and removed from the intersection
- Additional northbound traffic lane on the Princes Highway, feeding a four lane northbound bridge.
- 135m dual right turn bays into Bridge Road, accessed from the high lane only
- Two lanes northbound onto the bridge, allowing the left-slip lane onto the bridge to be low-angle and operate independently of the through movement
- 70m left-turn slip lane onto Bridge Road from Princes Highway south
- Pedestrian crossing operated by traffic lights on northern approach of intersection

Intersection**Changes from existing****Princes Highway / Local road connection**

- Give way control intersection, left in – left out only
- Three through lanes on Princes Highway in both directions;
- 60m short left turn bay from the north into the new local road connection

5.5 Traffic performance of proposal

5.5.1 Intersection performance

SIDRA intersection modelling was carried out to assess the performance of key intersections in the vicinity of the proposal. The existing intersection performance is assessed in this report in terms of the following factors for each intersection:

- Degree of Saturation
- Level of service
- Maximum queue length (in metres)

Signal phase times were optimised through visual observations in Paramics, and then inputted directly into the SIDRA network models.

The results of the SIDRA intersection modelling are outlined in the table on the following page. Key findings of the modelling are described in the sections below.

Bolong Road / Princes Highway

Once the proposal is operational, the intersection is forecast to perform at LoS C or better until at least 2046 with the proposal. This is due to the additional capacity provided on the Princes Highway by widening the road from two lanes to three lanes in each direction. The modelling found that, even with the provision of a new east-west pedestrian crossing across the Princes Highway on the northern side of the intersection, the intersection will perform acceptably in future years.

Table 14 Intersection performance: Princes Highway / Bolong Road

Approach	AM Peak			PM Peak		
	DoS	LoS	Max Queue (m)	DoS	LoS	Max Queue (m)
2026 – do minimum						
Princes Hwy (N)	0.76	A	34	0.90	A	112
Princes Hwy (S)	0.47	A	71	0.99	B	188
Bolong Rd (E)	1.18	F	664	1.60	F	1396
Total	1.18	F	664	1.60	F	1396
2026 – with proposal						
Princes Hwy (N)	0.58	A	79	0.68	A	106
Princes Hwy (S)	0.58	A	65	0.84	A	123
Bolong Rd (E)	0.50	B	102	0.52	B	109
Total	0.58	A	102	0.84	A	123
2036 – do minimum						
Princes Hwy (N)	1.03	F	868	1.07	F	1172
Princes Hwy (S)	0.45	A	68	0.94	B	153
Bolong Rd (E)	1.41	F	1147	1.69	F	1569
Total	1.41	F	1147	1.69	F	1569
2036 – with proposal						
Princes Hwy (N)	0.67	A	94	0.81	A	162
Princes Hwy (S)	0.67	A	74	0.92	A	146
Bolong Rd (E)	0.57	C	115	0.56	B	117
Total	0.67	A	115	0.92	B	162
2046 – do minimum						
Princes Hwy (N)	1.19	F	1939	1.24	F	2451
Princes Hwy (S)	0.44	A	66	1.14	F	359
Bolong Rd (E)	1.49	F	1328	1.77	F	1732
Total	1.49	F	1939	1.77	F	2451
2046 – with proposal						
Princes Hwy (N)	0.75	A	121	0.98	D	529
Princes Hwy (S)	0.75	A	83	0.93	B	226
Bolong Rd (E)	0.61	C	126	0.57	C	169
Total	0.75	A	126	0.98	C	529

Illaroo Road / Princes Highway

The proposal would improve overall intersection performance from the current LoS F to LoS B or better until at least the year 2046 in the peak hour periods. This is the result of the significant enhancement in capacity at the intersection with an additional right and left turning lane provided on Illaroo Road and three through lanes on the Princes Highway.

The performance of Illaroo Road would improve from LoS F in the AM and PM base case to LoS C and D in the 2036 AM and PM peak periods respectively. In the 2046 scenario, the LoS in the AM peak would be an acceptable LoS D and reach current levels of performance in the PM peak (LoS F). Delays at the intersection would progressively increase in the future years however, based on predicted queue lengths all queued traffic would typically clear during each green light phase of the intersection up until 2046.

The proposal retains the existing pedestrian crossings on the northern and western approaches of the intersection. The proposal does not include a pedestrian crossing on the southern approach as it would significantly reduce the overall efficiency of the intersection.

Table 15 Intersection performance: Princes Highway / Illaroo Road

Approach	AM Peak			PM Peak		
	DoS	LoS	Max Queue (m)	DoS	LoS	Max Queue (m)
2026 – do minimum						
Princes Hwy (N)	1.16	C	289	1.84	F	359
Princes Hwy (S)	0.61	A	65	0.79	A	39
Illaroo Rd (W)	1.40	F	1378	1.04	F	401
Total	1.40	F	1378	1.84	F	401
2026 – with proposal						
Princes Hwy (N)	0.57	A	34	0.78	A	45
Princes Hwy (S)	0.56	A	62	0.62	A	133
Illaroo Rd (W)	0.68	C	97	0.47	C	70
Total	0.68	B	97	0.78	A	133
2036 – do minimum						
Princes Hwy (N)	1.29	E	359	2.05	F	359
Princes Hwy (S)	0.64	A	72	0.79	A	37
Illaroo Rd (W)	1.63	F	2026	1.22	F	822
Total	1.63	F	2026	2.05	F	822
2036 – with proposal						
Princes Hwy (N)	0.68	A	43	0.67	A	50
Princes Hwy (S)	0.65	A	100	0.87	A	199
Illaroo Rd (W)	0.71	C	113	0.63	D	90
Total	0.71	B	113	0.87	A	199
2046 – do minimum						
Princes Hwy (N)	1.25	D	359	1.99	F	359
Princes Hwy (S)	0.66	A	79	0.91	A	118
Illaroo Rd (W)	1.87	F	2689	1.39	F	1284
Total	1.87	F	2689	1.99	F	1284
2046 – with proposal						
Princes Hwy (N)	0.73	A	49	0.79	A	85
Princes Hwy (S)	0.69	A	106	0.80	A	86
Illaroo Rd (W)	0.92	D	173	0.92	F	155
Total	0.92	B	173	0.92	B	155

Bridge Road / Princes Highway

The proposal, specifically widening the Princes Highway to three lanes in each direction, allows the intersection to operate well at LoS A or LoS B during all modelled years.

Table 16 Intersection performance: Princes Highway / Bridge Road

Approach	AM Peak			PM Peak		
	DoS	LoS	Max Queue (m)	DoS	LoS	Max Queue (m)
2026 – do minimum						
Princes Hwy (N)	0.67	A	25	0.75	A	36
Pleasant Way (E)	0.28	F	11	0.30	F	12
Princes Hwy (S)	1.17	F	1037	1.25	F	1653
Bridge Road (W)	0.29	A	22	1.09	F	1191
Total	1.17	F	1037	1.25	F	1653
2026 – with proposal						
Princes Hwy (N)	0.58	A	73	0.68	A	107
Pleasant Way (E)	-	-	-	-	-	-
Princes Hwy (S)	0.59	A	84	0.80	B	157
Bridge Road (W)	0.37	A	64	0.68	A	152
Total	0.59	A	84	0.80	A	157
2036 – do minimum						
Princes Hwy (N)	0.72	A	32	0.82	A	52
Pleasant Way (E)	0.28	F	11	0.30	F	12
Princes Hwy (S)	1.32	F	1613	1.43	F	2506
Bridge Road (W)	0.50	B	150	1.25	F	2077
Total	1.32	F	1613	1.43	F	2506
2036 – with proposal						
Princes Hwy (N)	0.71	A	114	0.72	A	45
Pleasant Way (E)	-	-	-	-	-	-
Princes Hwy (S)	0.67	A	103	0.87	B	205
Bridge Road (W)	0.51	B	110	0.83	A	258
Total	0.71	A	114	0.87	A	258
2046 – do minimum						
Princes Hwy (N)	0.71	A	29	0.79	A	45
Pleasant Way (E)	0.28	F	11	0.30	F	12
Princes Hwy (S)	1.48	F	2265	1.61	F	3362
Bridge Road (W)	0.37	A	31	0.82	A	165
Total	1.48	F	2265	1.61	F	3362
2046 – with proposal						
Princes Hwy (N)	0.79	A	145	0.91	A	283
Pleasant Way (E)	-	-	-	-	-	-
Princes Hwy (S)	0.77	B	132	0.91	B	324
Bridge Road (W)	0.56	A	127	0.85	A	338
Total	0.79	A	145	0.91	B	338

5.5.2 Overall road network performance

The performance of the overall Princes Highway corridor an, including side roads was estimated with and without the proposal for the base case and for 2026, 2036, and 2046 traffic volumes. The performance of the network was evaluated using estimates of the following measures:

- Unreleased vehicles (i.e. number of blocked vehicles). The greater the number of unreleased vehicles, the more significant the traffic congestion and delays in the model.
- Vehicle Hours Travelled (VHT) by all vehicles within the model, calculated using the average trip time for each traffic movement and multiplying this by the total traffic demands. A lower VHT indicates improved performance of the road network and a greater ability for the network to accommodate the forecast traffic demands.
- Average travel time spent by vehicles within the road network - which is VHT divided by total travel demand across the model. A lower average travel time indicates improved road network performance and reduced traffic delays.
- Vehicle Kilometres Travelled (VKT), which is the sum of all distances travelled by vehicles during the peak hour. Higher levels of VKT indicate improved performance of the road network as the network is able to accommodate the forecast traffic demands.

A summary of these results is provided in Table 17 (for the AM peak hour) and Table 18 (for the PM peak hour) and described in further detail in the sections below.

Table 17 Network wide performance: AM Peak hour

Scenario	Vehicle kilometres travelled (VKT)	Vehicle hours travelled (VHT)	Average travel time (min)	Blocked vehicles
2014 Base	7411	296	4.0	274
2026 Do minimum	8434	490	5.4	1214
2026 With proposal	9272	234	2.6	0
2036 Do minimum	8660	771	7.4	2672
2036 With proposal	10578	299	2.9	0
2046 Do minimum	8623	1,087	9.3	4734
2046 With proposal	11566	422	3.6	94

Table 18 Network wide performance: PM Peak hour

Scenario	Vehicle kilometres travelled (VKT)	Vehicle hours travelled (VHT)	Average travel time (min)	Blocked vehicles
2014 Base	8189	393	4.5	1062
2026 Do minimum	8990	612	5.7	2212
2026 With proposal	10969	282	2.6	0
2036 Do minimum	9019	1,132	9.3	4536
2036 With proposal	12392	369	3.0	0
2046 Do minimum	9279	1,442	10.5	6262
2046 With proposal	13721	538	3.9	0

Unreleased vehicles

The number of unreleased vehicles at the end of each modelled period (both AM and PM) is presented below in Figure 26. The Do minimum scenario develops substantial numbers of unreleased vehicles, indicating the current network cannot accommodate the projected travel demand. The proposal accommodates the travel demand well into 2046, with very few unreleased vehicles at the end of model simulation.

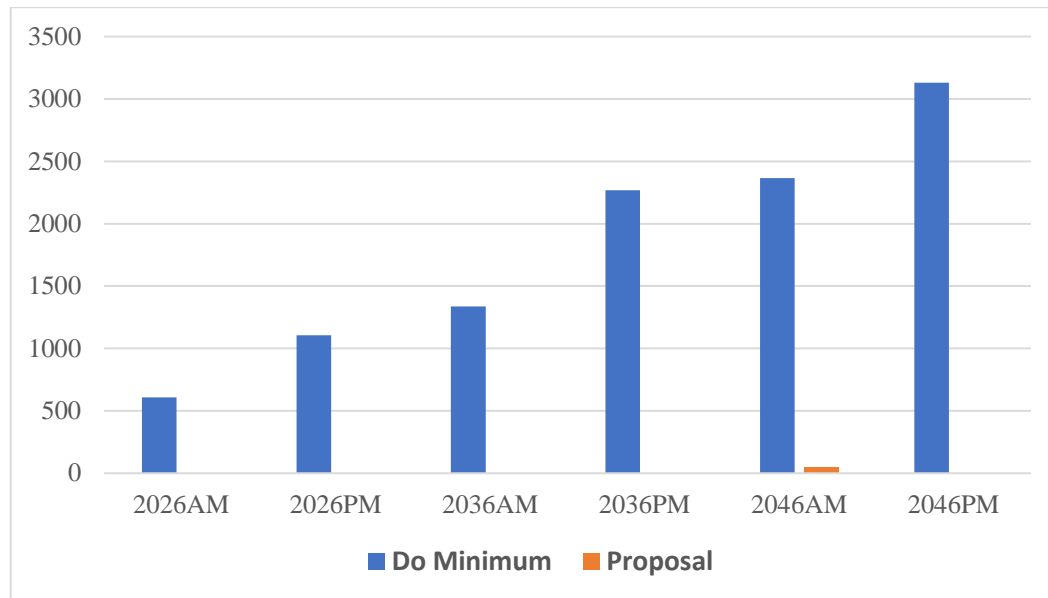


Figure 26 Unreleased vehicles at end of simulation

Vehicle kilometres travelled

The traffic modelling indicates the Do minimum scenario has little capacity to accommodate additional traffic movements, with VKT increasing by 16 per cent despite a growth in travel demand of 55 per cent by 2046. In contrast the proposal indicates VKT growth commensurate with the growth in traffic demand, which is reflective of its capacity to accommodate the high travel demands on the network.

Vehicle hours travelled and average time in model

The traffic modelling indicates that vehicles hours travelled (VHT) increases from 296 hours in the existing situation to 1087 hours by 2046 during the AM peak hour in the Do minimum scenario – an increase of over 250 per cent. This is reflective of the inability of the existing road network to accommodate future traffic flows in the area. A similar increase is forecast in the PM peak hour. The modelling indicates that VHT levels in 2036 are similar to existing levels under the proposal in both the AM and PM peak hours, with VHT increasing in 2046 due to higher volumes of traffic on the road network.

In dividing the VHT by the total travel demand, a theoretical average time in model was derived. Considering the current network performance as the benchmark for future year assessments, the “design life” of each option can also be inferred and compared. A comparison of the average times between the do minimum and preferred option is shown in Figure 27 and Figure 28. The figures

show that, under the proposal, the average travel time for vehicles within the study area improves compared with current conditions – even in the year 2046.

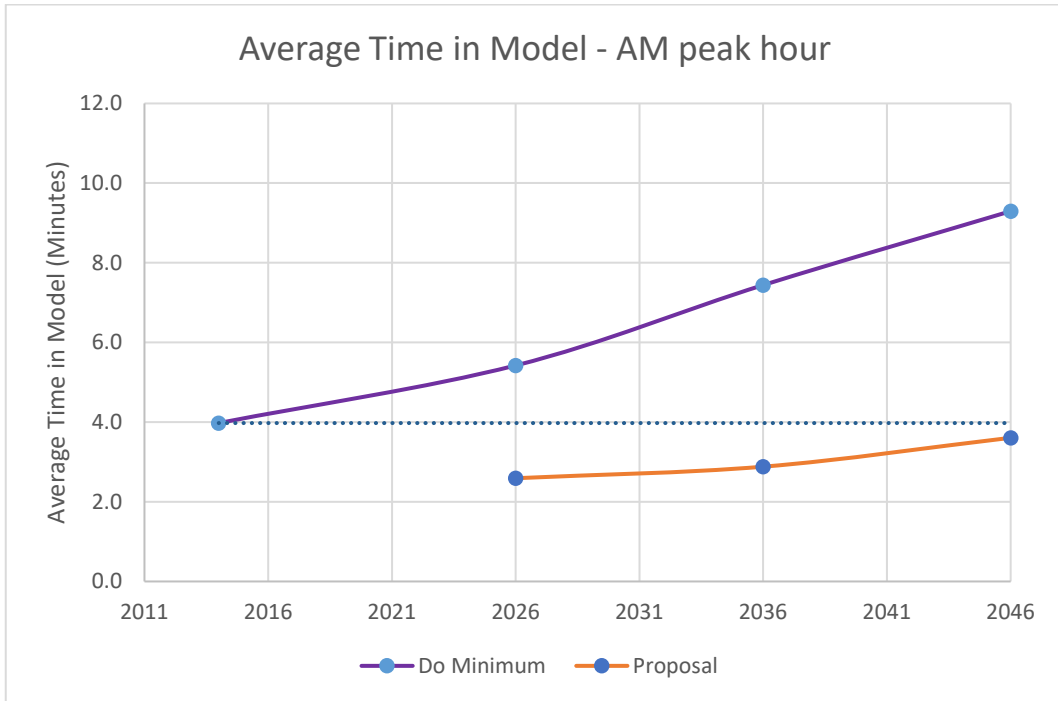


Figure 27 AM peak hour average travel time

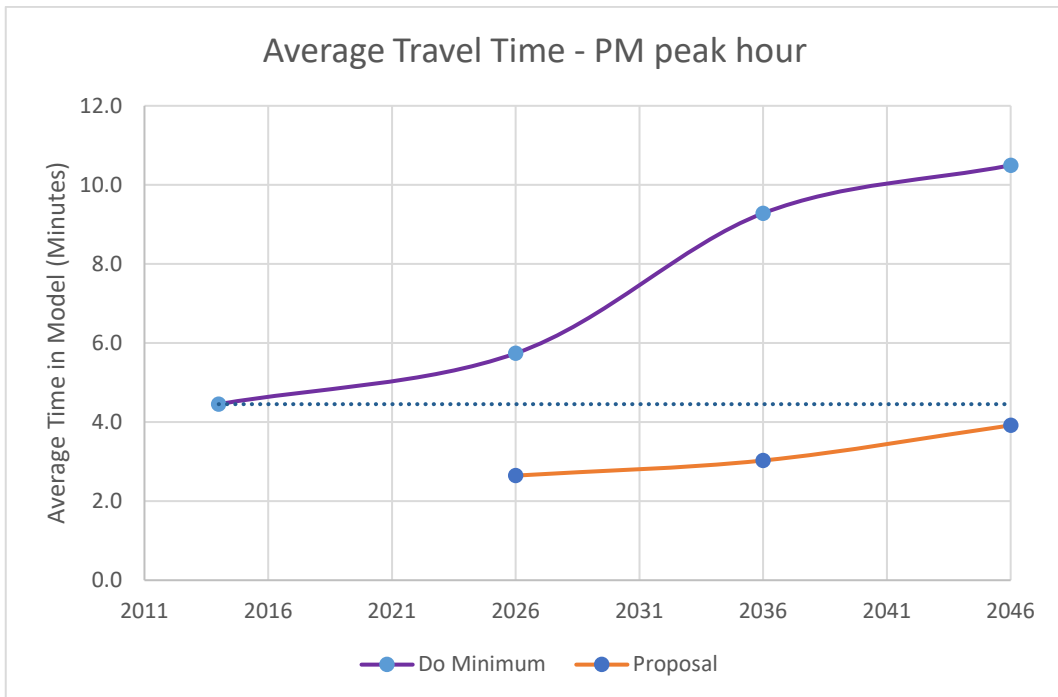


Figure 28 PM peak hour average travel time

5.5.3 Local road traffic impacts

The proposal will result in some small changes to traffic flows on local roads within the study area, as summarised below:

- Significant reduction in traffic volumes on Pleasant Way due to the closure of the access point to the Princes Highway as part of the proposal
- Increases in traffic volumes on sections of Lyrebird Drive and Hawthorn Avenue. This is associated with the new local road connection from the Princes Highway which connects with these two existing local roads
- Increases in traffic volumes on Hyam Street as a result of the Scenic Way / Bridge Road intersection reverting to a left in – left out arrangement as part of the proposal. Vehicles will therefore not be able to turn right into Scenic Drive from Bridge Road and will instead use Hyam Street
- Reduction in traffic volumes on Scenic Drive as a result of the Scenic Way / Bridge Road intersection reverting to a left in – left out arrangement

A small increase in traffic on Moss Street associated with the removal of the existing right hand turn lane from the Princes Highway (northbound) into Pleasant Way. Based on recent 2018 traffic data, the number of vehicles currently undertaking this movement were 10 in the AM peak hour and 24 in the PM peak hour.

An assessment has been undertaken to understand the impact to the operation of the Princes Highway / Moss Street intersection associated with the expected increase in vehicles turning right from the Princes Highway (travelling north) into Moss Street. The vehicles currently turning right into Pleasant Way from the Princes Highway were added to the existing traffic turning right into Moss Street. The performance of the intersection is summarised in the following table.

Table 19 Intersection performance: Princes Highway / Moss Street

Approach	AM Peak			PM Peak		
	DoS	LoS	Max Queue (m)	DoS	LoS	Max Queue (m)
Existing						
Princes Hwy (N)	0.57	C	130	0.81	C	158
Moss Street (E)	0.77	D	102	0.69	D	88
Princes Hwy (S)	0.85	D	244	0.91	E	312
Moss Street (W)	0.58	D	71	0.92	E	181
Total	0.85	D	244	0.92	D	312
Existing plus redistributed traffic due to closure of Pleasant Way						
Princes Hwy (N)	0.58	C	130	0.91	D	163
Moss Street (E)	0.77	D	102	0.68	D	91
Princes Hwy (S)	0.85	D	244	0.91	E	322
Moss Street (W)	0.57	D	71	0.92	E	187
Total	0.85	D	244	0.92	D	322

The traffic modelling demonstrates that the small amount of additional vehicles turning right from the Princes Highway into Moss Street does not impact the performance of the intersection. The existing level of service is maintained with the addition of the existing traffic that currently turn right from the Princes Highway into Pleasant Way.

5.6 Heavy vehicles

The existing constraints to HML heavy vehicles would be removed with the proposal and allow them to travel south over the Shoalhaven River. Other restrictions on the height and length of heavy vehicles due to the existing southbound bridge would also be removed, allowing freight vehicles to access locations south of Nowra without having to detour or compromise vehicle size. The need for vehicles with a clearance height of between 4.3 metres and 4.6 metres to travel in the centre of the bridge, which is presently a source of traffic delays, would also be removed. The removal of these restrictions would see an increase in the proportion of heavy vehicles that are HML, however, the increase is not expected to be significant as there are still height and weight restrictions at other locations on the network south of the proposal.

The freight industry would also see an increase in productivity due to use of HML vehicles, reduced travel times, and improved journey reliability across the Shoalhaven River.

5.7 Active transport

The proposal would improve conditions for pedestrians and cyclists by providing a range of improvements to the existing network and facilities.

Many of the existing designated shared pedestrian and cycle paths within the study area do not meet current design standards, particularly in terms of the available width. Works as part of the proposal will also involve improving gradients and accessibility for all user groups.

The new northbound bridge would provide a 3.5 metre wide shared use path along the western side of the bridge. The shared use path would be physically separated from the traffic lane by 0.5 m shoulder and a safety barrier. This pathway would connect into upgraded shared paths at the Illaroo Road and Bridge Road intersections.

The proposal improves east west connections across the Princes Highway for pedestrians and cyclist by providing an additional controlled crossing point at Bolong Road, as well as upgraded pedestrian and shared path underpasses at the northern and southern foreshores respectively. The existing southbound bridge will be retained for adaptive reuse such as a shared pedestrian and cyclist path. Retaining the existing southbound bridge for this purpose would provide a shared path physically separated from traffic thus improving links to other active travel routes in the area and making walking and cycling more attractive modes of travel.

5.8 Public transport

As discussed in Section 2.8.2, a number of local and regional bus routes run through the study area. The intersections which buses utilise are listed in

Table 20. Improved traffic performance at the intersections along the Princes Highway would reduce travel times and improve journey reliability for bus services in the study area. All existing bus stops and shelters within the study area can be maintained under the proposal.

There are no proposals to extend the rail network further south from Bomaderry Station.

Table 20 Intersections through which buses pass through

Route No.	Bolong Road / Princes Highway	Illaroo Road / Princes Highway	Bridge Road / Princes Highway	New local road / Princes Highway
705	✓	✓	✓	✓
709	✓	✓	✓	✓
721	✓	✓	✓	✓
722		✓	✓	
724	✓	✓	✓	
732	✓	✓	✓	✓

5.9 Maritime environment

The new bridge would be located west (upstream) of the existing crossings. The new bridge would provide a navigational clearance of 28.5 metres between the pile cap faces for spans 2-8 and 21.5 metres for span 9, and a minimum 7.1 metres vertical clearance from mean high water spring level (MHWS). This configuration would generally match that of the existing northbound bridge, noting that the existing southbound bridge has a vertical clearance of 7.1 metres MHWS.

In view of the above, there would be no change to navigability for watercraft as a result of the proposal.

5.10 Parking

The permanent parking impacts resulting from the proposal will be limited to the existing off-street car park fronting Illaroo Road which services North Nowra Rotary Park. This car park currently contains about 14 spaces and is proposed to be relocated to the west along Illaroo Road where a like for like replacement will be provided.

No other parking areas (either on-street parking or off-street car parks) will be impacted by the proposal following the completion of construction.

5.11 Impacts on road safety

As highlighted in Section 2.5, a significant number of crashes have occurred at key intersections within the study area. These may be attributed to congestion currently occurring at the intersections adjoining the bridge. The proposal is to improve congestion and travel times across the bridge and reduce delays at the intersections. This is likely to reduce the risk of crashes within the study area.

Pedestrian and cyclist safety is likely to improve as all existing pedestrian crossings would have traffic lights. The change from unsignalised zebra crossings to traffic lights could also improve the flow of traffic and improve road safety.

6 Assessment of construction impacts

6.1 Construction impact summary

During construction, there would be varying impacts to traffic and transport near construction areas. Generally, the impacts to traffic and transport would include:

- Temporary increases to travel times for vehicles, cyclists and pedestrians due to:
 - Speed limit restrictions around constructions zones
 - Diversions around areas of works that are located or impinge on the existing road and footpath carriageway
 - Increased traffic on the surrounding road network from:
 - Heavy construction vehicles hauling materials to or from the site
 - Additional movements in the vicinity to and from ancillary sites associated with deliveries and work force movements
- Altered property access arrangements
- Safety impacts through temporary work areas
- Altered access to the local road network
- Possible delays in the bus timetable due to temporary traffic control measures
- Removal of some local road connections.
- On water exclusion zones

6.2 Construction staging

The construction sequencing for the proposal would broadly comprise:

- Early works including geotechnical and utility investigations
- Establishment works including construction compounds and ancillary facilities
- Utility relocations
- Building and vegetation removal
- Earthworks and drainage
- Construction of bridge approaches
- Construction of the new northbound bridge and widening of Bomaderry Creek bridge
- Pavement construction including local road works
- Landscaping and finishing works
- Removal of construction compounds, ancillary facilities and site rehabilitation.

Detailed construction staging of works would be developed as the design progresses in consultation with Roads and Maritime Services and other relevant stakeholders.

At the time of preparation of this report, a preliminary construction staging strategy had been developed comprising four stages. This is subject to further development to optimise construction and to minimise impacts by the construction contractor. Discussion of impacts in this section is based on the preliminary strategy, and additional consideration of impacts would be required for any future revisions of the strategy.

6.3 Ancillary sites

Five potential sites have been identified for ancillary facilities such as construction compounds, plant / equipment storage, and temporary storage / stockpiling of construction materials. These sites are located principally in areas that minimise the amount of site preparation for use (such as clearing of vegetation).

The sites are shown in Figure 25 and described in detail in Table 21.

Table 21 Ancillary facilities

Site	Potential uses	Access and Impact
Bomaderry Creek, located on the eastern side of the Princes Highway between Bomaderry Creek and the Bolong Road intersection	Temporary office and workers amenity buildings, construction plant and materials storage	Via a temporary access point (left in – left out only) located off the Princes Highway – accessed via the northbound carriageway. Could impact the movement of northbound vehicles on the Princes Highway due to heavy vehicles accessing and egressing the facility
Fairway Drive, generally occupying the area of the existing car park and a small area of adjacent cleared land to the southwest of the car park	Temporary materials and plant storage Temporary barge mooring and loading facilities Use of the site would be managed to minimise impacts on boat ramp users and golf course patrons	Via existing access point to car park adjacent to Fairway Drive. Impacts limited to people accessing the Nowra Golf and Recreation Club.
Shoalhaven River southern bank, located immediately west of the Princes Highway on the southern side of the river	Main construction site on southern side of river, used for fabrication and potential launching of the new bridge Temporary materials and plant storage Temporary barge mooring and loading facilities	Access via Scenic Drive. Would impact local traffic using Scenic Drive as well as people travelling to the Nowra Aquatic Park. May also result in a small increase in traffic on nearby residential streets.
Bridge Road, located on the triangle of land to the south of the Bridge Road intersection bounded by Bridge Road, the Princes Highway and the car park to the north of the Shoalhaven Entertainment Centre	Materials and plant storage Access to construction areas on western side of Princes Highway	Via existing access point to car park located off Bridge Road or temporary access point off Bridge Road. Impacts would generally be limited to local and regional traffic on Bridge Road, as well as the operation of the Princes Highway / Bridge Road intersection

Site	Potential uses	Access and Impact
Pleasant Way, generally comprising the existing car park bounded by the Princes Highway, Pleasant Way, Hawthorn Avenue, and Graham Lodge	Materials and plant storage Access to construction areas on eastern side of Princes Highway Former information centre building may be leased for use during construction period	Via existing access point to car park located off Pleasant Way. Would impact local traffic using Pleasant Way as well as people travelling to the adjacent Caravan Park.

All construction access routes would be identified in the Construction Traffic Management Plan to be developed by the construction contractor prior to construction. Any required traffic management or controls would be identified in the plan.

6.4 Construction traffic

Construction traffic for the proposal would involve light and heavy vehicles and greatly depend on the stages of construction.

Light vehicle movements would be associated with the construction workforce travelling to, from and within the construction site, and with small deliveries.

Heavy vehicle movements would be associated with tasks such as:

- Delivery of construction materials (concrete and its components)
- Delivery of imported fill
- Delivery of construction equipment and machinery
- Spoil and waste removal.

The number and types of construction vehicle movements would vary depending on the stage of construction. The peak period would be during excavation works due to high heavy vehicle movements associated with the movement of cut and fill as well as concrete truck movements. To provide a comparison with average traffic movements, traffic numbers have been estimated for a typical period of bridge construction when concrete batching is occurring which would represent a 'worst case' scenario.

Estimated traffic movements during these periods are summarised in Table 22.

Table 22 Estimated construction vehicle movements

Vehicle type	Estimated vehicle movements per day	
	Average	Peak
Light vehicles (workforce & commercial/deliveries)	120	150
<i>Sub-total: Light vehicles</i>	<i>120</i>	<i>150</i>
Concrete deliveries	30	60
Earthworks trucks	100	150
<i>Sub-total: Heavy vehicles</i>	<i>130</i>	<i>210</i>
Total	250	360

Construction vehicle movements would be within the capacity of the highway and the surrounding local road network. All these vehicle movements would not occur in one location, and would be spread around the different ancillary facilities and work sites.

6.5 Construction impacts

Interaction between construction traffic and highway traffic would occur along the proposal area. The greatest impact would be during AM and PM peak periods when the use of the highway is at its highest. However, during off peak periods, construction traffic is not anticipated to adversely affect the highway.

6.5.1 Impacts on regional and local roads

As shown in Table 21, the construction of the proposal would generate between 250 and 360 vehicle movements per day.

The distribution of these movements on the road network would depend on the stage of work (and hence the auxiliary facility accessed by the workforce), the home destinations of the workforce, the source of imported material and destination of exported material. For the purposes of this assessment, vehicles have been assumed to be split equally between approaching the site via Princes Highway north, Princes Highway south and Bolong Road.

This construction traffic has been compared against daily traffic movements on individual roads in the vicinity of the work, as shown in Table 23.

Table 23 Construction traffic movements on surrounding roads

Road	Existing average daily traffic flow	Average construction period		Peak construction period	
		Construction traffic	Per cent increase	Construction traffic	Per cent increase
State and regional road network					
Princes Highway south of Bolong Road	37,900	165	0.44%	238	0.63%
Princes Highway across Shoalhaven River	51,300	125	0.24%	180	0.35%
Princes Highway south of Bridge Road	42,500	83	0.20%	119	0.28%
Bolong Road	15,300	125	0.82%	180	1.18%
Local roads					
Illaroo Road	17,600	50	0.28%	72	0.41%
Bridge Road	13,100	38	0.29%	54	0.41%
Pleasant Way	1500	38	2.53%	54	3.60%
Scenic Drive	Unknown, likely less than 1000 vpd	13		18	
Fairway Drive	Unknown, likely less than 1000 vpd	13		18	

The construction traffic assessment indicates that daily traffic movements would increase. However, these increases would be minor and would not affect the performance of local and regional roads. A minimum of two lanes in each direction of the Princes Highway would be maintained for bi-directional traffic flow at all time during construction. An exception is during approved night works to remove and replace median, line marking, etc.

Throughout the construction period, haulage or traffic movements would be required along the Princes Highway and within the local road network. Traffic management plans and construction staging would be progressively developed and refined during construction to facilitate the safe and efficient movement of traffic through and around the proposal area and to and from construction locations and ancillary facilities.

In addition, depending on the location of works, temporary speed limit restrictions may be required to provide protection for construction workers. These would be identified as part of the construction traffic management plan.

Existing access to local roads, properties and businesses would be maintained throughout the construction of the proposal, where practicable. However, interruptions may occur for short periods, but only in agreement with the affected property owner, business or government agency. Alternative access arrangements would be developed in consultation with the affected property owner. Some

delays on local roads may occur where heavy vehicles are accessing the ancillary facilities.

The construction contractor would be responsible for liaising with Roads and Maritime and other key stakeholders including the Shoalhaven City Council to ensure road closures and disruptions are managed safely and efficiently.

6.5.2 Impacts on intersection performance

To facilitate the construction work, there would be impacts to the operation of some intersections in the study area. These are noted below:

- Princes Highway / Bolong Road: No impacts expected apart from a potential increase in vehicles using Bolong Road to access the various parts of the construction area.
- Princes Highway / Illaroo Road: To allow construction of the new northbound bridge on the northern embankment of the Shoalhaven River, Illaroo Road would need to be realigned to the north. These works would impact traffic operations at the Princes Highway / Illaroo Road intersection, in particular reducing the capacity of the right turn for southbound vehicles from the Princes Highway into Illaroo Road.
- Princes Highway / Bridge Road: Construction to facilitate the proposed intersection upgrade works at this location may result in some short term traffic capacity impacts. This intersection would also experience an increase in traffic movements associated with construction vehicles accessing the ancillary facilities located adjacent to Pleasant Way and Bridge Road.

6.5.3 Impacts on pedestrians and cyclists

The existing pedestrian and cyclist crossings of the Shoalhaven River would be maintained throughout the construction period. Where pedestrian crossings are provided at intersections controlled by traffic lights, formal crossings would be maintained at all times throughout the works where practicable.

To facilitate the intersection upgrade works and widening of the Princes Highway, there may be periods where pedestrians and cyclists would need to be temporarily directed to the other side of the road due to necessary footpath closures. For safety reasons, the existing pedestrian paths underneath the existing bridges on both sides of the river would need to be closed during the construction period.

6.5.4 Impacts on public transport

The existing routes and bus stop locations of the five bus services that currently pass through the study area would not change as a result of the construction works. At times throughout the day buses may experience additional delays due to the reduced road capacity during the construction works.

No bus stops are impacted by the construction works.

6.5.5 Maritime impacts

The construction of the new bridge would require the use of boats, barges and other maritime vessels. The number and type of maritime vessels required and any land based facilities and temporary wharves to service the maritime operations is currently unknown and would be determined by the construction contractor and methodology selected to construct the bridge.

The use of maritime vessels and need to provide construction areas on the water would introduce temporary impediments into the river for recreational and commercial boat operators. However, it is not anticipated that these would have a major impact on commercial and recreational watercraft movements. It may be necessary to implement specific measures during water-based construction activities to maintain safe passage and boating conditions such as exclusion zones around construction locations in the river. The need for these and the nature of them would be developed by the construction contractor in consultation with the Maritime part of Roads and Maritime, and other relevant stakeholders.

As part of the construction traffic management plan, Roads and Maritime and the construction contractor would provide appropriate notification of any closure or restrictions to maritime vessels.

6.5.6 Parking

Where practicable, public parking would be maintained. However, due to the requirement for construction compounds and work areas, some existing public car parking areas may be temporarily impacted during stages of the construction period. These are as follows:

- Existing public off-street car park adjacent to Fairway Drive (about 100 spaces). This comprises all spaces within the car park.
- Existing on-street parking on the northern side of Scenic Drive, immediately west of the Princes Highway (about five spaces) and at the northern end of Scenic Drive at the existing cul-de-sac (about 20 spaces). The remaining 40 spaces on Scenic Drive would remain unaffected by the works.
- Existing on-street parking on the western side of Bridge Road, south of Scenic Drive (about 10 of the existing 44 spaces).
- Existing informal (i.e. grass) parking area to the north of the Shoalhaven Entertainment Centre (about 50 spaces). The formal parking in this area is unlikely to be impacted during construction as the ancillary site does not cover this area
- Existing public off-street car park adjacent to Pleasant Way and Graham Lodge (about 75 spaces). This comprises all spaces within the car park.
- Existing public off-street car park off Illaroo Road serving the North Nowra Rotary Park (about 14 spaces). This comprises all spaces within the car park. As part of the proposed works this car park will be relocated to the west along Illaroo Road, which will result in no net loss of spaces from the existing situation.

It should be noted that these temporary parking impacts would only be for part of the construction period, with not all spaces necessarily impacted at any one time.

6.5.7 Impacts on property access

A number of existing access points to properties on the Princes Highway, Illaroo Road and Bridge Road may be temporarily impacted during the construction period.

7 Management and mitigation measures

Management and mitigation of traffic impacts from the proposal are presented in the following sections.

7.1 Construction

Measures to be implemented to manage potential traffic impacts during construction are:

- A Traffic Management Plan (TMP) will be prepared and implemented for traffic as part of the Construction Environmental Management Plan (CEMP) for the construction phase of the proposal. This will adhere to *Roads and Maritime Traffic Control at Work Sites Manual* (RTA, 2010) and *QA Specification G10 Control of Traffic* (Roads and Maritime, 2008). This will include details on:
 - Measures to maintain access to properties, local roads and the waterway
 - Site specific traffic control measures to manage and regulate traffic movement
 - Requirement and methods to consult and inform the local community of impacts on the local road network and waterway
 - Measures to maintain pedestrian and cyclist access
 - Access to ancillary sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads
 - A response plan for any construction road or marine traffic incident
 - Consideration of other developments which may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic
 - Monitoring, review and amendment mechanisms
- Traffic management plans would be prepared for the construction area and progressively updated as the works progress. The plans would be prepared and implemented by suitably qualified personnel.
- Schedule partial and full road closures to avoid peak periods.
- Undertake consultation with local and regional bus companies prior to and during construction
- Undertake consultation with emergency services prior to and during construction to confirm any diversions during construction and any operational road network changes
- Undertake consultation with property owners and occupiers regarding changes to access arrangements
- Undertake consultation with Shoalhaven City Council regarding potential impacts to parking during the construction period.

- Notification would be issued to the local community regarding changes to pedestrian and cycle path access, diversions or alternative routes and any proposed changes to parking.
- Obtain a Road Occupancy Licence where required

7.2 Operation

Measures to manage potential traffic impacts and changes during operation include:

- Review traffic light phasing along the Princes Highway to identify opportunities to improve efficiencies in traffic flow
- Consult with local residents who may be affected by the closure of Pleasant Way to the Princes Highway

8 References

- NSW Roads and Maritime: *Roads and Maritime Traffic Modelling Guidelines*, February 2013 Version 1.0
- NSW Roads and Maritime: *Guide to Traffic Generating Developments, Version 2.2*, October 2002
- Austroads: *Austroads Guide to Traffic Engineering Practice*
 - Part 3 – Traffic Studies Analysis
 - Part 6- Intersections, Interchanges, Crossings
- Shoalhaven City Council: *Nowra Key Road Projects Strategic Overview Report*, May 2017
- NSW Roads and Maritime: *Shoalhaven Estuary Safe Boating Plan 2009-2013*
- Transport for NSW: *Princes Highway Corridor Strategy*, August 2016
- Shoalhaven City Council: *Shoalhaven Bike Plan*, December 2013
- Austroads: *Guide to Traffic Management Part 3: Traffic Studies and Analysis*, 2013